Content Preservation and Digitization of Maps Housed in the KU Natural History Museum Division of Archaeology: An Analysis of Opportunities and Obstacles

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A study presented in partial fulfillment of the requirements for the degree of Master of Arts in Museum Studies

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April 27 2017

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***With special thanks to Dr. Sandra Olsen, Dr. Peter Welsh, and Mr. Steve Nowak for serving on my committee and overseeing my research.**

Abstract

The purpose of this research is to explain the obstacles museums face in preserving map collections, as well as the steps museums can take to overcome these obstacles. The research begins with a brief history of paper conservation of maps in museums and libraries, and digitization of maps. Next, there is an explanation of the theoretical framework/approach that is used in this project. Following that is a presentation of a SWOT analysis of the archaeological map collection held by the KU Biodiversity Institute & Natural History Museum. The first two components of the SWOT analysis, strengths and weaknesses, focus on advantages and shortcomings of the collection in its current state. The last two components, opportunities and threats, focus respectively on the benefits that can be expected from preserving the map collection, and the obstacles that may hinder process. Finally, the study outlines a procedure for preserving and digitizing the archaeological maps held by the KU Biodiversity Institute, in order to expand accessibility to the collection.

Keywords: Conservation, Preservation, Digitization, Accessibility

Introduction

The purpose of this project is to answer two questions: “What obstacles do museums face in preserving their map collections?” and “What steps can museums take to overcome these obstacles?” The primary objective of answering these questions is to find the most reliable long-term strategy for preserving maps in the collections in the Division of Archaeology at the University of Kansas Biodiversity Institute & Museum of Natural History.

To accomplish this objective, this research begins with a brief history of paper conservation of maps in museums and libraries, and digitization of maps. Next, there is an explanation of the theoretical framework/approach that is used in this project. Following that is a presentation of a SWOT analysis of the archaeological collection held in trust by the KU Biodiversity Institute & Natural History Museum. The first two components of the SWOT analysis, strengths and weaknesses, focus on advantages and shortcomings of the collection in its current state. The last two components, opportunities and threats, focus respectively on what benefits can be expected from preserving the map collection, and what obstacles can be expected to hinder the process. The Division of Archaeology collections and archives are housed in Spooner Hall, formerly the location for the KU Museum of Anthropology (McCool 1994), and the Biodiversity’s West Campus collection storage Building, known as the Public Safety Building. The entire map archive is located in Spooner Hall alone. Based on the guidance provided by the SWOT analyses, this research concludes with a series of recommendations for preserving the maps, including preserving the content of the maps through digitization.

A Brief History of Paper Conservation and Digitization in Museums

Different techniques exist for paper conservation depending on the item in question and its needs. There are a number of different materials used to create paper or similar media, often with varying chemical and physical properties. Parchment is manufactured from animal skins, normally from calves, goats, or sheep, and is known long-lasting durability. Because this material is so resilient, parchment has a history of being used as a medium for documents of legal or religious purposes. Such documents include the U.S. Constitution, the Declaration of Independence, the Articles of Confederation, and the Bill of Rights. Parchment has also become a layman term with misleading connotations. Parchment paper, despite what the name suggests, is not constructed from animal skins, nor is it as durable. Instead, the raw materials come from cellulose fibers in plants, making it no different from regular, everyday paper ("Differences Between Parchment, Vellum and Paper", 2016).

Speaking from experience working in different museum environments, paper archives can be compromised by a number of different environmental factors. These factors can include water damage, pest infestations, intense lighting, adhesive residue from tape and other binding agents, improper handling and storage, and the natural degradation of fibers over time. Different treatment methods exist to counteract different hazards to paper. Among these methods are the use of Japanese tissue to fix tear marks, liquid paper pulp to fill spaces where paper is missing, and inpainting for when some of the ink has been lost. Other treatment methods include dry cleaning the paper to remove dirt and food stains, smoothing out creases in the paper to maintain condition and legibility, and the application of alcohol solutions to deter pests ("Before and After Gallery"). When manuscripts, letters, and documents are torn in places, they can sometimes be treated using shaving techniques, meaning that the back of the paper must be filed down around

the edges where the paper has been compromised. Shaving techniques must be implemented sparingly, especially if any writing has been damaged, in which case the area must be covered with paper of the same color. Chemical treatments are not recommended when caring for manuscripts if there is any chance that the writing will be compromised as a result (Schweidler, 2006: 9, 146).

The area of professional paper conservation is often re-evaluated, and methods which were once interpreted as the be-all, end-all, miracle solutions to paper deterioration issues could just as easily be proven to less effective, or even dangerous to some degree. In the past, such methods have included the use of cellulose nitrate or N-methoxymethyl nylon. These agents have been used for preserving paper documents in the past, and have proven to be less effective than other treatment methods (Baynes-Cope, 1982: 259-260).

A recent international survey conducted on paper conservation methods used in national archives, museums, and other similar repositories suggests that the most typical approaches are ones that are comparatively straightforward, with a tried and true history to support their reliability (Alexopolou and Zervos, 2016: 929). It should be noted that the survey results, while informative, were not entirely comprehensive. Out of the 213 organizations that were invited to participate, only 62 completed the entire survey before submitting their answers. It appears that the researchers were only interested in completed survey results (Alexopolou and Zervos, 2016: 924). From the information submitted, the most common methods used by the organizations in the survey appear to be “dry cleaning, washing in water, deacidification with calcium hydroxide and paper mending with Japanese paper and paste” (Alexopolou and Zervos, 2016: 929). Most of these organizations appear to avoid using more intricate methods, such as laser cleaning and

mass deacidification, nor do they make a habit of using chemical conservation treatments. (Alexopolou and Zervos, 2016: 929).

The survey answers also revealed that some of these organizations use approaches that are considered dangerous or unreliable. Three of these organizations rely on ethylene oxide for disinfection and sterilization, even though using this chemical is a serious health risk. A larger number of the organizations claimed to use bleach to clean their paper products, which is generally not recommended as it can break down cellulose. Some organizations even use dangerous chemicals for bleaching procedures, such as chloramine, sodium hypochlorite, and potassium permanganate (Alexopolou and Zervos, 2016: 924).

Digital innovations in museums began in the mid-20th century, at a time when the space race between the U. S. and the Soviet Union called for devices to be manufactured using smaller, lighter components. The development of the transistor paved the way for a number of portable everyday items, including handheld radios. The electronic gallery guide became a common tool for museum tours. Inspired by the Acoustiguide tour of Hyde Park in 1957, museums began creating their own electronic guides, allowing visitors to personalize their experiences and decide which subject matter they want to learn more about. Eventually, museums began implementing personal touch-screen kiosks to provide a similar experience (Angus, 2012: 39-40).

Museums were among the first to adapt to the use of the Internet, as they recognized the potential that it had to offer. Because of the Internet, museum staff have been able to communicate information to each other at a more efficient rate, and researchers have been able to make their work available to the general public in a virtual format. With the development of the World Wide Web, museums were able to engage and communicate with audiences by displaying images of their collections and related information on websites. Building on past innovations,

social media has allowed audiences to provide creative input on how museum content is shaped (Angus, 2012: 40-43).

Digital images of maps and excavation plans from archaeological archives are primarily kept in a museum's private database, as a means of creating a suitable record in the event that the original archives are compromised. However, displaying a small sample of these images online can allow anyone to access the content/information online in order to learn more about the origins and contexts of different items in the collection. In late 2003, the Royal Tropical Institute of The Netherlands, also known as the Koninklijk Institut voor de Tropen, underwent the project of digitizing their extensive collection of maps. The collection began with a series of Dutch colonial maps in 1864, when the Institute was known as the Colonial Museum. The images are converted to TIFF files for printing, and JPEG files for display on the Internet. The project suggests that the digitization of these maps has helped to increase accessibility to the content and information they provide (Levi, 2010: 39-45).

Any method of physical or digital content management can be expected to have some sort of challenge involved in it, so it's important for a collections management team and other relevant staff members to plan ahead for those eventualities. As Nicholas Thomas wrote:

"Technical advances in many fields, ranging from conservation to online cataloguing, may create new and exciting possibilities[,] but also inflate expectations, exacerbating the financial and logistical difficulties of looking after, and maintaining access to, collections that in some cases consist of millions of artefacts and specimens" (2016: 43).

Although preserving collections is a challenge, an important aspect for any museum is making its collection openly accessible to visitors in a public venue. When a museum makes the

effort to preserve archives in their collection, as well as to digitize the contents of the archives for display in a virtual format, the general public and other stakeholders, such as academic researchers, will have more options for accessibility to the museum's archives and the information they have to offer.

Background, Theoretical Framework, and Methodology

Background

During the spring semester of 2016, I held an internship under Dr. Sandra Olsen, Curator of Archaeology for the Biodiversity Institute & Natural History Museum at the University of Kansas. My internship duties included transcribing 2,258 paper reference documents for a series of maps in the collection held at the Division of Archaeology into an electronic database using Microsoft Excel to preserve the data. Information on the documents included, but was not limited to, the project name, the map maker, locations covered, coordinates for archaeological sites, condition of the map, dates when the map was made and repaired, if applicable, and notes in the margins of the documents such as keys and legends. (See Figure 1.) Transferring this information from physical paper records into an electronic database provided a more stable version of the index records, a version which could be maintained and updated easily in the event that the original index records were compromised. Importantly, the Excel data file can be searched and new data, such as catalogue numbers for the maps, can be easily added.

Recently, the Division of Archaeology has begun cataloguing all the maps in their archive as part of a routine initiative to keep their records thorough and updated. The electronic records on which I worked during my internship are being used as a resource to cross-reference the maps, and the new catalogue numbers are being added for each map entry.

During my internship, Dr. Olsen and I began discussions of a long-term plan to preserve as well as to digitize the maps in the collection. Having created a list of digital map records, the next step is the ongoing process of reorganizing the maps in the cabinet drawers, cataloging the maps, and updating the electronic records to reflect these changes. The third and final step will be to digitize the maps themselves. The virtual replicas of the maps and their index records will be stored under the Division of Archaeology network.

For the purposes of my final project, I decided to focus my research on examining the strengths and weaknesses of the storage system for the map collection, the opportunities and obstacles that museums face in preserving and digitizing maps, and the steps they might take to overcome these obstacles.

Theoretical Framework

The theoretical framework guiding this research is aligned with ideas regarding accessibility and engagement put forth by John Cotton Dana. During the Progressive Era, Dana established a reputation through his career at the Newark Public Library. As a librarian, Dana approached his work unconventionally for his time. He believed that connections were meant to be established between the library and the local community in order to serve "a democratic civil society" (Mattson, 2000: 514).

Following his work as a librarian, Dana went on to create the Newark Art Museum. In those days, museums were typically on the outskirts of communities, pandered to the upper classes, and were not as easily accessible as they are today (Corwin 36-37). Dana's goals as a museum director went beyond the traditional practice of showcasing objects in a glass vitrine with only a small label explaining them. He strove to make the collection at the Newark Art

Museum as accessible and relatable to the local community as he possibly could. Not only did he showcase objects that had been crafted by local businesses, but he also loaned objects out to other institutions for academic purposes (Roberts, 2012: 144). In keeping with Dana's interpretation of museum collections, I anticipate that preserving and digitizing the maps held by the Division of Archaeology will provide long-term physical, as well as virtual, accessibility to their cartographic information and a more in-depth understanding of the nature of the archaeological collection for the general public and researchers. Below, I will discuss the methodology used to structure my research.

Methodology

The method I use for examining map preservation and paper conservation is a SWOT analysis. A SWOT analysis consists of four components: Strengths, Weaknesses, Opportunities, and Threats. Strengths and weaknesses in a SWOT analysis focus on a subject's advantages and disadvantages. Opportunities and threats in a SWOT analysis are external factors, and focus respectively on what potential the subject could have, as well as what obstacles would hinder that potential (Valentin, 2001: 54). Using a SWOT analysis to examine a subject can make it easier for one to isolate the problem (or problems) and come up with good, strong solutions (Renault, Date Unknown).

Below, I discuss the strengths of the Division of Archaeology's map collection, as well as the role the maps play in the archaeological collection. Next, I discuss weaknesses of the map collection that can be improved. Third, I discuss opportunities that could be presented if the maps are preserved and digitized. Fourth, I discuss any and all issues that could hinder the efforts to preserve and digitize the maps. Following the SWOT analysis will be a recommendations section, in which I list examples of different techniques the Division of Archaeology could use to

preserve and digitize their maps. I intend to outline the advantages of these different methods as well as the challenges that each method poses. Finally, the paper will be brought to a close with my own proposed strategy for digitizing the maps in the future. My primary goal using this research is to find the most reliable methods of preserving and digitizing the map collection, methods that will pose the least amount of risk to the conditions of the maps.

Strengths of the Archaeological Map Archive

Reference materials for the artifacts in the collection

There are two main types of maps in the Division of Archaeology's archive. The first kind consists of site location maps. Most of these are commercially produced maps on which site locations identified during surveys have been marked with pencil or pen. The second type of map consists of excavation plans of individual sites. (See Figure 2.) These plans are drawn in pencil or pen to illustrate the site's area and the excavation grid squares and features. Features in the excavation plans include details such as houses, pits, post holes, hearths, etc. Both kinds of maps are essential records for interpreting the context of artifacts in the collection. By preserving information on where these artifacts were discovered, researchers can often determine patterns regarding the cultural origins and functions of the objects. If the maps and their contents are preserved and digitized, more options will be made available for accessing the information and cross-referencing it with different archaeological artifacts to preserve their locations.

Size of Collection

The map collection is comprised of roughly 2,200 maps. A sizable portion of these maps are hand-drawn excavation plans for different dig sites. Another large portion consists of commercially-made United States Geological Survey (USGS) maps. Some of the USGS maps,

though not all of them, have also been annotated with information about archaeological dig sites in the areas covered (Olsen, pers. comm., April 17, 2017). The bulk of the maps are of sites within the state of Kansas, but some of them are of locations in Missouri, South Dakota, and other places (Olsen, pers. comm., April 6, 2017).

Current Digitization Equipment

The facility where the archaeological maps are kept also contains an imaging center where digitization equipment has been installed. Among the digitization equipment is a photographic station with features such as a high-resolution photographic scanner, four LED panels with adjustable barn doors, digital cameras and a tripod with a side arm. There is also a three-dimensional laser scanner with a rotating stage. Finally, the digitization equipment includes some excellent fieldwork devices, such as a GoPro camera with a wide range of attachments, and a Gigapan Epic robotic mount which can shoot panoramic photographs of exceptionally high quality ("Imaging Center", Division of Archaeology, Biodiversity Institute, University of Kansas).

Variety of Maps

A number of the maps in the archive are of excavation plans of sites where large quantities of artifacts in the archaeological collection were discovered. Other maps in the collection were printed by a professional source for the US Geological Survey. Some of these have excavation site locations added in pen or pencil. Although the USGS maps would cost money to replace if they were compromised, the unaltered ones are easier to replace than the ones with hand-drawn site markers, or the hand-drawn excavation maps in the archive. Unaltered

USGS maps are already available in digital format, so the Division does not need to photograph or scan them.

Well-Organized Storage

Most of the map archive is currently housed in eight proper map cabinets, each with five drawers, allowing the maps to be stored flat. (See Figure 3.) Each drawer has a black vinyl cover with a metal strip attached that slides into a slot at the front of the drawer to ensure that light does not seep in. (See Figure 4.) The cabinet holds all the maps that will fit into its 40" x 50" drawers, and these are organized by project and region. The maps in the cabinets lie flat in archival, acid-free sleeves.

Weaknesses of the Map Collection

Insufficient Imaging Equipment

As effective as the facility's imaging equipment currently is, the devices are unable to digitize every map in the collection due to size limitation. Most of the maps are too large to be scanned entirely with the current equipment. The largest document that can be scanned on the two photocopiers in Spooner Hall is 11.5" x 17", and the high resolution photographic scanner is smaller than that. Larger scanners could be used offsite to scan the oversized documents and complete the virtual archive, but this would be an expensive solution. The KU Libraries have somewhat larger scanners, but these devices operate by paper feeders. The feeders would pose a risk to the documents and possibly cause a paper jam. Given these limitations, an improvised method of photographing a map in its entirety or in sections and merging the photographs together in a digital format could serve as a viable alternative (Wehr, Jocelyn; Personal Interview #2).

Vulnerability to Environmental Hazards

The maps in the archaeological collection provide important information about where the artifacts were discovered, so from a research standpoint, they are significantly valuable. For that same reason, the means of storing and preserving the maps needs to be addressed. Another concern to be addressed is whether the larger maps can safely fit in a map cabinet drawer. As mentioned previously, the Division of Archaeology's map cabinet drawers only measure 40" x 50", and these dimensions are insufficient to store the entire map collection, leaving more of them vulnerable to hazardous elements. While most of the maps are kept secured in metal map cabinets, others are rolled up and tucked away on open shelves, where they are relatively more likely to be compromised by external factors, such as dust, insects, and ultraviolet light. Some of the maps are inserted in cardboard tubes sealed with plastic caps. However, not all of these tubes are acid-free, and some of the caps have cracks in them and need to be replaced. Labeling on the exterior of the tubes and caps is largely absent or no longer legible. If the information on the maps is lost, researchers will find it more difficult to trace the artifacts in the collection to where they were discovered. Furthermore, the current storage system is not particularly user-friendly, as it is difficult to remove individual tubes or identify their respective contents.

Oversized Materials

It is not uncommon for maps to be large enough that scanning the contents is problematic. Even for scanners supposedly designed for oversized documents, success is not guaranteed. A typical backup plan in this case is to photograph the maps using a mounted camera; however, if the details on the maps are very fine or faded, these cameras must be able to capture images of exceptional quality to ensure that the contents are legible (Perrin, 2016: 15).

Opportunities for the Map Collection

Increased Access and Preservation

There are a number of benefits that would come from digitizing the map collection. Perhaps the most obvious advantage is that the effort will create stable, accurate images of the maps. A sample of these virtual images could be accessed by the public at any time through a digital interface, assuming, of course, the division chooses to upload them into their website. Meanwhile, the conditions of the original maps can be maintained with minimal handling when the virtual images are available.

Increased accessibility is often a potential benefit of digitizing collections, whether the objects are flat media or physical artifacts. Digital photography of museum objects has allowed the British Museum to increase public access to their anthropological collections. For decades, this collection was almost impossible to access. The American Museum of Natural History has also benefitted from digitization initiatives. They are now capable of displaying virtual images of their anthropological objects in an online catalogue, supplemented by links to field notes and other information. Digital photography of museum collections has become a common means for museums to further their goals of promoting public access to their objects (Newell, 2012: 291).

The National Archives and Records Administration, or NARA, understands the importance of preservation of and access to their materials. Among their digitizing objectives, NARA aims to preserve their original documents to the best of their ability and to make their digital replicas publicly available online. The agency has undertaken an as yet ongoing process of digitizing their records and compiling them in an online catalog to be made available to the general public (“Digitization at the National Archives”, 2014).

> Although most of our holdings are currently available only at the archival facility in which they are stored, our digitization efforts are continuously increasing public access to our records. Through the catalog, our customers, regardless of their proximity to our holdings, will have access to digital copies of NARA records on the web. Furthermore, the catalog will provide the essential archival context of these digital images. ("Digitization at the National Archives", 2014)

In Leslie Carraway's article, "On Preserving Knowledge", the author mentions the number of advantages and disadvantages of paper, analog, and digital archiving. With regard to digital archiving, the advantages listed by Carraway include increased, more comprehensive accessibility. Going into detail, Carraway argues that "digital archiving of publications and datasets allows for a shared common memory, for an infinite number of copies of publications and datasets to be available to anyone, anywhere in the world and for the potential of information being stored in context" (Carraway, 2011: 3, 4).

If the Division of Archaeology maps can be scanned or photographed, the information could be made available on its website amongst the collection highlights, providing further supplementary information about the items in the collection and where they were discovered. In late 2003, the Royal Tropical Institute of The Netherlands, also known as the Koninklijk Institut voor de Tropen, underwent the project of digitizing their extensive collection of maps. The collection began with a series of Dutch colonial maps in 1864, when the Institute was known as the Colonial Museum. Since their successful efforts to digitize these maps, the Institute now has an enormous virtual archive available to the public for all manner of eventualities (Levi, 2010: 39-45):

> Now that the maps are accessible online, interest from all over the world has increased and the maps are frequently consulted for scientific research and in the planning of development projects… The collection also serves as a source for international arbitration in determining land and sea borders and preparation of military peacekeeping missions. (Levi, 2010: 45)

Now, this is not to say that digitizing the maps for a virtual interface would mean that the original maps are disposable. Surprisingly, there are a number of librarians who have arrived at this conclusion. In doing so, they risk forgetting the traditional idea behind conservation practices, the argument that a duplicate of any sort, however accurate, can never and will never replace the original work. It is important to remember that digital reproductions of paper archives are merely a secondary tool to convey information and content while simultaneously limiting potential damage to the originals (Bee, 2008: 179-180).

Education

Updating archives by converting them to a digital format holds the potential for educational opportunities for students in the museum studies discipline. Digital museum collections can serve as one of many educational tools for visitors and Internet users. They may not be real-world physical evidence like the original objects. However, they can still be just as informative and educational to the visitors about historical events and cultural identity (Newell, 2012: 291).

Threats to Digitization Efforts

Basic requirements

It's important for collections managers to understand the full responsibility and work load that come with digitization efforts. For digital collections to be properly sustained, routine management of the content and supplementary information is a must. Unfortunately, a regular maintenance schedule can be especially difficult for smaller museums, as it becomes an issue of securing funds to keep the maintenance going. Other factors than can make digitization and routine maintenance an expensive endeavor include the necessity of having trained staff readily available to keep everything running smoothly, as well as access to a reliable source of internet bandwidth, which is a common essential for operating most digital systems in this day and age (Phiri, 2015: 115-116).

Going one step beyond the matter of basic requirements is the matter of constantly having to update the equipment and software involved in the digitization process. Without necessary updates, any digitized information faces the risk of being compromised such that the data can no longer be read by whoever accesses it (Carraway, 2011: 4). Files can be lost it the hardware crashes, if they are deleted by mistake, or, most easily, if the files are not being updated consistently (Perrin, 2016: 124-125).

Copyright issues

Museums might find themselves hesitant to digitize their map collections for fear of upsetting any existing legal precedents that would obstruct the process. Libraries seem hesitant to digitize their collections because they find it difficult to understand the limitations set by copyright laws, possibly due to a large quantity of vague sources that fail to explain the matter

appropriately (Glushko, 2011: 28). Since museums function in ways that are similar to libraries, they share those same concerns.

> Copyright law allows for multiple overlapping rights to exist in a single work, such as a sound recording. For example, sound recordings of musical works are typically covered by at least two rights: The songwriter or publishing company may own rights in the composition itself… but a record company typically owns the rights to a particular sound recording of a performance of the song… This overlap… can occur in several other contexts, such as radio performances of dramatic works like plays, or audio versions of literary works such as poetry or novels (Butler, 2015: 154).

Perhaps the reason as to why copyright policy is so confusing about digital images of museum objects is because not everyone agrees on how copyright law should be enforced in this area. Museums and similar institutions do not have definitive authority on how digital access to their collections is regulated. Usually, these institutions find a budget for digitization and distribution by entering arrangements with commercial publishers. The publishers are granted the rights to digitize the objects. In return, the commercial publishers grant access by paid subscription. Meanwhile, arguments are being made to maintain free accessibility to and use of digital works as well as peer-reviewed scholarly articles (Fyffe and Warner, 2003: 3-4, 7).

> Digitization agreements with the publisher should clearly indicate who owns the copyright to the digital files, individually and in aggregated form, as well as the rights licensed to the other party. It is important to clarify that any exclusive marketing right enjoyed by the publisher pertains to the digital files and not to the original collection that was digitized. The public-domain status of these works and the repository's tax-exempt

> status suggest that proposals of competing publishers should be honored (Fyffe and Warner, 2003: 16).

On the subject of copyright issues applying to distribution and access of cultural property, multiple organizations have created standards they recommended be followed out of respect for provenance. The standards put forth by the World Intellectual Property Organization emphasize the importance of preserving cultural heritage, promoting cultural diversity, and respecting cultural rights (Chowdhury, 2015: 51).

The USGS maps held by the Division of Archaeology, with or without the hand-drawn content, are commercially printed works, so any digital reproductions would probably be a violation of fair use. For the hand-drawn excavation plans, a logical step would be contacting the original illustrators and ask for their permission before digitizing the plans.

Financial Issues

One reason museums are behind on digitizing their collections could be an absence of fluid capital at their disposal. Finances and other obstacles are discussed in *Digital Preservation for Libraries, Archives, & Museums* by Edward M. Corrado and Heather Lea Moulaison (2014):

> One of the biggest challenges is that while funding streams need to be secured indefinitely, the value of such expenditures is not often immediately apparent. Digital preservation is a more abstract, but no less important, good. Decision makers and funders need to see evidence of the benefit of digital preservation in order to commit to adequate funding levels over time (Corrado and Moulaison, 2014: 68).

Because the financial strain of preserving collections is so daunting, museums have, at times, chosen to disregard the possible long-term effects of deterioration:

> If we are really going to store and preserve records forever, of course, preservation measures would need to be taken forever and space for records storage would have to be maintained forever… Because the very concept of permanent retention is preposterous… archivists have permitted themselves to ignore the consequences of acts of preservation that fall short of permanent retention. They have overlooked the obvious fact that conservation of the original records of contemporary society… is impractical in the extreme (Bearman, 2015: 123).

Financial issues; Outsourcing

If digitization equipment is too expensive, large-scale devices in particular, or hiring and training staff in-house, other options such as outsourcing might appear relatively convenient. However, outsourcing is not always the best choice for digitization procedures. If the maps are delicate enough, outsourcing the work may not be worth the risk of the items sustaining damage during shipping and handling (Perrin, 2016: 40-41).

Poor Planning

Preservation with digital equipment can also be an urgent matter if objects are kept in a facility with poor environmental conditions. In the country of Nigeria, there are a number of facilities where Nigerian Arabic manuscripts are kept on display to the public. However, these collections are stored in places where conditions are not ideal to keep the manuscripts fully intact and undisturbed. In spite of efforts made in the past to confront these problems, the collections remain exposed to numerous hazards which could potentially compromise the manuscripts. Sources indicate that these collections remain at risk not only because the storage facilities are

insufficient, but also primarily due to the negligence of policy makers on the matter of preserving the collections (Bala, 2011: 1).

> The present conditions of Arabic manuscripts collections, especially in the Jos Museum Library and Gidan Dan Hausa, are very poor because they are held in buildings that provide anything but protection. These buildings are made of cast concrete or cement block construction, which under tropical conditions absorb a lot of heat with no proper ventilation. Moreover, the roof in the Jos collection is generally flat and hence is full of leaks during the rainy season, which directly affects the manuscripts. (Bala, 2011: 7).

Risk of Damage to Paper Materials

On the subject of maintaining the conditions of paper materials such as manuscripts and maps, it is important that the equipment being used to scan these materials can function without accidentally causing physical damage, such as overly intense lighting during the scanning process. At the University of Kansas, the larger scanners have paper feeders, which are prone to paper jams and may damage brittle or torn pages.

Lack of Space

Even if the right equipment can be acquired to digitize the maps, there is still the matter of allocating space for the equipment when it is not being used. After the collection is fully digitized, there is no way of knowing when the museum will have use for the digitization equipment. Space can especially be an issue for the equipment if it is designed for oversized documents. One way that the issue of space can be avoided more easily is if the equipment is just being rented by the museum. The equipment can be returned when the digitization efforts are finished, and rented again in the future if necessary, but the museum may still have to consider

the question of rental fees for the equipment, and whether or not paying the fees will be worthwhile.

Space in a physical area is not the only kind of space to be considered. Computers can be implemented to help process scanned images and convert them into long-term files. The rate of efficiency for this process is determined by the amount of available RAM, or temporary memory space. When images are processed by a computer, they are stored in the temporary memory, edited, then moved to long-term memory space. If a computer has more RAM, more digital images can be processed simultaneously. However, the number of gigabytes available for temporary memory will depend on the computer's operating system. A sixty-four-bit operating system will recognize any amount of RAM. Within those parameters, an efficient average of RAM would be between 8 and 32 gigabytes. On top of that, it is possible that a computer's software would be designed to use less than the full amount of RAM provided, so the full capacity of the software should be perfectly understood before the work begins (Perrin, 2016: 46-47).

Disrupting the Status Quo

When museums and similar institutions engage in digitization projects for their collection, even if the objects are made out of paper, implementing new procedures can hamper an institution's everyday routine. Libraries, in particular, have struggled to make adjustments for a digitization initiative. The preservation of physical, tangible books and paper archives will always be considered a priority for librarians, but to include a new responsibility of scanning their contents into a virtual collection will naturally call for a re-allocation of time and resources to keep everything running smoothly (Baker and Dube, 2009: 26).

Time

The process of digitizing a map collection, any collection, will require sufficient time to be set aside by staff members to organize every facet of the project. When the staff at the National Institute of Standards and Technology (NIST) took on the workload of digitizing their collection, they allocated time and adjusted their schedules to plan how the digitization work was going to be accomplished in a timely fashion (Avila, Sanders, Martin, 2011: 14):

> The stored objects were moved in stages to newly installed wire mesh cages in the library's basement over the course of the project. As items were relocated to the new storage, they were photographed, and records were modified and added into the museum's database. The goal was to complete the project within 4 to 6 months. (Avila, Sanders, Martin, 2011: 14)

Training Staff

In order for a museum's maps to be digitized properly, the manager has to be sure the staff members know how to operate the equipment. If the staff members require training in this area, this can take up more time and slow down the digitization work for the museum. Similar workplaces such as library environments appear to run into this sort of problem as well. Research libraries have only been able to fund a position for a hybrid conservator in response to the growing number of new preservation programs. Often, these positions have entailed the supervision and training of other staff members. These are among the most common responsibilities undertaken by hybrid conservators in research libraries (Baker, 2004: 179, 184-185). It stands to reason that sufficient time should be allocated on a routine basis to train staff members effectively in this area.

Health and Safety Risks

Museum paper archives may incorporate hazardous materials, in which case the safety and well-being of the staff members must be taken into consideration. Unfortunately, there are also still museums and similar organizations with a focus on paper archives that still rely on outdated, sometimes dangerous conservation methods. It's entirely possible that these organizations do not fully understand the risks that some of their methods pose, including ethylene oxide in the case of sterilization and disinfection, and bleaching as a means of cleaning the paper (Alexopolou and Zervos, 2016: 924-925).

When the NIST began digitizing the artifacts in their collection, the health and safety risks of some of the objects needed to be addressed (Avila, Sanders, Martin, 2011: 13, 16).

> The health and safety of the team was a primary consideration for this project. Since NIST was founded in 1901, the collection included a number of scientific instruments that had been manufactured in the early 20th century, before modern safety standards were adopted. Since the majority of the artifacts had been in storage for decades, they needed to be inspected for possible safety hazards. For example, some of the artifacts had been used for chemical and radioactivity measurement and could still be contaminated. Fortunately, NIST has safety specialists on staff who were willing to review the artifacts for potential dangers prior to the start of the photography project. (Avila, Sanders, Martin, 2011: 16)

Risk of Damage to the Original Documents

Based on information in the Division of Archaeology map index records, some of the maps had already undergone repairs at least once. A number of the maps are too delicate to be

fed through a scanner for digitizing them without the risk of causing further damage to the contents. For these maps, the Archaeological Research Center had to find an alternative method to digitize the maps in the collection.

Poor Resolution

It is important to find a scanner that can create digital images with high resolution, but this can be made more difficult depending on the size of the original. It is also important to remember that when scanning images, the size of the print influences the amount of PPI (Pixels Per Inch) necessary to preserve all of the information in the image. However, higher resolutions will not always improve the quality of the image in a digital format. In fact, if the resolution of an image is too clear, the fibers in the paper medium can actually become noticeable in the digital image, compromising the image's data and undercutting the visual experience. (Koelling, 2002: 6-7).

Recommendations

So the question remains: What steps can museums take to overcome obstacles in digitizing their collections? There are a number of different models for museums to use when developing a digital preservation process for their collections. Although not all of these models have been fully developed, they provide options for museums of all sizes. Different models are better suited for different situations, and they all have different benefits. However, the benefits of these different models do not always outweigh their respective risks. One of the simplest options would be the installation of a minimal repository, a digitization system without too many bells and whistles. A minimal repository would involve the use of what tools are already available, such as existing servers at KU Museums. The initial cost of this kind of system would be more

reasonable, the system could easily be adapted to accommodate local needs, and it would provide a good stepping stone for training museum staff members in the area of digital preservation (Brown, 2013: 63-65).

An organization might resort to a readily-made commercial option, such as the Rosetta program (Brown, 2013: 67, 303). Not to be confused with the Rosetta Stone computer program, Rosetta is a fully-developed program designed for long-term preservation of digital content, easily adjustable for when a collection expands, and can easily suit the needs of museums, libraries, and similar institutions ("Rosetta").

Another way that a system can be tailored to accommodate an organization's needs, supposedly with a wider range of benefits, is through use of open source tools. Using this technology will not only provide a readily-made foundation for a digitization system, but also provide opportunities for staff experience in developing preservation software. A good example of one of these programs would be DSpace, a collaborative product developed by HP Labs and MIT (Brown, 2013: 66-67, 304). DSpace is a trusted open-source program utilized by a number of different archival institutions, universities, and other organizations in countries all over the world ("DSpace User Registry")

Real-World Experiences

When a museum is considering options for a digitization software program, the nature of the collection must be kept in mind, whether the collection consists of paintings, documents, pottery, frescoes, or biological specimens. Observations indicate that there is no one-size-fits-all digitization method that can be applicable to just any sort of collection.

Dr. Olsen, Dr. Adair and I recently met with Dr. Whitney Baker, the Head of Conservation Services for the KU Libraries, to gauge her opinion on the state of the Division of Archaeology map archive. Most of the map archive is stored in 40” x 50” map cabinets that have drawers with black vinyl covers to protect against ultraviolet light. Baker’s assessment was that the maps were being treated and stored well, but the archive needed additional cabinets to maintain all of it. She found the metal shelving unit being used to store the oversized maps that were rolled up in cardboard tubes acceptable. She would have recommended a honeycomb storage shelf, but that might have taken up more space by comparison. While we were discussing the map collection and its history, Dr. Adair mentioned that she had used a flatbed scanner to digitize some of the smaller excavation plans back in 2008. The collection has had time to grow since then.

Dr. Baker provided us with some practical advice about maintenance techniques and materials, and preserving the map collection as it was. A good average temperature to maintain in a paper storage environment is 70˚ Fahrenheit with a baseline humidity of 40-50%, although fluctuations can occur. If one is using acid-free sleeves to file paper documents, deacidification is not necessary, or even encouraged. One must wash one’s hands before handling the documents, and if wearing gloves, they must be either nitrale or cloth, as opposed to latex. Dr. Baker also suggested checking the map cabinets and removing other types of paper documents, such as photographs or illustrations. Understandably, this is because they would likely be made of different material and require different storage conditions.

On the subject of materials that should be avoided, Dr. Baker discouraged the use of adhesive materials. If post-it notes are used on paper archives, they can pull text off and leave residue behind when they are removed. Fastening sleeves together with strips of tape can be

problematic, because paper materials can get stuck to the tape. If the writing on a paper document is done entirely in graphite, plastic sleeves are not recommended, as static electricity can make the sleeve difficult to open, possibly smudging the graphite or rubbing it out completely (Baker, Whitney, pers. comm. 31 Jan. 2017). Adhesive labels and tape should be gently removed, unless this action would damage the original document.

Dr. Baker also recommended contacting Jocelyn Wehr at the Spencer Research Library to discuss the strengths and limitations of their digitization equipment (Baker, Whitney, pers. comm. 31 Jan. 2017). Professor Wehr said that the scanning equipment at the Spencer Research Library was normally used only for the Spencer collections. However, for the purposes of this project, Professor Wehr offered to help us use the equipment to scan 16 of the smaller maps in the archaeological collection, a fraction of the total, but helpful in demonstrating the best practices for us to follow going forward. Their equipment included a flatbed scanner, a large-scale photography setup, and a whiteboard with magnets. The facility also contained a camera stand from B&H Photo Video, with a camera fastened to the stand for overhead shots. (See Figure 5.) Finally, the equipment included a 36”x36” dolly platform where the maps could be laid out underneath the camera. Because the USGS maps are easier to replace than the excavation plans, a reliable course of action would be to digitize the excavation plans first, before they become irreparably damaged (Wehr, Jocelyn; Personal Interview #1). Priority should be given to the documents that appear to be deteriorating and in the worst condition.

Working with Professor Wehr gave us a chance to see the photographic equipment at Spencer Research Library being put into use. As we photographed the maps, we learned about routine obstacles that could be expected from working with the equipment. First, not all of the maps we brought had much concentrated detail, in which case a full page of text was stacked on

top of the map to make sure the camera could be focused properly on the intended subject. Second, the maps were primarily made on square sheets of paper, and the camera had a rectangular format. As a result, the exact dimensions of some maps were difficult to photograph accurately. Third, a pane of window glass had to be placed over the maps to keep them flattened. Any rips and tears were easier to hide with the glass keeping everything in place. Also, the glass was designed in a way that prevented the lighting fixtures on the ceiling from creating a glare on the surface.

Finally, some of the maps were large enough that they could not always be captured in one photograph, even by zooming out and refocusing the camera. We ended up having to take photographs of some maps in different sections, transfer the images to a computer, and stitch the images together to create a composite virtual image using a Photomerge program in Adobe Photoshop. Even then, however, the images didn't always line up perfectly, so some trial and error was necessary to get the images exactly right (Wehr, Jocelyn; Personal Interview #2).

A week after working with Ms. Wehr to make digital photographs of the maps, Dr. Olsen and I began emptying out the cardboard tubes where some of the larger maps were being contained. As mentioned previously, not all of these cardboard tubes were 100% acid free, which posed an environmental threat to their contents. The objective here was to move the maps into acid-free sleeves and place them in the metal drawered cabinets in the main collection room in the Division of Archaeology.

Moving the maps to acid-free sleeves presented a new set of challenges. For example, not all of the maps were small enough to fit into these sleeves, which are designed to fill the cabinet drawers. In order to take appropriate measurements, the contents of each cardboard tube had to be removed to find out if individual maps would fit in the sleeves. Any maps that were too large

were wrapped up in acid-free paper, returned to their cardboard tubes, and tucked away in an upright metal shelving unit for their own protection. Some of the maps came with additional information printed on old sheets of paper. The information was transcribed on clean, acid-free sheets of paper so it would not be lost, and the new label was then placed with the map. After transferring the small maps from the tubes into new sleeves, smoothing out the curled edges in the process, we stacked the map sleeves and placed a series of books across the top to act as makeshift paperweights. They are currently laid out in this manner to allow the maps time to relax in preparation for storage into the map cabinet drawers for their permanent disposition. Great care had to be taken to ensure that the maps remained smoothed out as evenly as possible.

While we were relocating the maps to better storage conditions, another issue cropped up regarding old strips of tape on the paper. The tape left behind adhesive residue, and was old enough that removing it likely would not have been very easy, so I decided to investigate the matter of paper damage from tape and adhesive residue. In her article entitled "Preservation of Mixed-Format Archival Collections: A Case Study of the Ann Getty Fashion Collection at the Fashion Institute of Design and Merchandising", Rachel Clarke emphasizes the inherent problems with preserving materials bound with different agents, acknowledging that adhesive residue from tape is not the only concern to be addressed:

> While needs of each format can and should be researched separately, this knowledge resolves only part of the problem. More challenges arise when the materials are combined, not only because of the possible differences in preservation treatment and handling, but also because methods of adhesion (including but not limited to glue, tape, and staples) are known to cause additional preservation problems. Interaction among materials, such as acid migration among papers and adhesives, or other chemical

> interactions between materials and nearby objects, also contributes to deterioration. (Clarke, 2009: p. 188)

Clarke also discusses how collection items in differing formats are sometimes bound together deliberately, long before acquisition. Often, this leads to arguments about interpreting and displaying the items:

> All too often, however, a collection requires preservation as a whole, without physically separating documents of varying formats. Photographs arrive glued into scrapbooks, newspaper clippings stapled to letters, flowers pressed between book pages, and fabric swatches taped to artistic drawings. In many collections of this type, the juxtapositions of the various materials create intrinsic value. The placement of the documents creates context and meaning for the materials. The original order of such an archival collection should not be disturbed. Yet the combination of disparate documents also creates significant long term preservation concerns. How, then, do archivists address the preservation challenge of a mixed-format collection while retaining its intrinsic value and original order? (Clarke, 2009: p. 186)

In addition to moving the maps to safer storage conditions, Dr. Olsen and I also tried taking more photographs of the maps using what was available at Spooner Hall. A small selection of maps were secured to a whiteboard with magnets. (See Figure 6.) When we took photographs of these maps, we tried to focus as much on the intended subjects as we could, without including anything unnecessary in the shots.

Establishing A Standard Procedure

In order to meet the needs of digitizing their collections, universities have occasionally taken it upon themselves to write up a standardized procedure for digitization projects. At the University of Arkansas in Little Rock, the Center for Arkansas History and Culture has written such a policy for digitizing their collections and made it available on the UALR website. The digitization manual is revised and updated as befits the changing needs of their collections ("Digitization Manual"). Under the section on making digital scans of documents, the established procedure begins by creating a "Preservation Master", a high-resolution scan of the original document, functioning as the virtual equivalent of a master print for a construction project. The procedure continues other pertinent information such as how to name master preservation files to be identified properly in the future, as well as where specifically the preservation master should be saved, and how secondary copies of the master file should be created, with an addendum that secondary copies should not be saved over the original master file (UALR, 2016: 24-27). The Center for Arkansas History and Culture has clearly defined procedures that could serve as a guideline for the KU Biodiversity Institute and Museum of Natural History to conduct digitization projects in the future.

Maintaining the conditions of an existing collection can be done more efficiently by designing, implementing, and following a set collection management plan, as demonstrated by the National Park Service Museum Management Program ("NPS Museum Handbook, Part I: Museum Collections."). Having this sort of plan in place can help to assess current maintenance procedures, the current condition of the collection, and any existing problems that must be rectified for the good of the collection. Among other things, a good collection management plan must outline the scope of the collection, list museum records with updates as seen fit, instruct the

reader on facing different threats to the collection, and explain rules concerning access to the collection. When a collection management plan is being formulated, input must be provided from all relevant parties to maintain efficiency and productivity (NPS, 2012: 3:10).

Even if the Division of Archaeology is granted access to a sufficient scanning device for digitizing the maps, the staff must consider how best to protect the condition of the maps while they are being scanned. Recent publications indicate that the most common strategies for paper conservation treatments in institutions such as museums, libraries, and other archival repositories, involve using simple, reliable methods with a tried-and-true history. These methods include dry cleaning, Japanese paper and paste for reparations, and deacidification using calcium hydroxide (Alexopolou and Zervos, 2016: 922, 929).

In 2009, the now-Head of Conservation Service at the KU Libraries, Dr. Whitney Baker, collaborated with Liz Dube, Conservator at the University of Notre Dame Libraries in Indiana, on a similar survey about typical paper conservation methods specific to research libraries. Of the conservation units that were included in the survey, at least 75% of them, some general collections, some special collections, were most likely to be maintained through a process of photocopying pages, as implemented for general collections, or by using the Japanese paper and paste mending method, as was the case with both general and special collections. The research also suggested that not very many libraries have switched over to newer methods, including certain case binding practices and board reattachment procedures. Theoretically, there could be any number of reasons why this is the case: It could be because demand for these practices in libraries is relatively low, because the treatments have not been sufficiently promoted, or even because the more advance methods still need time for people to learn about them (Baker and Dube, 2009: 21, 29-30).

Proposed Strategy

At the moment, the map records have already been created in both a physical and digital format. Currently, the Division of Archaeology is in the process of reorganizing the maps in the cabinet drawers, cataloging the maps, and updating the electronic records to reflect these changes. The next step would involve cross-referencing the map index records based on the physical conditions of the maps. After that, the maps would be prioritized for digitization based on their physical conditions. The most fragile maps should be treated with the most urgency. The final step will be the creation of digital master files. These files, along with the digital index records, will be filed under the Division of Archaeology Network. This strategy could also be applied to other two-dimensional media, such as old documents, letters, and photographs (Olsen, pers. comm., April 6 and April 17, 2017).

It is my firm belief that making these virtual images of the maps accessible to the public, even if it's just a sample of the images, will assist in carrying on the tradition followed by John Cotton Dana. Dana believed in expanding access to a collection, to improve one's understanding of the focus of the museum. Virtual images of these maps could be accessed through the Biodiversity Institute website, eliminating the need for some people to travel to the museum while still providing a learning experience concerning the focus of the archaeological collection. The images could also be used at educational resources for underfunded academic researchers. The images could even serve as a useful tool during in-class lectures, in the event that a tour of the facility is too difficult to coordinate. Finally, these virtual images could be made accessible to underserved and/or underrepresented populations.

Appendix

Figure 1

Sample from Map Index Spreadsheet

Information shown below includes locations covered, project name and number, and map serial and site numbers

State	Project	Map # (site)	Map # (Serial)	Proj. #
Easter Island	Norwegian Archaeological Expedition	E~ (E+R~)	555, a-c	Prof. C. S. Smith
Easter Island	Norwegian Archaeological Expedition	E~ (E+R~)	556, a-d	Prof. C. S. Smith
Easter Island	Norwegian Archaeological Expedition (Maunga Auhepa)	E 1	417	Prof. Carlyle Smith
Easter Island	Norwegian Archaeological Expedition (Maunga Auhepa)	E 1	418	Prof. Carlyle Smith
Easter Island	Norwegian Archaeological Expedition 1955	E 1	1629, a-f	NA
Easter Island	Norwegian Archaeological Expedition	E 2	419, a-b-c	Prof. C. S. Smith
Easter Island	Norwegian Archaeological Expedition (Tupa of Hiramoko)	E 3	420	Prof. Carlyle Smith

Figure 2

Excavation Plan

Includes key representing physical features in area.

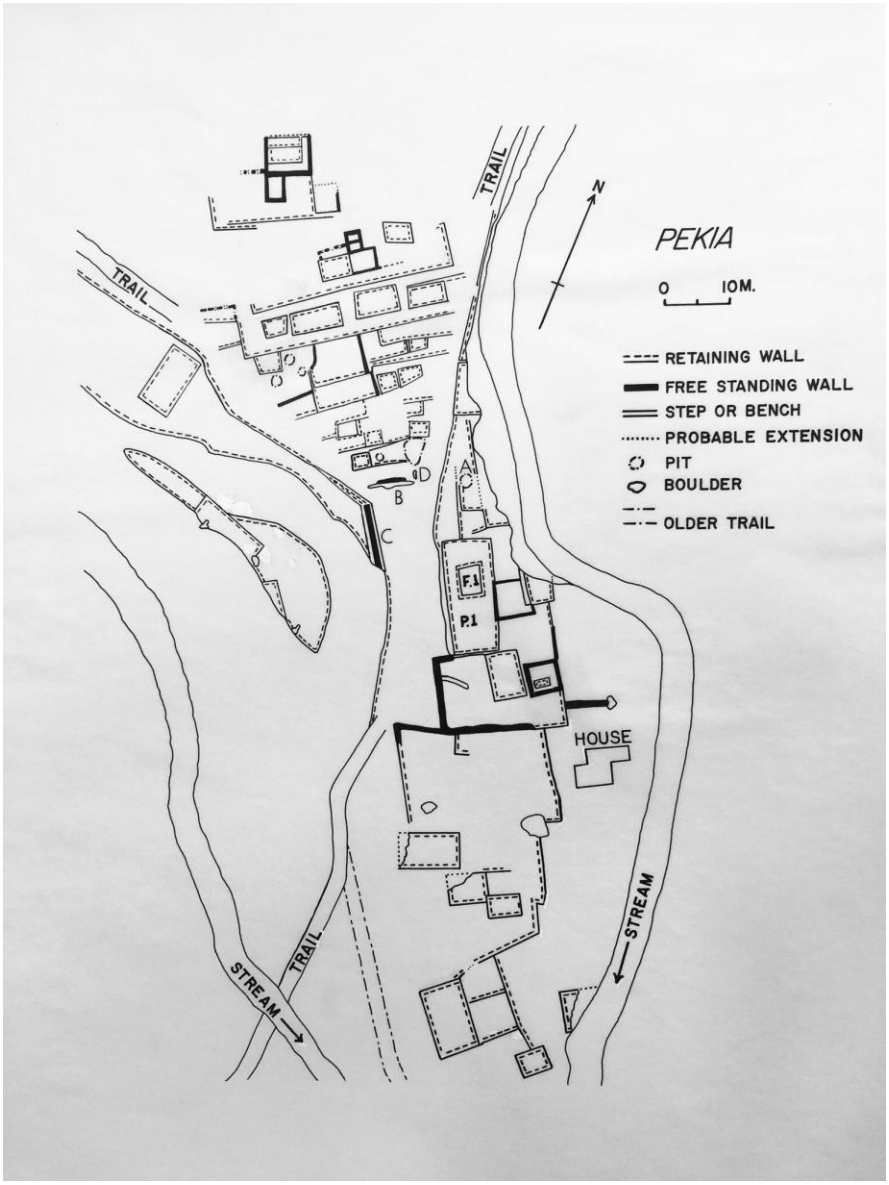

Figure 3

Spooner Hall

Map Cabinet Drawer Exterior

Drawers measuring 40” x 50” for maps in acid-free envelopes

Figure 4

Spooner Hall

Map Cabinet Drawer Interior

Drawers are fitted with black light guards to protect against UV rays and other hazards; maps stored in acid-free envelopes

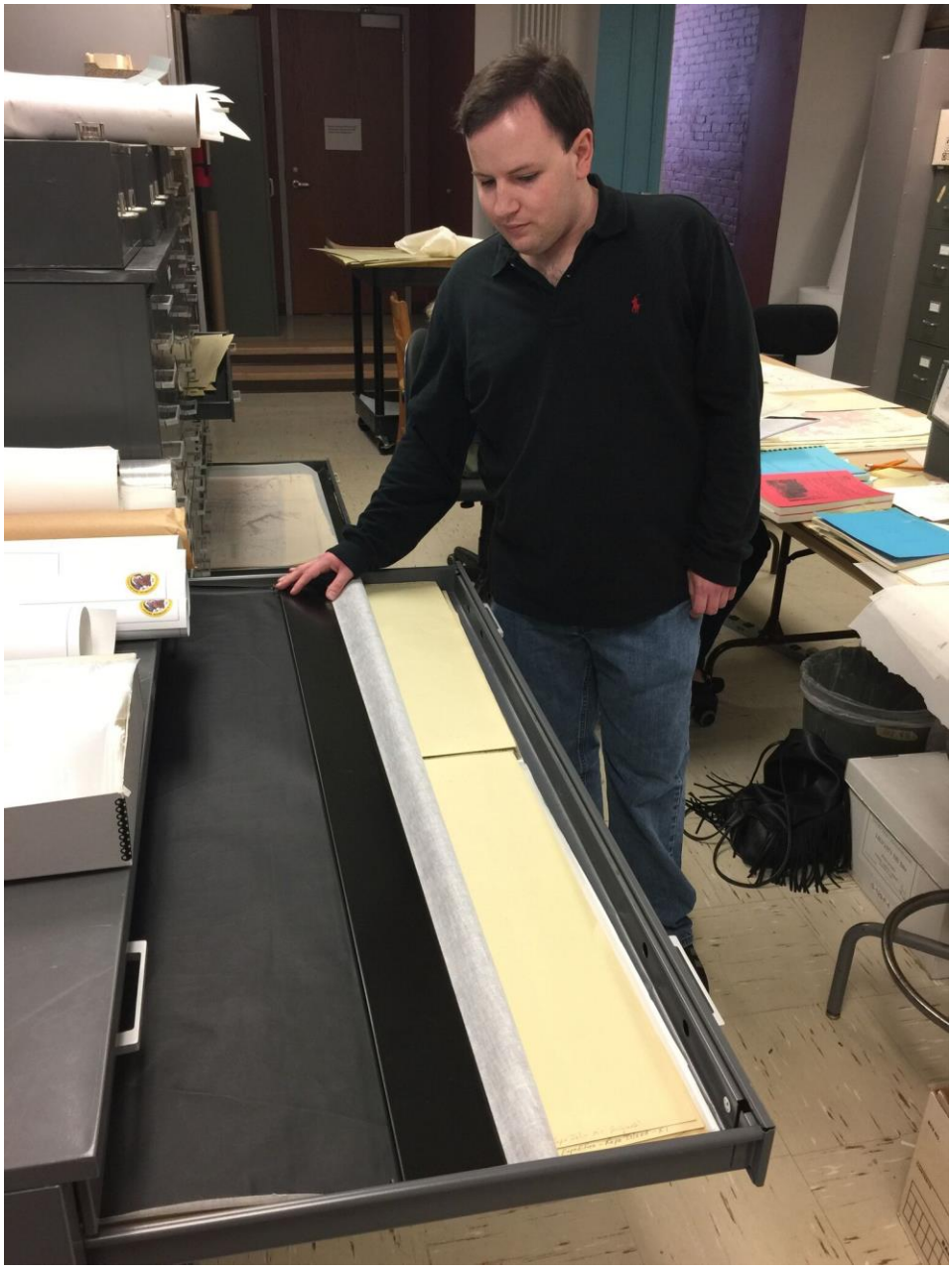

Figure 5

Spencer Library

Archival photography lab with camera stand in foreground and white board with magnets in background

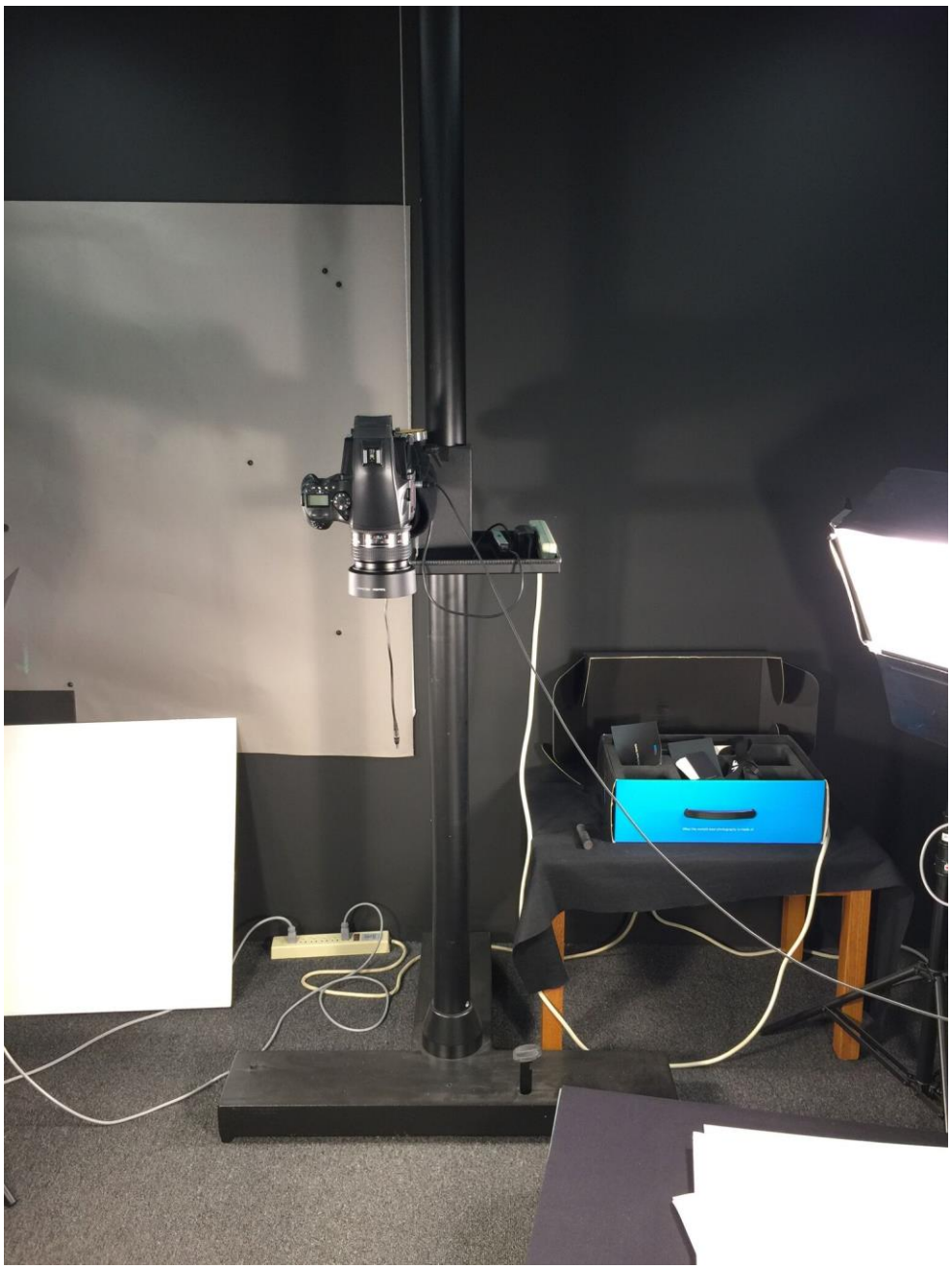

Figure 6

Spooner Hall

Photograph of map mounted on white board with magnets

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