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The Preservation of Archaeological Records and Photographs

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THE PRESERVATION OF ARCHAEOLOGICAL RECORDS AND PHOTOGRAPHS

By

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Substantive and organized research about archaeological records and photograph preservation, especially those written by and for archaeologists, are few. Although the Society for American Archaeology has a code of ethics regarding archaeological records preservation, and the federal government has regulations regarding the care and preservation of federally owned archaeological collections, there is a lack of resources. This is detrimental to archaeology because not all archaeologists, given the maturity of the discipline, understand how important it is to preserve archaeological records and photographs. Without documents and photographs from projects, irreplaceable information is lost. This thesis adds to the existing body of knowledge and is developed from over 10 years of professional research into and observations on the topic. Research shows there are simple and inexpensive ways to preserve archaeological records and photographs for repositories and archaeologists on any budget.

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CHAPTER 1: INTRODUCTION

It has happened many times. An archaeologist wants to look through an important artifact collection, but soon realizes there are no records accompanying the artifacts. These artifacts, once part of an important archaeological discovery, now seem little more than a box of rocks. Or consider this, repository collections staff peruse an artifact collection, but since the artifacts do not have accompanying records, the staff do not realize how important the artifacts are and how much research potential they have. In both instances, a great deal of information was lost that may not have been if the associated records had been retained with the artifacts.

DEFINITION OF AN ARCHAEOLOGICAL RECORD

Archaeologists use the term "archaeological record" to describe various aspects of interpretable archaeological deposits including the "preexisting receptacle for material deposits" (the ground before archaeological deposits are made), "material deposits" (sites with artifacts), "material remains" (artifact lists), "archaeological samples" (how data is organized), and "archaeological reports" (Patrik 1985:29-30). The Society for American Archaeology publishes a monthly journal "American Antiquity" and refers to prominent publications as "the archaeological record." For this thesis, "archaeological record," refers to all written documentation and photographic material and is interchangeable with documents and archives.

Archaeological archives include any documentation related to an archaeological project, whether it is an excavation or survey project. An "archive" is a "depository of records that holds and conserves key documents that outline the history of an individual archaeologist, the discipline, or a state, federal, or private archaeological program or society," (Sullivan and Childs 2003:50). Archives can also refer to the curated documents inside the repository. Possible media formats for archaeological records are paper, magnetic tape, CDs, DVDs, and digital data (Blackmar 2002).

Archaeological records fall into four distinct categories: (1) field preparation records, (2) field records, (3) analysis records, and (4) curation records. Field preparation records encompass the planning stages of a project including, but not limited to, project plans, requests for proposals (RFPs), permission to collect forms, grant proposals, background research, and maps. They also include documents about the initial site discovery and any artifacts collected during field survey or excavation (Blackmar 2002).

Field records include, but are not limited to, field notes, provenience logs, field forms for units and features, field bags with original provenience information, field notes, drawings, photographs, slides, photograph logs, and maps (Bennett 1998:228; Blackmar 2002; Ewen 2003:118; Short 1982:212; Sprague 1982:206; and Sutton and Arkush 1996:4, 5, 19, 27, 28). King (1985:10) divides field documents into two smaller groups. Her first group, "data records," includes field notes, photos, catalogs, plans, drawings, sound recordings, video, and computer information. Her second group, "administration records," includes correspondence, billings, shipping notes, and publicity.

Analysis records include all documents generated after completing fieldwork during the analysis phase. This includes, but is not limited to, raw data, tables, drawings, computer information, correspondence, artifact photos, and published and unpublished reports (Blackmar 2002; King 1985b:11). It can also include the lab records corresponding with the artifacts. Examples include artifact inventories, documents detailing artifact processing, and documents listing any conservation work needed (Ewen

2003:118; Reibel 1997:80). A document people do not always consider an analysis record is the project's final report. Often times, this report is the only lasting piece of documentation about a project when no one has saved the other project records.

Repositories generate curation records while they care for and store artifacts and project documentation (Blackmar 2002). These documents detail how staff manage the collection and include the legal documents in the accession file (Blackmar 2002; Reibel 1997:80). It also includes, but is not limited to, repository specific documents such as catalog records, disaster plans, loan forms, object treatment reports, and storage locations.

Field records are arguably the most important type of document to the archaeologist because they use them to make conclusions about their research and write reports. In addition, if another archaeologist wants to reanalyze a project or group of artifacts, these types of records would be vital. In fact, reanalysis would be nearly impossible with only the final report and no field or lab records.

On the other hand, field preparation and curation records are arguably the most important records for the repository. Field preparation records give the documents' and artifacts' provenance, i.e., the history of how they arrived at the repository. If ownership is in dispute, these records can help clarify any problems. Curation records tell the documents' and artifacts' provenance while at the repository including the type of care received.

REQUIREMENTS FOR RECORDS PRESERVATION

Preserving archaeological records is vital to the continuation of archaeology as a scientific discipline. Indeed, there are legal and ethical requirements for preservation. Federal regulations ensure repositories care for and preserve federally owned archaeological collections, which include the associated records (36 C.F.R. § 79.5). The Society for American Archaeology, the preeminent organization for North American archaeology, has a code of ethics to which its members adhere and says they should actively preserve and provide access to archaeological collections irrespective of their creation date (Society for American Archaeology 1996).

Cultural resource management (CRM) projects incorporate these ethics. Regrettably, archaeologists involved in these projects do not always follow the ethical standards of the discipline. This may be because space to permanently house documents at a CRM firm can be limited and costs can be high if one needs to store documents at a federally approved curation facility (Fowler and Givens 1995:101). Despite these limitations, we know that each CRM project at a minimum creates a final report, and often there is more documentation than this (Fowler and Givens 1995:101, 102).

THESIS PURPOSE

The archaeological records care is a separate subfield within archaeology and requires archaeologists and repositories to have knowledge about document and photograph preservation (Barker 2003:76). In my career, I have seen a lack of documentation about archaeological sites and projects as well as a lack of care applied to documents in the field, lab, and curation facility. I believe this stems from not understanding what records we should save, why we should save them, and how we should care for them. These questions can remain even if archaeologists understand the legal and ethical requirements.

This thesis seeks to address these issues by providing archaeologists and those who care for archaeological records with a theoretical, practical, and focused source explaining archaeological records preservation. Where Sullivan and Childs (2003), Hester (1997), and others deal with the curation of all archaeological materials, the scope of this thesis is limited to a discussion of paper and photograph preservation. It differs from other publications on the subject because it gives practical approaches that repositories and archaeologists can more easily attain. This thesis will not discuss digital media preservation. Although this is an increasingly necessary topic as more records are born digital or are backed-up as digital files, it would require a separate extensive treatment. In addition, digital standards, hardware, and software change at such a rapid pace making any guideline obsolete within a few years.

This thesis, I hope, will be a resource for people whether they are familiar with archaeological documents or not. Older references appear throughout the thesis to show how archaeological records preservation methods and theory have changed in light of new research. At times, these references also show that some methods have remained the same.

CHAPTER ARRANGEMENT

I present this thesis in eight chapters. This introductory chapter discusses what archaeological records are and how ethics and legal requirements guide their care. Chapter 2 discusses how to make accurate and durable archaeological records. Chapter 3 discusses why archaeologists and repository staff should save archaeological records. Chapter 4 reviews how archaeologists and repository staff should care for their paper records. Chapter 5 discusses how archaeologists and repository staff should care for their photographic media. Chapter 6 discusses why archaeologists should submit their records to a repository and how they can prepare for the transfer. Chapter 7 gives five real-world examples of how archaeologists and repositories treat archaeological records in the field and lab referring back to materials presented in previous chapters. Chapter 8 discusses areas for future research.

CHAPTER 2: MAKING ACCURATE AND DURABLE RECORDS

INTRODUCTION

This chapter discusses how to make accurate and durable archaeological records through easily controlled methods. It includes sections about what necessary information archaeologists should record, how to use standardized forms, why archaeologists should document a project or site, how archaeologists can document with digital and film cameras, and what supplies archaeologists can use to safely record data.

WHAT TO RECORD

Some information obtained for a site or project should be considered obligatory because without this information, relocating and reconstructing a site or project would be impossible. The contract for the work may also require this information before it is complete. Required information may include site name, site number, site location, landowner, site type, site description, site size, description of the surrounding environment, site integrity, provenience, stratigraphy, types of remains, significance, description of the survey/excavation methods, bibliographic references, draft or final copy status, name of the recorder/author, date, accession and catalog information, list of all abbreviations used, master list of field bag numbers, and photographs (Feder 1997a:127, 129; Feder 1997b:68; Hester 1997; Museums and Galleries Commission 1992:15, 25; Short 1982:212; Van Houten 1985:19). A state’s official repository for archaeological information may not officially record a site if some or all of this information is missing. For example, the Nebraska State Historical Society needs site location information before it can record site specific data in its geographic information system (GIS) database (Trisha Nelson, personal communication 2010).

Some data, although considered obligatory, may not pertain to a particular project. For example, if a survey crew does not find any sites, there is no need to include site-specific information like site number, site name, or site location.

To ensure the collection of information, it is useful to rely on standardized forms that all crew members take into the field. One way to encourage archaeologists to save documents they generate, help them understand why they are saving them, and make the site/project archives easy for others to use and understand is by using repository specific forms. These forms are beneficial to repository because staff members are familiar with them and know what information they include. They will lessen the chance of problems arising due to missing information, incorrect information, or a lack of standardized language (Orna and Pettitt 1980:43).

The River Basin Surveys (RBS) provide one example of standardized information recording. Both Butler (2009:212) and Lehmer (1971:17-18) discuss how the archaeologists for these projects created a standardized set of forms for survey and excavation including the survey form, general feature form, burial form, photograph catalog, artifact catalog, unworked animal bone identifications, and continuation forms. The survey form included a space to draw the site location within the General Land Office Survey's section, and the feature and burial forms included grids to sketch proveniences (Lehmer 1971:17). The verso sides of the forms included space for additional information. Field crew members completed their own excavation and survey records before returning from the field (Lehmer 1971:17). This is important because they completed documentation while the information was fresh in their memories, increasing the chances for accuracy.

“No recording system can be better than the men who keep the records,” (Lehmer 1971:18). Even with the best intentions, no project, including the RBS projects, has perfectly recorded information. In the case of the RBS projects, not everyone used the same methods making generalized statements about the projects more difficult (Butler 2009:214). One reason for this is the level of detail needed. Archaeologists and repositories typically desire more information (Bewley et al. 1999:12), but this can provide more opportunities for errors and omissions. Documents are only one part of a system for handling records; it also includes the artifacts, repository policies, use of a standardized vocabulary, and the people who handle and care for the records (Orna and Pettitt 1980:21, 58). If one part of this system fails, all other parts will suffer making built in redundancies important. These redundancies can mean including some of the same information on all types of forms or making sure each person completes a daily field journal.

WHY ACCURATELY RECORD INFORMATION?

Archaeology is a scientific discipline, which means interpretation of its data must be replicable. To ensure this, documentation must be accurate (Hester 1997b:98), appropriate and complete. Without accurate records, archaeological data becomes less reliable and therefore less replicable. Complete and accurate records preserve archaeological data and can prevent future problems when a researcher is looking through old records. For instance, one piece of contextual information preserved and used for later analysis is the spatial relationships between artifacts and features at an archaeological site (Feder 1997a:114). If this information is not available for an artifact or feature, archaeologists will have limited analyses. With contextual information, analytical opportunities are greater (Blackmar 2002; Fowler and Givens 1995:98).

Another reason for making and preserving archaeological records is that excavation (and sometimes survey, too) are inherently destructive processes that destroy archaeological sites (Feder 1997a:113-114). In the end, artifacts and associated documentation may be the only remaining parts of archaeological deposits and are necessary to reconstruct it as accurately as possible (Blackmar 2002; Fowler et al. 1996: 31; Ruwell 1985:1). Even with the best records or photographs, once archaeologists excavate a site, they cannot excavate it the same way again.

Scientific disciplines also build off the work of previous scientists. Therefore, archaeologists gain knowledge and develop theories based, in part, off past archaeologists' work. Documents made while working on a project today create a useful body of knowledge for later stages of research and can be helpful for future researchers (Bewley et al. 1999:12; King 1985b:10), especially if the documents are accurate. Future researchers will incorporate observations made today, so it is critical to complete records while the project is active (Bewley et al. 1999:12; Novick 1980:31).

HOW TO PHOTO-DOCUMENT PROJECTS

No archaeological project is complete without photographic documentation. It is an important tool for accurately recording every phase of a project beginning in the field and ending in the lab (Lehmer 1971:18) because they, "provide clear, accurate records of what the researcher saw, serving as both checks and mnemonic devices for later recall" (King 1985a:43). One choice institutions and archaeologists can make is to take black and white images with a film camera and color images with a digital camera. Black and white film lasts longer than color film, is easier to preserve, and records the subject accurately. In digital photography, the image is the pixilated representation of the subject. It allows the photographer to instantly look at the images and delete and retake them as necessary without wasting film or time waiting for images to develop, but the files do not preserve readily. Archaeologists and repository staff need to spend much time preserving these files by continually migrating them to newer software and hardware. Printing the digital files produces a tangible image, but is typically not an exact representation of the subject due to the image resolution and printers' color differences.

Both film and digital cameras should come with instructions for choosing the most appropriate settings. If using a film camera, use the lowest speed (ISO number) and finest grain film for the lighting conditions (King 1985a:41). Set digital cameras to the desired shutter speed, aperture, and ISO. Finally, always use a scale in field and lab photos to give the subjects a spacial relationship (Simmons 1969:78).

Every institution should have a schedule to migrate data as necessary as they can loose data if they do not migrate it. Several years ago, I looked through decades old VHS videos created at a survey project. First, I had a difficult time finding a VCR player in our office. When I found a machine and played the tapes, I discovered they had deteriorated over the years to the point that it was impossible to tell the location of the survey or who any of the participants were. If a migration schedule had been in place, this problem may not have occurred, and information may not have been lost.

Proper records must accompany the images (Simmons 1969:45). On field photography catalogs, record the site, unit, level, geographic location, direction, important identifying objects, date, time, lighting (natural or artificial & type), exposure, camera, lens, filters, image #, photographer, rights management (copyright, legal, and financial restrictions), shutter speed, film type or equivalent, file format (for digital), and resolution (for digital) (Bewley et al. 1999:13-20; Simmons 1969:46, 80) Lab photography requirements are much the same. Although lab photography catalogs may not require location information, direction, or time, record the type of object in the photograph and the object's catalog number (Simmons 1969:80).

SUPPLIES FOR MAKING DOCUMENTS

While there are many types of writing utensils for writing on documents, pencil is best for document preservation (Bennett 1998:232; Van Houten 1985:36). First, pencil ensures the writing is removable. Second, it does not contain acids as many inks do. On the other hand, pencil marks can fade over time. If someone catches fading early enough, that person can rewrite the information or make a photocopy to preserve the information. One way to counteract potential data loss due to fading is to schedule regular monitoring.

Some of the worst writing utensils for document preservation include inks and markers, e.g., ballpoint pens, felt-tip pens, gel pens, and Sharpie® (Schrock and Noack 1995:5; see Feder 1997:129 for a disagreement). To increase the longevity of documents created with these inks, type out hand-written records or photocopy them (Van Houten 1985:19, 36). If photocopying documents, copy them onto acid-free, buffered, 20% cotton-rag paper and only use heat-fusion methods (the method laser copiers use) (Van Houten 1985:19). If using a marker or pen, archival inks such as those found in a Pigma®, Identipen® or Zig® are preferable, but they still should never be used on original documents because of their irreversibility.

Use acid-free, buffered, 20% cotton-rag paper for all original field and lab documents. Spiral or bound notebooks with grid pages are good choices for drawing artifact locations, profiles, and plan views, and if high humidity or precipitation may be a problem, archaeologists can find ones with water resistant pages (Feder 1997:116).

There are differing opinions regarding the use of pressure sensitive labels. One opinion says to avoid using any pressure sensitive labels directly on documents, but that it is acceptable to use them on boxes or folders (Schrock and Noack 1995:5). This is because boxes and folders are not archival documents, and if the labels stain them, no damage is done to the documents. If damage occurs to boxes or folders, staff can replace them while keeping the documents inside safe. The other opinion does not advocate using any pressure sensitive labels even on folders or boxes, but instead advocates writing directly on containers (Bennett 1998:232) because labels can fall off creating a loss of information. Another reason for this opinion is that labels, although not in direct contact with documents, are in close enough contact with them allowing harmful materials in the labels to leach into documents.

I do not recommend using pressure sensitive labels on documents or folders because of the risk of acid migration and potential data loss, but agree they can be helpful for labeling boxes. Several years ago, I processed a collection of archaeological records where most of the original folders had pressure sensitive labels. Many of the folders still had their labels, but other folders were missing them. Part of my task became matching disassociated labels with folder contents. Box labels are easier to monitor than folder labels, and if boxes are in a well-functioning repository, staff members will continually monitor them and replace any labels when necessary. If a box label falls off, it will be possible to create a new one by using the old one and examining the contents inside.

CONCLUSION

This chapter discussed how to make accurate and durable archaeological records by incorporating essential information from each project into standardized forms. It talked about why that information is essential and how archaeologists can document projects by using digital and film photography. The final section included information about what supplies archaeologists can use to ensure their documents create a permanent record of the project.

CHAPTER 3: SAVING RECORDS

INTRODUCTION

Chapter 3 discusses why archaeologists and repositories should save archaeological records. It gives a brief history of archaeological records preservation, examines what documents archaeologists and repositories should save, and tells how they can promote records preservation beginning with a project's early planning stages and ending with the curation facility.

A BRIEF HISTORY OF RECORDS PRESERVATION

For most of the 1990s, the only effort made to save archaeological data was to preserve the artifacts and not the associated documents (Trimble and Marino 2003:100) because very early archaeological work typically did not produce much documentation. When the discipline was in its infancy, archaeologists did not understand the importance of recordation or documenting the entire deposit. As part of this, many collections created during these early years contain only limited amounts of artifacts. The amount of documentation changed, however, during the Works Progress Administration projects of the 1930s and Missouri River Basin Surveys of the 1940s through 1960s, both of which produced a plethora of archaeological documentation. Despite the increase in documentation, it was not until the 1970s that archaeologists began to focus on the archaeological collection as a whole, i.e., artifacts, documents, associated data, and reports (Lindsay and Williams-Dean 1980:20). This paradigm shift occurred not only because of increased documentation, but also from the increased fieldwork due to cultural resource management (CRM) projects.

Trimble and Marino (2003:100) discuss the history of records preservation over the past 35 years. They note that professional meetings began to include sessions about archaeological conservation in 1976. Then, in the 1980s, archaeologists started to listen to those who had promoted the care of the whole archaeological collection. Even in meetings today, there are sessions dedicated to preservation, and the conclusion is always that something needs to be done quickly to preserve archaeological collections. Unfortunately, although people have been advocating for archaeological records preservation for over 40 years, not all archaeologists seem to understand its importance.

WHY SAVE THE INFORMATION?

Once archaeologists accurately record information from their projects, they must save it. But why? The easiest reason to give is if archaeologists take the time to create the document, they should take the time to save it. First, is not good scientific practice to record information then not save it. Principle 7 in SAA's code of ethics says

> "Archaeologists should work actively for the preservation of, and long term access to, archaeological collections, records, and reports. To this end, they should encourage colleagues, students, and others to make responsible use of collections, records, and reports in their research as one means of preserving the in situ archaeological record, and of increasing the care and attention given to that portion of the archaeological record which has been removed and incorporated into archaeological collections, records, and reports," (Society for American Archaeology 1996).

Second, a contract with a governmental entity may require archaeologists to save the documents from its sponsored projects because those documents become government property (Sullivan and Childs 2003:88). The federal regulations in 36 C.F.R. § 79.5 (2009) provide for the preservation of preexisting collections and state that, "The Federal Agency Official is responsible for ensuring that preexisting collections, meaning those collections that are placed in repositories prior to the effective date of this rule, are being properly managed and preserved." They also provide for new collections and state:

> "The Federal Agency Official shall deposit a collection in a repository upon determining that:
>
> (1) The repository has the capability to provide adequate long-term curatorial services...
>
> . . .
>
> (3) The repository has certified, in writing, that the collection shall be cared for, maintained and made accessible in accordance with the regulations in this part and any terms and conditions that are specified by the Federal Agency Official" (36 C.F.R. § 79.5 2009).

Third, it will be possible to refer back to the originals if there is a mistake in the research (Sutton and Arkush 1996:19). Fourth, artifacts may lose their interpretability throughout their life in storage (Blackmar 2002). This loss of interpretability happens when artifacts deteriorate in poor storage conditions. If this occurs, documents may help with interpretation.

Finally, the information is necessary for future research in the project area. If archaeologists want to reanalyze someone else's work or conduct new research, they will need all data, not just the final report, something archaeologists do not always write (Eiteljorg 1998:21; Ewen 2003:117; Kenworthy 1985:80; Nelson and Shears 1996:35-

36). "One can never predict how these materials will be used in the future as archaeological methods and interests change over time, but one can be assured that they all have considerable value," (Sullivan and Childs 2003:87). For example, researchers may not be interested in the artifacts or field methods, but in other details of the project including who the lead archaeologist was, who the crew was, what the daily hours were, what the weather was like, or even who the cook was (Sprague 1982:206).

WHAT TO SAVE AFTER MAKING DOCUMENTS

While he believed some records should be saved, Sprague (1982:207), in the early 1980s, wrote that, "We can dispose of survey records very quickly," in which he included site forms, maps, and notes. I disagree with this statement. If generating documents about a project, preserve them. It is better to err on the side of caution and have "too many" documents than not enough. Over the years, I have worked with many project and site files that have little to no information. Many times, even basic information such as site location is missing.

The Museums and Galleries Commission (1992:13, 15, 25) discussed what records it believed repositories should retain. These records included documents regarding ownership, records regarding conservation treatments, loan information, exhibition information, inquiries about a project, bound registers of all accessions and long-term loans, the object catalog, and repository information including subjects, donors, and location lists. While this list speaks primarily to what documents the repository would complete, archaeologists should be aware of them because they are important to the project.

Saved documents should include field notes; maps; background research; field forms such as site, feature, artifact, photograph, and object forms with documentation regarding provenience, provenance, maker, use, collection method, material, or date collected; special field forms such as burial, pollen, and C_{14} dating forms; lab paperwork including object treatment reports and artifact catalogs with a description of the cataloging process; raw data including tables and charts; official and legal records including proposals, permits, contracts, administrative records, correspondence, fiscal data, photography permissions, ownership documents, and object transportation, importation, and exportation documents; analyses and re-analyses including an explanation of methods; publications in all stages; news clippings; grant proposals including background research, applications, and reviews; photographic material including slides, prints, negatives, movies, and transparencies; and magnetic media including an explanation of the computer system, programs used, and a schedule for backing up or migrating data (Novick 1980:105; Paine 1992:16, 19-20; Parezo and Person 1995:166, 167; Sease 1992:23; Sprague 1982:206, 207, 208; and Trimble and Marino 2003:105). This is not an exhaustive list nor will all projects include all types of documentation listed here.

Fowler and Givens (1995:102) discuss reports and why repositories should save them. Most projects require a final report whether it is a short "letter report" or a long multi-volume one. Save the final report, in addition to draft versions with maps, charts, diagrams, and graphs because even negative finding reports can be useful to future researchers as they show evidence of what research archaeologists did and where they did it. Because archaeological reports, including the majority of CRM reports, often include restricted location information, they usually are not formally published, but become "gray literature." Gray literature is typically not available to the public, but only to landowners, scholars, and professional researchers who need access to specific data. It becomes more important to save these reports when one realizes there are typically few of them and are not available from the local library or bookstore.

Saving all documentation from every project will require much storage space. Unfortunately, repositories do not have an unlimited supply of space, and although it destroys information, it is inevitable the project director or repository will discard some documents. In consultation with the repository, only discard documents through deliberate and careful "weeding" due to possible records redundancy or cost concerns for curating (King 1985b:13). The Museums and Galleries Commission (1992:13) states there is no agreement in the archaeological profession regarding what records may be disposed of, but urges caution and "conservatism." No matter what archaeologists and repositories retain, field records are the documentation from archaeological projects and nearly all will be relevant to current or future projects (Ruwell 1985:3). As is the case with many things, as soon as someone disposes of something, someone else will come along asking for it so exercise caution when weeding them.

HOW TO PROMOTE RECORDS PRESERVATION

"The long-term management of archaeological collections, records, and reports is not just the job of the curator, but a key responsibility of the field archaeologist," (Sullivan and Childs 2003:79). Before a project is complete, there is a professional, ethical, and possibly legal responsibility to ensure a repository permanently cares for the documents (Sullivan and Childs 2003:79). Thus, just as project planning involves securing support for salaries, food, lodging, and analysis, also plan for the permanent curation of project documentation. At an early stage, select a repository for the documents and artifacts, begin to decide which records are most important, and budget for needed supplies as well as possible preservation activities (King 1985b:7; Ruwell 1995:199; Sullivan and Childs 2003:81). Throughout the project's duration, continue to evaluate which records will have the most potential for future research (King 1985b:7). It is also important to check that all documents are legible, labeled properly, and complete (Ruwell 1995:199; Van Houten 1985:21).

Once documents enter the repository and after all have decided what to retain and archive, it is necessary for staff to care for them properly. Information may be lost if repositories keep documents in an unsafe and insecure environment or if they do not maintain records regarding the locations of artifacts or their treatments (Blackmar 2002). The repository or sponsoring agency should insist that it will not consider a project completed until the records are documented and cataloged (Nelson and Shears 1996:37).

If the repository is unfamiliar with archaeological work, it should put a priority on training staff to curate archaeological documentation by purchasing reference books that help with curation and archival concerns (King 1985b:7; Nelson and Shears 1996:37). A repository can also work collaboratively with other institutions such as universities, museums, and governmental agencies to help researchers, the public, and students get the most benefit from their collections (Nelson and Shears 1996:37).

CONCLUSION

This chapter discussed saving archaeological records. The first section gave a brief history of records preservation. The second section told why archaeologists and repositories should save information. The third sections told what preparation, field, lab, and curation records to save. The fourth section discussed how to promote records preservation.

CHAPTER 4: CARING FOR RECORDS

INTRODUCTION

Chapter 4 tells archaeologists how to care for their records. The first section reviews the macroenvironment and microenvironment in repository space, paper types, housing guidelines and materials, oversized documents, and environmental monitoring. The second section discusses how environmental conditions and improper physical care can damage documents. The third section discusses how to maintain proper environmental and physical conditions. The fourth section discusses how to protect archaeological documents from a disaster.

HOW TO CARE FOR ARCHAEOLOGICAL RECORDS

When caring for archaeological records, preserve them in a state no worse than when they entered the institution (Pearce 1990:92). The primary goals are to keep the documents as stable as possible and ensure any action taken to preserve them is reversible in case it needs to be undone or removed in the future (Blackmar 2002). For example, if paper is torn, do not use standard pressure sensitive tape to repair it. Instead, either put the pieces together in a polyethylene sleeve to retain their association with one another or talk to a paper conservator about reattachment with glues like wheat starch paste. Most practices today follow this reversibility rule, and conservators, archivists, curators, registrars, and collections managers understand its importance. One way of ensuring this principle is to be sure the person working with the documents understands the properties of the media and is able to store them in the best possible environment (Blackmar 2002). These rules apply no matter what the value of the materials (Ritzenthaler 1993:68).

There are simple steps anyone can take to aid archaeological records preservation. Wear gloves when handling photographic media; ensure forms, field notes, site survey forms and other documents are on acid-free paper and completed with pencil; ensure maps are printed on Mylar D ®/Melinex ®; watch for signs of damage and contamination; limit the use of fragile records; and have an easily understandable organizational system (Bachmann and Rushfield 1992:5; Bennett 1998:231; Blackmar 2002; Hester 1997a; Kenworthy 1985:80; Sullivan and Childs 2003:69; Sutton and Arkush 1996:32; Trimble and Marino 2003:105). Apply a simple organizational system with the use of both check-out forms for documents, folders, and boxes and cross-reference forms for maintaining a connection between records stored in the main location and records stored elsewhere (King 1985b:7; Ritzenthaler 1993:86). These forms will tell other researchers that a record has been removed, by whom, and when.

More complicated measures for preserving documents include controlling the temperature and RH, having clean air with good circulation, controlling light levels, stopping biological infestations, maintaining good housekeeping measures, employing security measures, and protecting records from disasters (Ritzenthaler 1993:51). Others add to this and say that keeping storage areas separate from other activities, minimizing handling, avoiding wooden shelving units and map cases, and not storing records in basements or attics are important steps to aid document preservation (Bennett 1998:231; Blackmar 2002; Craddock 1992:15). No repository will have perfect conditions, but taking all appropriate and possible steps and following policies and procedures will lengthen the life of the records.

Some have stated the importance of making multiple photocopies of certain documents (Paine 1992:16, 25, 53; Sutton and Arkush 1996:38). Paine (1992:16) believes in making two photocopies of the final report, notebooks, maps, plans, and diagrams to keep one copy in the archives and make the other available for daily use. If making multiple photocopies, house at least one copy in a separate location from the original in case of disaster (Paine 1992:16, 25, 53; Sutton and Arkush 1996:38). The copy stored in a separate location becomes a "security copy" so, if possible, store it in a different city. Should a disaster like a flood or tornado occur that destroys the originals, the security copy should still be available.

Macroenvironment v. Microenvironment

If designing a storage system for archaeological records, first determine how often documents move into and out of storage (Bachmann and Rushfield 1992:5). After this, regulate two environmental levels to obtain an appropriate environment for the records: the macroenvironment and the microenvironment.

The macroenvironment includes carpet, blinds, curtains, shutters, window awnings, insulation and vapor barriers on external walls, ambient temperature and RH, and ambient air (Craddock 1992:20; Florian 1997:5; Pearce 1990:92). With space concerns and the macroenvironment in mind, place storage and processing areas away from overhead pipes that may leak or the repository may one day need to mitigate water damage caused by a broken pipe (Paine 1992:39). Store magnetic media in a room with an uncarpeted and un-waxed floor that is damp mopped (Bennett 1998:234) because this lessens the chance of dust and static electricity damaging the media.

People often overlook the microenvironment as having much influence over the environmental conditions that affect records. The microenvironment includes the boxes, drawers, file cabinets, and the records themselves (Bennett 1998:231; Blackmar 2002; Florian 1997:5; Pearce 1990:92). To give records the best possible microenvironment, use heavy-duty, non-damaging, rust-free, baked enamel metal shelves and cabinets without sharp or damaged edges (Bennett 1998:231; Kenworthy 1985:85; Pearce 1990:94; Ritzenthaler 1993:77-78). Archivists prefer metal to wood because wood will off-gas harmful chemicals as it deteriorates. Acids can also leech into your documents. Repositories should use cabinets that are fireproof, secured to a non-movable structure to prevent falling, faced away from windows to protect against light damage, located against interior walls to protect against large fluctuations in temperature and relative humidity, and have bottom shelves that are at least six inches off the floor to protect against flooding (Bennett 1998:231; Paine 1992:39; Ritzenthaler 1993:77-78; Short 1982:218).

Some advocate repositories house boxes on top of shelves or cabinets (Ritzenthaler 1993:77), but I disagree in certain situations. Do not place boxes on shelves or cabinets if pipes are overhead. If any water falls due to leaks or fire suppression systems, these boxes will become wet. If the leak is slow, no one may notice it and damage to documents will be greater because the repository did not fix the situation quickly. If there were no overhead pipes, I would allow boxes on top of cabinets, but continue to guard against a leaky ceiling. If part of the ceiling leaks, do not place boxes on top of shelving in that area.

Paper

A great deal of paper manufactured today contains short cellulose fibers, which affects the quality of paper and shortens its life expectancy to less than 50 years (Ritzenthaler 1993:24, 25; Thomson 1986:144). Poor quality paper also contains a high proportion of lignin, a short fiber related to cellulose (Ritzenthaler 1993:22; Thomson 1986:144). Because of these short fibers, damage is greater to poor quality paper than high quality paper (Ritzenthaler 1993:24; Thomson 1986:144). One example of a lignin containing paper is newspaper, which is made to last only a short time before turning yellow and disintegrating (Thomson 1986:143). Because of the inherent instability of acids, purchase paper that does not contain lignin, ground wood pulp, or alum-rosin sizing (Ritzenthaler 1993:24; Schrock and Noack 1995:2).

“Durability” is the degree to which paper retains its original physical strength and mechanical properties over time (Ritzenthaler 1993:26; Van Houten 1985:23). Good quality rag paper can last 500 years or more in the proper storage conditions (Ruwell 1995:198). Rag paper contains long cotton fibers from select pieces of waste cotton textiles or “rag” fibers from the long fibers of softwood trees, which are treated to remove naturally occurring acids (Thomson 1986; Van Houten 1985:23). Rag is a component in the most durable paper so it resists tearing, fraying, and cracking (Van Houten 1985:23).

“Permanence” is paper’s ability to remain chemically stable over time and resist deterioration from environmental pollutants and paper’s inherently unstable impurities (Ritzenthaler 1993:26; Van Houten 1985:23). By remaining chemically stable, paper resists discoloration and retains its original textures (Van Houten 1985:23). The most permanent papers are acid-free or alkaline buffered to 7.0-8.5 pH (Kenworthy 1985:87;

Schrock and Noack 1995:2; Van Houten 1985:23, 28). Traditionally, acid-free paper products contained 100% cotton rag fibers with no lignin content, but acid-free paper today usually contains acidic materials, typically lignin, although the manufacturing process removes these acids (Applebaum 1991:103). Acid-free, lignin-free paper is available, but even this has a small amount of lignin, but is <0.2%, which is not enough to cause damage (Schrock and Noack 1992:2).

Alkaline reserve paper is buffered with calcium carbonate to an alkaline reserve of 2-3% giving it at least an 8.5 pH, which will increase an acidic paper's life by neutralizing any acids that may touch the paper (Applebaum 1991:103; Van Houten 1985:28). This is not a permanent benefit though because if buffered and acidic papers are in direct contact over a long time, the amount of acid neutralizing buffering will decrease as acids leach into the buffered paper. While these papers are appropriate to use in most instances, do not use them in contact with blueprints or color photos (Applebaum 1991:102; Schrock and Noack 1995:2) due to the processing methods of these materials.

Housing

Schrock and Noack (1995:2-3) discuss the properties of housing materials noting that such housing comes in paper and non-paper based materials. Many archival supply companies sell acid-free file folders that come either buffered or unbuffered. There are also several types of acid-free corrugated board for making archival storage boxes. Blue/gray barrier board has an 8.5 pH, 3% calcium carbonate buffer, smooth outer surface, and inner lining of white lignin-free paper. While this is safe to use, if making a box with it, place documents within buffered or pH neutral folders before storing them in the box because it contains a small amount of lignin in its outer layers. Tan, lignin-free barrier board also has an 8.5 pH and 3% calcium carbonate buffer, but is made of long lignin-free sulphite-sulfate pulp fibers, which archivists prefer over blue/gray board for important documents in permanent storage. When making boxes, ensure they are sturdy, have reinforced corners, and have snug covers to keep out soil and other pollutants.

Do not underfill, but do not overfill containers either because this may put too much stress on the documents (Ritzenthaler 1993:86) when removing and replacing folders. The general guide for filling boxes and folders is to provide a maximum amount of support with a minimum amount of stress (Paine 1992:41; Ritzenthaler 1993:70). Provide this by ensuring all loose paper documents are inside file folders or envelopes that are inside boxes, drawers, or cabinets (Ritzenthaler 1993:86). One approach to preventing too much stress is to use the score marks provided at the bottom of the folder and make a fold depending upon the amount of material inside (Ritzenthaler 1993:87). Boxes and drawers should be relatively full to prevent documents from sagging (Bennett 1998:232; Van Houten 1985:20). When using filing cabinets, use the "slide bar" as a guide to apply the correct amount of pressure. If a box is not full, use inert packing or support materials such as a spacer made of archival blue board to fill extra space in fairly empty boxes (Paine 1992:41).

Clear plastic sleeves are useful for housing high use objects, brittle items, and documents repository staff need to see while in storage. These enclosures use static electricity to keep documents in place and can be made from polypropylene or polyethylene, but are usually made from uncoated polyester (Mylar D®/Melinex®) as polypropylene is usually reserved for making boxes and polyethylene for making bags (Schrock and Noack 1995:3).

Oversized Documents

Oversized documents require different care than smaller items because they do not fit in traditional storage. Unfold any folded documents and house them in larger folders or boxes (Bennett 1998:232; Van Houten 1985:20) because folds in the paper create permanent creases that weaken paper and make tearing easier. Unroll any tightly rolled documents by flattening or humidifying them. Consult a conservator about the humidification process. Ideally, group oversized documents by size and material and store them in heavy folders inside map cases (Ritzenthaler 1993:88-89). Store multiple documents in one folder as long as it is not too full and there is an alkaline-buffered paper or tissue as an interleafing sheet between each document (Ritzenthaler 1993:89). Horizontal storage in several flat archive boxes is a good alternative to large map cases if only a few documents in an institution need oversized storage (Ritzenthaler 1993:88).

Ritzenthaler (1993:90-91) gives several options for storing oversized documents that are too large for a map drawer. One option is to gently fold the documents once. A second option is to roll these documents onto wide-diameter, alkaline tubes, but do not roll more than one document on a tube. Also, do not put them inside the round tubes because the documents will conform to the diameter of the tube making retrieval difficult. A third option is to gently roll these documents and put them into a long rectangular box. As with round tubes, only put one document in each box. With this method, the diameter of the rolled document should be as large as the diameter of the box to keep the roll as loose as possible and minimize stress on the document. Store tubes and boxes horizontally, and rotate them periodically to reduce stress and ensure the weight of the document is not always resting on the same side.

HOW ARE ARCHAEOLOGICAL RECORDS DESTROYED?

Atmospheric pollutants, inherent chemicals in paper, light, temperature, relative humidity (RH), biological agents, lack of proper storage, insufficient funds to hire professional staff, improper curation methods, low priority for long-term preservation, and physical agents are some of the factors that damage records, and many are related (Bennett 1998:231; Blackmar 2002; Fowler et al. 1996:31). Typically, either poor storage conditions or improper handling directly causes this damage (Bennett 1998:231; Blackmar 2002; Ritzenthaler 1993:45). Poor storage conditions are due to having an inappropriate temperature or RH, which can either be too high or too low (Ritzenthaler 1993:45). The agents that damage documents the most, from most to least destructive are discussed here.

Light

Light damage is cumulative and irreversible (Applebaum 1991:65; Ritzenthaler 1993:48). Ultraviolet (UV) light damages documents the most, but visible and infrared (IR) light also damage documents (Ritzenthaler 1993:48; Thomson 1986:15; Van Houten 1985:29). UV light is on the blue end of the light spectrum and contains a high amount of energy (short wavelength). These short wavelengths create chemical reactions that change the properties of paper such as fading colors and causing structural changes like whitening and embrittlement (Applebaum 1991:67, 78; Blackmar 2002; Bradley and Daniels 1990:3; Kenworthy 1985:81; Ritzenthaler 1993:47, 48; Van Houten 1985:29). Embrittlement happens when the long cellulose fibers in paper break because of light exposure (Applebaum 1991:67). IR light's longer wavelength and lower energy cause less damage (Florian 1997:5-6; Ritzenthaler 1993:48). Although the damage is less, IR light damages paper when the heat emitted from direct sunlight and incandescent bulbs expands materials (Applebaum 1991:85).

Although UV light is more harmful, the amount of damage depends upon the wavelength, intensity, and length of the exposure. Exposing a document to a brief amount of high intensity light can be as damaging as exposing it to a lower intensity light for a longer amount (Ritzenthaler 1993:48) so know both the amount of light and length of exposure to determine the amount of damage (Applebaum 1991:70; Bradley and Daniels 1990:4). If a work space needs higher wattage bulbs, make sure lights are turned off when the space is not needed. Serious damage to paper occurs by 4.5 million foot-candle hours (about 48 million lux hours) (Applebaum 1991:72). A foot-candle is the amount of light intensity in a one foot radius; a light meter can measure this.

Photocopier lamps are also a source of light damage and cause most harm to lignin containing paper. This is because acidic paper is more sensitive to light than is alkaline or neutral paper (Applebaum 1991:191). Limiting the exposure of lignin containing papers to photocopier lamps may be appropriate unless the copier has a UV blocker as the light will darken the paper (Ritzenthaler 1993:48; Schaeffer 2001:59, 60, 61-62). Allow a maximum of 10,000 copies over a lignin containing document's lifetime (Schaeffer 2001:59). Scanning also damages documents, but exposure from one or two scans is negligible (Schaeffer 2001:121) although damage will accumulate from repeated scanning. The amount of damage will depend upon the scan's length and the light intensity.

Flash photography will damage documents, but taking moderate amounts of photographs will not cause much damage (Schaeffer 2001:59, 60). One advantage to digital photography is the lack of UV light, but even the amount of light a 35mm camera produces when it flashes is not very harmful due to the short exposure length (Applebaum 1991:88; Schaeffer 2001:121).

Relative Humidity

Relative Humidity, or RH, is the percentage of moisture in the air relative to the amount of moisture the air is capable of holding at that temperature; warmer air has a higher holding capacity than cooler air (Applebaum 1991:25; Florian 1997:6; Ritzenthaler 1993:46). If the temperature is 70ºF with 50% RH, there is more moisture in the air than if the temperature is 40ºF with 50% RH. Documents are more sensitive to RH than temperature, which makes controlling RH more important than temperature (Applebaum 1991:26; Ritzenthaler 1993:46). Some argue the relationship between temperature and RH is the most important factor about temperature because when temperature drops, the amount of water a space can hold also drops causing RH to rise and absorb into documents (Applebaum 1991:25, 40; Florian 1997:7). Unless RH is constant, independent from the temperature, a rise in temperature will lower the RH and cause paper to become dry, less flexible, and easier to break (Thomson 1986:44, 66).

Knowing this, keep the temperature as low as possible in unoccupied areas without causing a rise in RH (Applebaum 1991:40; Kenworthy 1985:80; Museums and Galleries Commission 1992:50; Van Houten 1985:20). When determining the optimal RH for the institution, strive for a level around 50% if the temperature is in the upper 60ºs to lower 70ºs F. To increase paper's longevity by 500 times for alkaline paper and 1000 times for acidic paper, change the ambient environment in storage areas from 70ºF and 50% RH to 40ºF and 5% RH, but change them gradually, at a rate of 1-2% in 24 hours

(Applebaum 1991:190). Avoid drastically changing them, even if they remain within acceptable levels, because quick changes exacerbate many existing problems (Applebaum 1991:33, 34, 35, 39, 190; Bradley and Daniels 1990:1; Craddock 1992:15; Kenworthy 1985:78; Museums and Galleries Commission 1992:49; Paine 1992:49; Ritzenthaler 1993:53; Ruwell 1995:201; Schrock and Noack 1995:3l; Sullivan and Childs 2003:67; Thomson 1986:87, 88; Van Houten 1985:20, 32; Wilson 1995:1).

RH affects three types of deterioration: physical, chemical, and biological (Thomson 1986:82). Physical change occurs when paper expands due to a RH increase or contracts due to a RH decrease and is especially noticeable when RH is at a very low level (Thomson 1986:82). Paper can also warp and wrinkle and water-soluble inks bleed in environments with high RH (Ritzenthaler 1993:46; Van Houten 1985:32). These changes can occur in minutes so measure the hourly variation in RH (Thomson 1986:82, 227) and take steps to minimize fluctuation.

The rate of chemical reactions due to acid deterioration will increase with higher RH levels (Applebaum 1991:39, 190). These reactions can cause paper to become softer and tear more easily, can change the surface texture of documents, and cause coated paper to stick together (Applebaum 1991:190; Ritzenthaler 1993:46). Low RH levels can also cause chemical reactions. At around 40% RH, paper becomes brittle and desiccates making it easier to tear (Applebaum 1991:190; Blackmar 2002; Craddock 1992:15; Kenworthy 1985:81; Ritzenthaler 1993:46; Thomson 1986:87; Van Houten 1985:32).

High RH also causes an increase in harmful insect and fungal activity leading to an increase in biological deterioration (Applebaum 1991:39; Florian 1997:7; Ritzenthaler 1993:46). Mold can begin growing on paper when the RH is above 70%, but growth also requires warm, stagnant air (Applebaum 1991:39; Thomson 1986:87; Van Houten 1985:32). If there is air movement in the space, mold has difficulty growing.

Temperature

Regulating temperature is important in determining paper's longevity. High temperatures cause faster chemical and biological changes (deterioration) (Bradley and Daniels 1990:1; Florian 1997:6; Museums and Galleries Commission 1992:50; Thomson 1986:43; Van Houten 1985:30; Wilson 1995:1). For example, chemical activity roughly doubles with every 18ºF rise, which means a paper's lifespan doubles with every 18ºF drop (Applebaum 1991:40; Van Houten 1985:30). Because of this, isolate paper from direct heat sources such as sunlight, artificial lights (Museums and Galleries Commission 1992:49) and heaters.

Low temperature is critical to paper's chemical stability; a range from a deep freeze to about 65˚F is optimal (Applebaum 1991:40; Ritzenthaler 1993:52; Wilson 1995:1). No matter what the exact level in a repository, low temperatures are best for all types of media because high temperatures will accelerate chemical reactions that destroy paper (Blackmar 2002; Craddock 1992:15; Paine 1992:50; Ritzenthaler 1993:52; Short 1982:213).

It is also important to ensure the temperature in storage and working areas is stable, avoiding extreme or sudden fluctuations (Bradley and Daniels 1990:1; Kenworthy 1985:18, 78; Museums and Galleries Commission 1992:49; Ruwell 1995:201; Schrock and Noack 1995:3; Sullivan and Childs 2003:67; Van Houten 1985:30). These fluctuations can have a worse effect on paper than a constant high temperature because fluctuations cause constant expansion and contraction of the documents. Over time, the expansion and contraction will weaken the paper fibers and cause them to deteriorate.

Biological Agents

Biological agents such as insects, rodents, mold, and fungus can cause irreversible damage to documents (Blackmar 2002; Bradley and Daniels 1990; Ritzenthaler 1993:47-49). Nearly all their activity occurs in the microenvironment, which they prefer to be dark and moist with average temperature and oxygen levels, a neutral pH, and a lack of toxic chemicals (Applebaum 1991:122; Florian 1997:5, 125; Ritzenthaler 1993:49).

Insects harm documents when they eat paper, photographs, and adhesives; or their highly acidic feces stain them (Applebaum 1991:117, 137; Kenworthy 1985:81; Ritzenthaler 1993:48, 49; Van Houten 1985:33, 34). They prefer to eat new paper, but also eat old paper (Applebaum 1991:121). Control the RH to lessen damage, but it will not stop damage completely (Florian 1997:125; Thomson 1986:86).

Applebaum (1991:122) identifies silverfish (*Lepisma sacharina*), firebrats (*Thermobia domesticca*) and psocids/book lice (*Psocoptera syn. Orrodentia*) as typical pests found near documents. Silverfish and firebrats leave visible trails while eating paper that has a starchy finish, microscopic mold growing on damp plaster and drywall, and broken-down cellulose. They hide easily and usually enter a space in cardboard boxes brought into the repository. While the presence of a few of them may not be a concern, large amounts are indicative of poor storage conditions or poor housekeeping. Psocid/book lice's presence also suggests poor storage conditions, but they typically do not damage documents. Overall, there may be only a few noticeable pests in an institution, but their presence can be indicative of a larger problem as there will be many more hidden in unreachable places.

Mold typically appears when there is poor air circulation, the temperature is above 70ºF, and the RH is above 70%, but it can grow in a low temperature, high humidity environment like a refrigerator (Applebaum 1991:138; Florian 1997:125; Ritzenthaler 1993:48). Without regular housekeeping, hygroscopic dirt also promotes mold growth (Maekawa and Elert 2003:39). Mold is harmful because it breaks down paper fibers, staining and discoloring it, and causing foxing, i.e., the presence of brownish spots on paper (Applebaum 1991:141, 189; Ritzenthaler 48-49). Foxing is increased by a high RH, light, and acids in the paper (Applebaum 1991:189).

Physical Damage

Careless or rough handling, destructive photocopying, disfiguring with notations or marks, and spilling coffee or ashes all cause physical damage to documents (Ritzenthaler 1993:49). Mechanical damage from handling, such as tears, can be due to paper's unexpected embrittlement (Applebaum 1991:145). Embrittlement in paper occurs each time there is a fold or flex, and the cellulose fibers weaken and break (Van Houten 1985:36). Food, beverages, and dirty or greasy fingerprints can stain documents so do not eat or drink around documents (Applebaum 1991:147; Kenworthy 1985:81).

Inherent Instability

Inherent instability, or inherent vice, is due to paper's poor physical make-up, such as its acid content (Bachmann and Rushfield 1992:5; Bennett 1998:231; Blackmar 2002; Ritzenthaler 1993:45; Van Houten 1985:23). Acids affect paper in two ways. The first is from acid added during manufacture so paper becomes weak across the entire page

(Thomson 1986:144). The second is from sulfur dioxide reacting with the edges of paper weakening it in isolated areas (Thomson 1986:144). Both methods lead to paper's discoloration, brittleness, and powdering (Applebaum 1991:189). Ground wood pulp has short acid-containing fibers that deteriorate faster than long fibers (Van Houten 1985:26). Alum (potassium aluminate) is an acidic salt that degrades into sulfuric acid (Ritzenthaler 1993:25; Van Houten 1985:25). Rosin is a sizing agent, and over time becomes brittle as it oxidizes (Ritzenthaler 1993; Van Houten 1985:26).

A basic pH (>7.0 pH) is desirable in archival quality paper, but an extremely alkaline environment at 11-14 pH can be just as damaging as an acidic one (Ritzenthaler 1993:26). This is because the bonds in alkaline paper will break down at the ends while acidic paper typically breaks down in the middle (Ritzenthaler 1993:26). Check the pH of the paper with an inexpensive pH testing pen, which many archival companies sell (Applebaum 1991:103, 189; Kenworthy 1985:88). Also, get samples from archival supplies companies and conduct tests on their archival quality papers before placing large orders (Applebaum 1991:102).

Writing Inks

While most craft stores sell pens with fairly stable or "archival" ink, the ink in most standard pens has many problems. For instance, today's dye inks are less permanent than older ones and may contain additives that reduce the image's and paper's permanence (Van Houten 1985:35). Some ink is acidic and eats through paper, bleeds, or transfers through paper, and in the case of ballpoint pens, will run or smear in high humidity (Kenworthy 1985:66; Ruwell 1995:200; Van Houten 1985:35). The ink of felt-tip pens (magic marker, permanent marker, and highlighter) fades, is susceptible to feathering and bleeding if exposed to moisture, is not generally permanent, is often acidic, and may change color upon exposure to visible light and radiation (Ritzenthaler 1993:33; Van Houten 1985:35).

Atmospheric Pollutants

Atmospheric pollutants include gases, organic acids, and solid particles such as dust and soot (Blackmar 2002; Ritzenthaler 1993:47). Most damage from atmospheric pollutants happens with high humidity or light exposure (Thomson 1986:143). Solid particles are harmful because they tear; grind with abrasive action; attract moisture, other contaminants, and pests; and cause metal fasteners to rust (Applebaum 1991:98; Ritzenthaler 1993:47; Van Houten 1985:34). Particulates, e.g. smoke and greasy soot, also damage paper by staining (Applebaum 1991:98).

Gases cause damage when paper acts as a filter trapping pollutants as they flow through (Applebaum 1991:191). Nitrogen dioxide, sulfur dioxide (a component of air pollution), and gaseous pollutants combine with moisture in paper to make sulfuric, nitric, hydrochloric, formic, and acetic acids causing oxidation in cellulose fibers (Applebaum 1991:97, 98; Bradley and Daniels 1990:5, 6; Ritzenthaler 1993:47; Thomson 1986:152; Van Houten 1985:34; Wilson 1995:2). Ozone, a strong oxidizing agent when it reacts with water, partially converts to hydrogen peroxide, which can severely damage paper (Ritzenthaler 1993:47; Thomson 1986:151). Formaldehyde reacts with cellulose increasing its acidity and bleaching or discoloring it (Applebaum 1991:97-98). Off-gassing from wood, unstable plastics, and cleaners can also damage documents (Applebaum 1991:99-102). While these atmospheric pollutants damage documents, they can also harm people so take care to avoid these harmful substances.

Adhesives and Fasteners

Adhesives and fasteners can cause many problems for documents because they typically are not made for archival purposes. For example, the use of pressure sensitive labels or tape such as rubber cement or Post-It® notes on any documents will leave a temporary sticky residue, and after several years, may fail leaving a discolored and fragile area (Bennett 1998:232; Blackmar 2002; Ritzenthaler 1993:39; Ruwell 1995:200; Sullivan and Childs 2003:66; Van Houten 1985:36). These residues and stains also attract dirt and pests causing discoloration (Applebaum 1991:148; Ruwell 1995:200). Adhesives can also pull off part of the document when removing them (Applebaum 1991:148). Thus, these are not recommended.

All mechanical fasteners damage paper to some extent (Van Houten 1985:36). Metal paperclips rust and progressively adhere to paper until they are impossible to remove without damaging the paper (Applebaum 1991:148; Ruwell 1995:200; Sullivan and Childs 2003:66; Van Houten 1985:36-37). Both plastic and metal paperclips permanently crease paper causing a weak area. Rubber bands tear and abrade paper. The sulfur content also deteriorates over time losing elasticity and breaking, which causes them to stick to paper and leave stains (Applebaum 1991:148; Ruwell 1995:200; Van Houten 1985:37).

HOW TO MAINTAIN PROPER CONDITIONS

Light

Ideally, archives are in a space with no windows or light, but having no light at all is impractical. Protect all documents from excessive light exposure. If there are fluorescent lights or windows, drape windows with heavy fabric or cover them and fluorescent lights with UV-film (Applebaum 1991:67, 78; Blackmar 2002; Bradley and Daniels 1990:83; Kenworthy 1985:78, 81, 83; Museums and Galleries Commission 1992:49, 50; Paine 1992:49; Ritzenthaler 1993:61; Sullivan and Childs 2003:67; Van Houten 1985:19; Wilson 1995:2). UV-film works well except staff needs to replace it periodically as it has a limited lifespan. Other ways to protect documents from light are storing them in boxes or closed cabinets and keeping lights turned off when they are not needed in storage areas (Kenworthy 1985:81; Museums and Galleries Commission 1992:45; Ritzenthaler 1993:61, 62; Sullivan and Childs 2003:67).

In many spaces and situations, allow a maximum of 50 lux (a measure of light intensity) illumination, but allow up to 160 lux in some situations and even higher levels for very short periods (Applebaum 1991:72, 86; Kenworthy 1985:83; Museums and Galleries Commission 1992:58). One space that has different lighting needs at different times is storage. Some institutions do not have any visible, UV, or IR light in storage areas (Applebaum 1991:78: Sullivan and Childs 2003:67). This may be unwise though, especially if documents are stored in boxes or cabinets, because if there is a power outage while someone is in the space, that person would have a difficult time exiting. When designing a lighting scheme for storage spaces, design light levels so staff can see into all spaces equally with aisle lights that individually turn on and off (Applebaum 1991:95), and have emergency lights illuminating an exit path.

A light meter can be helpful for monitoring light levels in work and storage spaces (Applebaum 1991:70; Blackmar 2002; Bradley and Daniels 1990:1, 5; Kenworthy 1985:83; Paine 1992:49; Ritzenthaler 1993:62). Some models include both a lux meter to measure the total light level and a UV light monitor to give the portion of UV light

(Applebaum 1991:70; Bradley and Daniels 1990:5). After using one of these light meters, take informed steps to modify or correct any problematic areas. As with temperature and RH readings, a conservator should asses light readings every six months (Kenworthy 1985:78; Museums and Galleries Commission 1992:49)

Temperature and Relative Humidity

To achieve and most accurately maintain temperature and RH, use a heating, ventilation, and air-conditioning (HVAC) system (Blackmar 2002; Bradley and Daniels 1990:1; Craddock 1992:21; Paine 1992:49; Ritzenthaler 1993:51, 55-56). These systems can be set to desired environmental conditions and notify staff if there are problems. Although it is much less efficient, if the repository does not have relative humidity control built into its HVAC system, use humidifiers near documents when the RH drops and dehumidifiers or silica gel desiccant when the RH rises (Applebaum 1991:42, 43; Blackmar 2002; Bradley and Daniels 1990; Craddock 1992:21; Paine 1992:49; Ritzenthaler 1993:51, 55-56; Van Houten 1985:32).

An HVAC system will function optimally only if someone is responsible for monitoring and recording the environmental conditions throughout the year. Daily monitoring and recording are essential for documents' preservation in long-term storage because they show any problems allowing for informed decisions regarding changes (Kenworthy 1985:82; Ritzenthaler 1993:54; Sullivan and Childs 2003:67). Some ways to monitor environmental conditions include using a recording hygrothermograph, hygrometer, psychrometer, data logger, or RH indicator cards (Blackmar 2002; Bradley and Daniels 1990:2; Craddock 1992:21; Kenworthy 1985:83; Paine 1992:49; Ritzenthaler 1993:51, 54-55).

Recording hygrothermographs accurately record temperature and RH, but are less accurate at very high and low levels (Applebaum 1991:29; Bradley and Daniels 1990:2; Kenworthy 1985:83). They use a circulating drum to record temperature and RH on a 1, 7, or 30 day rotation. One advantage is they constantly monitor the environment, although there is a delay before conditions appear on the paper. Another advantage is they leave a visible record of environmental conditions. This can be advantageous because staff can easily write on it when a significant event occurs that might influence the conditions such as rain, floor mopping, and having many people in an area (Applebaum 1991:30). A disadvantage is that someone needs to change the paper on a regular basis. If no one changes the paper, the machine will continue to loop and make recordings, and it will be nearly impossible to analyze these readings as it will be difficult to distinguish what the environment was like at any given time. Because hygrothermographs need monitoring, that person should also be responsible for calibrating them seasonally by using a psychrometer (Bradley and Daniels 1990:3; Craddock 1992:18). Place the hygrothermographs in several different locations in the building, but do not place them too high where lights could influence them nor too low where they could be subject to stagnant air or a person could bump it (Applebaum 1991:30). Also, make sure to keep them away from windows and drafty doors and vents and unstable surfaces as vibrations can cause an inaccurate reading.

Hygrometers are inexpensive and give immediate RH readings, but like hygrothermographs, are inaccurate at very high and low levels (Applebaum 1991:29). Psychrometers come in sling and battery operated models. Both give a very accurate reading of the temperature and relative humidity at that moment (Bradley and Daniels

1990:2; Kenworthy 1985:83) and are useful for calibrating other types of environmental monitors, but neither model constantly monitors the environment. Data loggers include models like the HOBO®. These machines constantly monitor environmental conditions with the data downloadable into a computer (Applebaum 1991:31; Kenworthy 2985:83). This type of monitoring is beneficial because staff can easily analyze data with included software, and it does not create a bulk of paper to store. Staff also need to monitor these as the data logger's memory can become full if it is not downloaded regularly. RH indicator cards, or humidity strips, are inexpensive, but are only accurate to about 5% although they work in areas with very low RH (Applebaum 1991:31; Bradley and Daniels 1990:2; Kenworthy 1985:83).

A conservator needs to assess the results every six months (Kenworthy 1985:78; Museums and Galleries Commission 1992:49) to ensure the records are in the best environment possible. Someone will also need to monitor the HVAC system itself and put a regular maintenance schedule in place. Do not overlook problems with the HVAC system because a properly functioning HVAC system helps preserve documents. An improperly working HVAC system can quickly cause records deterioration.

With or without an HVAC system, try to use the building to the repository's advantage before doing environmental control (Applebaum 1991:41). One way is to separate the building into different climate zones, which is especially useful if there is a separate space for each material type (Applebaum 1991:42; Paine 1992:49). This can be very useful and less expensive than having one large room because not all areas would need to conform to strict environmental guidelines. Unfortunately, this is usually not possible for most institutions due to space constraints. It is also interesting to note that in most climates the RH in unheated buildings is more stable year-round than in heated buildings (Applebaum 1991:41) meaning a space with no environmental control can be better than a space with an improperly working HVAC system.

Listed below (Table 1) are ideal temperature and RH levels for many different material types. Experts debate some of the exact ranges, but the ones given here are generally accepted levels. If an institution is unable to maintain these conditions, do the best possible.

Table 1: Optimal Temperature and Relative Humidity Conditions for Documents

Media Type	Optimal Temperature	Optimal RH
Historic paper documents	41-64˚F	55-65%
Modern paper documents	65-72˚F	50-65%
Modern magnetic recording media	64-72˚F	35-45%
Modern computer disks and hardware	64-72˚F	35-45%
Modern microfilm	<59˚F	15-40%
Mixed media and work areas	60-75˚F	30-65%

(Applebaum 1991:40; Blackmar 2002; Craddock 1992:16; Kenworthy 1985:78, 80; Museums and Galleries Commission 1992:59; Paine 1992:59, 90, 91; Ritzenthaler 1993:53; Thomson 1986:45; Van Houten 1985:30, 49)

Biological Agents

Documents are susceptible to two types of biological agents: mold and pests. Mold can grow anywhere and in almost any climate. Growth can occur when the temperature ranges from 39-99ºF, but 68ºF is optimal (Florian 1997:6). Unfortunately, the most conducive temperature for mold growth is also the temperature in many office spaces. If mold is growing in the space, use alcohol or UV light sparingly and carefully to kill it as both will harm documents (Applebaum 1991:138, 141). If there is mold growth on documents, consult a conservator.

Pests are another biological agent that may destroy documents (Van Houten 1985:20). There are several easy ways to protect documents from pests. First, keep documents in metal boxes or cabinets because most insects will eat through paper ones. Second, do not allow food or beverages near documents because crumbs and spills attract pests that will eat those documents (Applebaum 1991:118; Kenworthy 1985:81). Third, isolate and inspect newly acquired items before incorporating them into the collection because pests may arrive at the institution riding in on documents (Applebaum 1991:124; Museums and Galleries Commission 1992:45) or packaging material. Finally, do not allow shrubs, flowers, or organic mulch near the entrance to the building and keep lights away from the door because these will attract pests (Applebaum 1991:125). It is also a good idea to keep plants and flowers out of areas with archives.

Dead bugs and dust will attract other bugs so have a thorough housekeeping program people follow, especially in the document storage areas (Applebaum 1991:124, 125; Bradley and Daniels 1990:6; Florian 1997:11-12; Museums and Galleries Commission 1992:45). Steps to take include dusting, vacuuming-not sweeping; thoroughly cleaning the outside of the building; sealing, inspecting, and cleaning entry points into the building; eating food only in approved areas; and immediately stopping unwanted water sources so items can be dried out, if necessary (Applebaum 1991:125; Bennett 1998:231; Blackmar 2002; Paine 1992:45; Ritzenthaler 1993:63; Sutton and Arkush 1996:38). When cleaning, be sure to inspect underneath furniture and in all dark areas where pests like to hide (Applebaum 1991:124).

The institution should implement pest control through an Integrated Pest Management Program (IPM) or an Integrated Inspect Pest Control Program (IIPC). They are “integrated” because conservators, collections managers, and maintenance staff all contribute to their success (Florian 1997:105). IPM uses assessment, prevention, and treatment to deter bugs and employs chemicals only as a last resort (Applebaum 1991:125; Maekawa and Elert 2003:1). To begin an IPM program, decide where to place sticky traps, document their locations, set up an inspection schedule (inspect more frequently in warmer months when pests are most active), decide the repository's threshold for treating an infestation, identify and document all pests found, research pests, and take action, if needed (Applebaum 1991:128, 130, 137). IIPC is similar to IPM, but is designed to eliminate insects completely (Florian 1997:105). Trained and experienced people should implement both programs (Bradley and Daniels 1990:7; Museums and Galleries Commission 1992:45; Sullivan and Childs 2003:68). Even if the institution has no formal IPM or IIPC program, use sticky traps to monitor pest activity. They are inconspicuous, easy to use, able to be out all the time, and catch a representative sample of the pests in the institution (Applebaum 1991:124).

To rid an institution of unwanted biological agents, use pesticides only as a last resort (Bradley and Daniels 1990:7). Prevention is best because, over time, the residue build-up from chemical dusts and sprays will damage documents, the building, and people's health to the point that many previously used chemicals are now illegal (Applebaum 1991:117; Florian 1997:81; Maekawa and Elert 2003:1). If using chemicals, get approval from applicable governing authorities, follow all applicable laws and safety regulations, and have knowledgeable people use them, preferably a pest removal contractor (Applebaum 1991:119; Maekawa and Elert 2003:3; Museums and Galleries Commission 1992:45). One disadvantage to using a contracting pest removal company is that they may not know about the sensitive needs of the documents so be sure to inform them and ensure they area doing what they can to keep them safe.

Freeze or heat items to treat active insect, mold, and fungus infestations (Florian 1997:128-129; Maekawa and Elert 2003:3). If freezing, do so after learning about techniques and the items' short and long-term properties (Bradley and Daniels 1990:7; Florian 1997:81). When freezing, kill all pests at all stages of their life-cycles (Florian 1997:81) otherwise there is a risk of a re-infestation. If heating, kill pests quickly at approximately 122ºF (Florian 1997:95, 96). To kill mold or fungus, the method depends upon the species, temperature, age, and density of the population (Florian 1997:12). Mold remediation companies and conservators will be able to help make these determinations.

An anoxic environment with nitrogen or argon gas is a good way to rid an institution of pests and mold (Florian 1997:96, 190; Maekawa and Elert 2003:4). Contract companies can tailor treatment to the repository's exact specifications (Maekawa and Elert 2003:1). How a pest reacts to the treatment though depends upon what type of pest it is and in what life-cycle stage it is (Florian 1997:97; Maekawa and Elert 2003:4). For example, it is easiest to kill adult insects so do not assume their deaths signify a completely successful treatment (Maekawa and Elert 2003:8). Temperature and RH also affect the effectiveness of this treatment. Anoxic treatment is more effective when the temperature rises and the RH falls (Florian 1997:97), but even with good environmental conditions, anoxic treatments are most effective if left for at least several days (Maekawa and Elert 2003:4). This is necessary because desiccation is an important part of the process, and it can take that much time to occur (Maekawa and Elert 2003:4). If treating the area for any shorter length of time, there is a risk of killing only some of the pests.

Physical Maintenance

While we want people to use archival documents, it is dangerous for the documents, and there will be a compromise between what is best for the documents' preservation and the researchers' needs (Wilson 1995:1). That said, there are some basic maintenance procedures to maintain and preserve archaeological records while still allowing use. This includes locking file cabinets, especially ones with highly sensitive information; backing-up everything and storing it in a different location (off-site storage); only using pencils in the archive area as they are the least harmful, are stable, and not affected by light exposure; not allowing researchers to make photocopies or retrieve documents; and, completing and updating an index and inventory of documents contained in the archive (Paine 1992:41; Ritzenthaler 1993:34, 68, 70, 72, 116; Sprague 1982:202, 207, 210, 216; Van Houten 1985:35).

Treat documents as if they are fragile and unique even if they are not (Applebaum 1991:145). When storing them, lay them flat, support them evenly with the maximum amount of support while allowing the minimum amount of stress, and ensure packaging materials are inert (Museums and Galleries Commission 1992:41; Van Houten 1985:36). Handle and move them as little as possible, but when moving them, ensure the proper supplies and people are available and follow handling procedures (Applebaum 1991:148; Museums and Galleries Commission 1992:41). Some procedures include having weight limits on boxes, keeping aisles and corridors clear of obstructions, using a container or cart to move documents, determining how much handling the repository allows, using gloves to protect the documents from dirt and oils in hands, protecting documents from jewelry, using two hands when moving documents, not moving documents unless they have a known destination, having the correct number of people to carry awkward items, and not carrying more than one document at a time (Applebaum 1991:145, 146, 147; Museums and Galleries Commission 1992:42).

To prolong a document's life and keep it clean, use a soft cloth; crumbs, gum, or a vinyl eraser; or, an archivist's cleaning pad in a sweeping motion going from the center to the edges (Van Houten 1985:20). Use soft brushes in short, quick strokes to sweep away dust and dirt very gently. Only a professional conservator should do any advanced cleaning or restoration on important documents (Van Houten 1985:21).

Items that hold papers together can be very damaging. As mentioned earlier, do not use pressure sensitive tape or labels or rubber cement to repair documents because they will all cause permanent damage (Van Houten 1985:20). These items must be removed from documents; a qualified conservator will be able to help (Ritzenthaler 1993:39). Rubber bands and metal fasteners such as paperclips are also damaging, but staff can usually remove them. If they do not, rubber bands will loose their elasticity and turn gummy and brittle while metal will rust (Bennett 1998:232; Blackmar 2002). If this has already happened to documents, consult a conservator. Several decades ago, some advocated using inert plastic or stainless steel paperclips or staples to hold groups of papers together (Sprague 1982; Van Houten 1985:20). Although many continue to use them, I do not advocate this because all paperclips, no matter their manufacture, will damage documents by putting permanent creases in them while staples put permanent holes in paper and create areas that tear easily. Paperclips and staples can also catch on other documents and damage them.

Sprague (1982:208, 209-210) wrote several maintenance procedures that current standards challenge. He stated everything should be on letter paper, even shrinking or enlarging the original in order to discard the oddly sized original. Another suggestion was that if a good letter sized map copy existed, staff could fold the original larger size and put it into the file with the other documents. Shrinking large maps to letter size can be beneficial for a general use copy, but if the map is extremely large, it may become unreadable when shrunk to that level defeating the purpose of copying the document in the first place. The same is true for enlarging very small documents. I also do not advocate folding original documents because it creates a crease and therefore a permanent weak line in the paper, but folding a use copy can be beneficial as it keeps all documents about a subject in one location.

Security is indispensable because archaeological records are irreplaceable (Bachmann and Rushfield 1992:5; Blackmar 2002; Ritzenthaler 1993:64). Any measures employed should concentrate on the building structure, windows, doors, and exhibits (Paine 1992:33; Ritzenthaler 1993). An institution can do this by controlling keyed access into the storage room, monitoring research space, and keeping an access log to know who used the archives and storage room and why (Blackmar 2002; Paine 1992:34; Pearce 1990:93; Ritzenthaler 1993:64; Sprague 1982:210; Sullivan and Childs 2003:68). Also, security alarms will detect fire (Paine 1992:33, 37; Ritzenthaler 1993:64), flood, or unauthorized entry.

Establishing, implementing, and updating written collections management policies and procedures are crucial for having a smoothly running repository (Bennett 1998:228; Blackmar 2002; Paine 1992; Ritzenthaler 1993:64, 113). In general, the access policy should allow for people to use the archives, except for confidential or restricted documents (Paine 1992:21; Pearce 1990:99). The policy should give specific statements regarding who has access, hours of access, location, access restrictions, use limitations, photocopying policies, the difference between open and restricted records, access log procedures, and proper handling techniques (Bennett 1998:228; Blackmar 2002; Ritzenthaler 1993).

Atmospheric Pollutants

Environmental pollutants may also destroy documents (Van Houten 1985:20). The easiest thing to do is not smoke near documents as it is a fire hazard, the smoke will stain documents, and the smell will absorb into them (Applebaum 1991:101, 118; Kenworthy 1985:81). Another easy method is to store them in closed containers such as polyester folders, complete encapsulation, boxes, and cabinets (Van Houten 1985:20-21).

A more difficult yet vital way to protect documents is through a good HVAC system. HVAC systems should provide enough of an even air exchange that the institution does not have microclimates like stagnant air pockets or breezy areas (Ritzenthaler 1993:56). These systems, in addition to controlling temperature and RH, are also capable of filtering out dust and air pollutants (Blackmar 2002; Ritzenthaler 1993:56). HVAC filters include charcoal, fiberglass, and potassium permanganate. Charcoal filters remove gaseous pollutants from the air while fiberglass filters remove solid particles (Applebaum 1991:113; Bradley and Daniels 1990:6; Kenworthy 1985:83; Wilson 1995:2). Replace all filters before they become “full” and in the case of charcoal and fiberglass filters, before they begin releasing pollutants back into the air (Applebaum 1991:113; Kenworthy 1985:83). When designing an HVAC system for a repository, put archive storage areas on a separate system than other areas such as the lab, kitchen, and offices because those areas can easily introduce pollutants into the air (Ritzenthaler 1993:56). For localized atmospheric control in a space like a lab, use a fume hood to rid the air of potentially harmful pollutants.

HOW TO PROTECT AGAINST A DISASTER

Protecting a repository and documents against disaster is necessary, but staff often do not discuss it or prepare for it. For security purposes and disaster preparation, keep a duplicate set of the records in a different building to help ensure that at least one copy survives (Burcaw 1997:97). If unable to keep a duplicate of the entire collection, keep a duplicate of the accession information and catalog in separate locations within a separate building (Burcaw 1997:97; Ewen 2003:118; Museums and Galleries Commission 1992:25).

To prepare for a disaster, institutions need to have a disaster plan laying out procedures to follow to protect and recover documents when experiencing a fire, flood, tornado, hurricane or other disaster (Museums and Galleries Commission 1992:55; Sullivan and Childs 2003:68). This plan can also guide an institution if a break-in or theft occurs. All staff members and volunteers should know the basic contents of the plan and receive training so they can implement it when necessary (Museums and Galleries Commission 1992:55). First responders (police, fire and rescue, etc.) should also know the plan and assist with its creation (Museums and Galleries Commission 1992:55).

The plan should include phone numbers of emergency responders, staff responsibilities, how to communicate emergencies to appropriate staff, phone numbers of appropriate staff, a building layout, mitigation priorities to minimize damage to documents, contact information for local experts and conservators, contact information for local cleaning and hazardous waste removal companies, a list of suppliers for any needed equipment, and security measures (Museums and Galleries Commission 1992:55). The institution must review and update its plan regularly as circumstances change (Museums and Galleries Commission 1992:55) such as staff, equipment, building, or archive priority changes.

Protecting Against Bad Buildings and Equipment

The building can be the first line of defense in protecting documents from disaster. One thing to do is inspect the building regularly to ensure it provides adequate protection against the weather (Museums and Galleries Commission 1992:45). "Maintenance of the fabric of the building must be given a high priority and funds budgeted for this. A badly maintained building will put a collection at risk from environmental damage" (Museums and Galleries Commission 1992:45). Review the building's construction materials, structure, and energy needs to make any necessary changes and ensure the institution is using it properly and efficiently (Ritzenthaler 1993:54). Also, check windows and doors to ensure staff do not need to re-seal them or add additional insulation, vapor barriers, or glazing (Ritzenthaler 1993:54).

Maintaining temperature and RH is easier if staff cares for and properly insulates the building (Museums and Galleries Commission 1992:45). Before installing or modifying environmental control equipment, monitor the environment for a year then follow expert technical advice when making changes (Museums and Galleries Commission 1992:45). It may take an additional year to work out any problems with the system (Ritzenthaler 1993:55). After that, continually evaluate the system and modify it to current needs (Ritzenthaler 1993:54). The ongoing maintenance schedule of environmental control equipment will depend upon how much the repository uses it (Museums and Galleries Commission 1992:45).

With baked enamel or powder coated steel furniture, make sure the manufacturer baked it at a high enough temperature and for a long enough time to burn off the organic component in the paint (Applebaum 1991:104). Note companies under bake white cabinets more often than darker cabinets because they do not want to show any potential burn marks (Applebaum 1991:104).

Protecting Against Theft

The Museum and Galleries Commission (1992:33) tells repositories how they can protect themselves against thievery and vandalism with physically defended windows and doors preventing an intruder from entering or delaying entry long enough for help to arrive. To do this, walls should be at least nine inch thick cement or brick. Unless the repository is in a historic building, reduce the number of windows by filling in unnecessary ones. Reduce the number of outside doors to the main entrance and emergency exits and either fill empty spaces with two inch thick cement or brick or completely seal unused doors with deadbolts.

Other ways to deter thieves include pitched roofs, fencing, anti-climb paint, and alarms (Museums and Galleries Commission 1992:33; Sullivan and Childs 2003:68). If the repository has an alarm system, ensure all openings have one, but simplify the system by using movement or body heat alarms to lessen the chance of false alarms (Museums and Galleries Commission 1992:34). Connect this alarm system to the security system's main office (Museums and Galleries Commission 1992:34) and the repository's security personnel.

Repositories should have a strict, enforced key policy by keeping staff with access to a minimum, keeping keys in a secure location, and only giving them to staff if they sign for them (Museums and Galleries Commission 1992:34; Sullivan and Childs 2003:68). No temporary staff, volunteers, or interns should have access to storage unless accompanied by permanent staff. No non-staff members, including researchers, should have access to storage.

Protecting Against Fire

A building must be a minimum fire risk and prevent the spread of fire (Museums and Galleries Commission 1992:37). To do this, insulate storage areas with fire retardant insulation minimizing fire spread to and from areas with high fire potential such as labs, kitchens, and mechanical rooms; ensure that all electrical wiring and equipment is up to code and check it regularly; and have a regularly maintained detection and alarm system installed along with fire fighting equipment such as a fire suppression system and fire extinguishers (Kenworthy 1985:85; Museums and Galleries Commission 1992:37; Sullivan and Childs 2003:68). Also use fire proof cabinets for documents and train staff and volunteers so they are familiar with fire safety procedures (Museums and Galleries Commission 1992:37; Sullivan and Childs 2003:68).

Protecting Against Flood

Flooding has the potential to create a major disaster for an institution. It can go undetected for a substantial time unless staff is constantly monitoring all areas of the building. To minimize risk, do not allow pipes in storage areas (Museums and Galleries

Commission 1992:39). This may be impossible in old buildings, but may be possible in newly designed or built structures. Even fire suppression systems have a chance, albeit small, of leaking. The repository will need to weigh the risks of protecting from fire versus protecting from flood (Museums and Galleries Commission 1992:39). Fire causes irreversible damage while water causes damage that is usually repairable, although with difficulty. If there are overhead pipes in storage, install automatic shut-off valves, and no matter if there are pipes or not, have water alarms (Museums and Galleries Commission 1992:39; Sullivan and Childs 2003:85). The pipes' locations should show on the building plan and be included in the repository's disaster plan (Museums and Galleries Commission 1992:39).

If a storage area has leaks from above, cover all shelving and storage containers in plastic, use waterproof boxes, and fix the leaks (Museums and Galleries Commission 1992:39). Minimize potential damage by ensuring documents are at least six inches off the floor and away from walls (Kenworthy 1985:85; Museums and Galleries Commission 1992:39). Staff and volunteers should also have training in flood prevention, control, and response (Museums and Galleries Commission 1992:39).

CONCLUSION

Chapter 4 discussed how archaeologists should care for their records. If archaeologists or repositories do not commit to caring for archaeological records and learn how to do so, they are not fulfilling ethical and legal requirements for the documents' care. The first section explained the difference between the macroenvironment and microenvironment, the different paper types available to repositories, methods to properly house documents, and methods to monitor a repository's environment. The second section explained how poor environmental conditions and improper physical care could destroy archaeological records. The third section discussed how to maintain proper environmental and physical conditions. The fourth section discussed how to protect archaeological documents from a disaster.

CHAPTER 5: CARING FOR NON-DIGITAL PHOTOGRAPHIC MEDIA

INTRODUCTION

Chapter 5 discusses how archaeologists and repositories should care for their non-digital photographic media. This topic is important because the archaeological record also includes photographic media. Considered here is how physical and chemical damage and poor storage conditions and materials destroy photographic media, how to store photographic media safely by using proper storage materials, having proper storage conditions, and air filtration, and how to prepare photographic media for storage at a repository.

HOW IS PHOTOGRAPHIC MEDIA DESTROYED?

Many of the same things that damage paper also damage photographic media. Photographs deteriorate chemically; photochemically; biologically from high temperature, high RH, air pollutants, residual processing chemicals, direct contact with harmful material, light exposure, fungi/insects, deterioration of the base and emulsion from internal or external causes; and, physically from mishandling (Short 1982:213; Weinstein and Booth 1977:127)

Physical Damage

Physical damage includes fading, stains, image distortion, tears, abrasions, fingerprints, and writing and paperclip impressions (King 1985a:47; Schrock 1995:1; Weinstein and Booth 1977:123). This damage occurs when people mishandle photographs or when dust and fingerprints remain on the surface; humidity that is too high or low exacerbates this damage (Short 1982:214). No matter what the humidity, dust and fingerprints attract moisture degrading photographic media just like paper.

There are many ways to avoid physical damage. Clean photographic media with a soft photostatic cloth. Do not use rubber cement or other unstable glues to mount photos to board, do not use cleaners to clean the emulsion (dull) side of a negative, do not write on the backs or fronts of photographs with non-archival or indelible ink, do not replace old envelopes without transferring identifying information, do not store negatives, prints, or newspaper together in the same enclosure or store more than one image in an envelope, and do not hold photographic material together with rubber bands or paperclips (Sullivan and Childs 2003:70; Weinstein and Booth 1977:124-124).

Chemical Damage

Chemical degradation occurs naturally over time, especially to color photographs, and is often the result of the inherent instability of certain photographic processes and materials, e.g. cellulose acetate negatives, cellulose nitrate negatives, color slides, and color prints (Applebaum 1991:97; Schrock 1995:1; Short 1982:213). It is impossible to stop this process, but stabilizing the photographs with proper storage will slow down the reactions. High RH and temperature will speed up any chemical activity (Time-Life Books 1972:105). Damage occurs when harmful chemicals remain in the photograph due to deterioration of the base and emulsion or inadequate fixing or washing during processing, which leads to staining and fading if chemical reactions continue past the desired time (King 1985a:47; Short 1982:213; Weinstein and Booth 1977:128, 129).

Poor Storage Conditions

Poor storage conditions can cause or accelerate damage to photographic material in much the same way as paper (King 1985a:49; Schrock 1995:1). Temperatures above 80ºF and RH values above 60% greatly increase harmful chemical reactions, and along with harmful pest activity, promote gelatin softening in emulsions causing them to stick to nearby smooth surfaces (Kenworthy 1985:81; Weinstein and Booth 1977:128). That same RH can also cause mold growth on photographs distorting the image (Schrock 1995:6; Short 1982:39; Time-Life Books 1972:110; Weinstein and Booth 1972:129). High temperatures and RH also increase pest activity. These pests cause damage when their feces stain images and when they eat photographs' paper base, although this damage can occur at any temperature or RH (Short 1982:39; Weinstein and Booth 1972:129). Light exposure, more specifically UV light exposure, for too long causes photochemical degradation by deteriorating the photographic paper or film base and by fading, which is a greater problem for color photos (Keefe and Inch 1984:231; Short 1982:214; Weinstein and Booth 1972:128-129).

Atmospheric pollutants damage photographic material and can cause more damage than improper temperature or RH (King 1985a:49; Short 1982:213; Time-Life Books 1972:105). Gases such as nitrogen oxides, sulfur dioxide, and hydrogen sulfide interact with the silver in photograph emulsions causing fading, staining, discoloring, and paper support embrittlement (Keefe and Inch 1984:231). Reactive dusts in the air also fade or stain a photograph's emulsion and scrape or stick to its surface (Keefe and Inch 1984:231). Black and white photographs are most susceptible to humidity, poor quality enclosures, and air pollution and will fade within 40 years if not housed correctly (King 1985a:44, 49; Schrock 1995:6). Color photos are most susceptible to humidity, heat, and light and will last only a few decades if they do not have proper storage conditions (King 1985a:43, 49; Schrock 1995:6).

Poor Storage Materials

Simply because a product says it is acid-free does not mean it does not contain harmful substances that will make it acidic in the future. One of these substances is alum (aluminum sulfate) sizing. It is not acidic, but becomes so when it breaks down into sulfuric acid (Keefe and Inch 1984:230). This and other acids in storage materials deteriorate photographic material as much as they do paper (King 1985a:49). Acids in transparent vinyl and polyvinyl pages may leak into images causing staining and deterioration (Keefe and Inch 1984:248; Schrok 1995:5; Shafer 1997:175). The lignin and alum in cardboard, untreated wood, Kraft paper, and glassine envelopes all affect the silver in photographs causing the images to fade (Time-Life Books 1972:100, 105). "Magnetic" photo albums have poor quality materials and adhesives on the pages that can cause discoloration making image removal difficult (Schrock 1995:5). The sulfur in rubber bands turns silver containing photographs brown or yellow (Time-Life Books 1972:105). When adhesives loose their tackiness, they damage photographs by causing discoloration and bleaching if they are too close to the emulsion (King 1985a:49; Time-Life Books 1972:105). Plastics can damage the emulsion and react with chemicals in the photos while some inks will eat through the substrate leaving holes (King 1985a:49; Time-Life Books 1972:105).

HOW TO STORE PHOTOGRAPHIC MEDIA

Properly storing photographic media is just as important as properly storing paper. The same ethical standards and federal regulations apply. Photographic media is important because it gives a visual representation of a project, and without that documentation, valuable information is not available research. While important to house all types of photographic media safely, if an institution has limited resources, it is best to concentrate on negative preservation (Time-Life Books 1972:106) because negatives are more stable than photographs and staff can print multiple photographs from one negative.

Good preservation methods include handling the media correctly, keeping up regular housekeeping, employing regular maintenance, and cataloging the material. Handling the media correctly includes wearing gloves, handling slides by their mounts, and handling photographs and negatives by their edges (Bennett 1998:234; Keefe and Inch 1984:266; Schrok 1995:2; Weinstein and Booth 1977:133). Wearing gloves is necessary when storing images in plastic enclosures because hands create static electricity and leave fingerprints on the plastic. Regular housekeeping minimizes the amount of dust, insects, and mold (Keefe and Inch 1984:231, 233). Regular maintenance includes having a back-up copy of the images, checking originals and back-ups for deterioration at least once every two years, replacing images as necessary (Keefe and Inch 1984:233; King 1985a:42). Have an original and back-up catalog with basic cataloging information and the image's condition (King 1985a:42). As part of the cataloging process, organize the images and label them with pencil, but only write on the backs of the photographs and slide mounts (Keefe and Inch 1984:254; King 1985a:42).

Storage Materials

Several types of good quality materials are useful for storing photographic media. The materials should be strong, durable, chemically stable, and pass the "Photographic Activity Test" (PAT), an accelerated aging test used to verify they are safe, and which is approved by the American National Standards Institute (ANSI) and the National Association of Photographic Manufacturers (Kenworthy 1985:88; Schrok 1995:3).

Protect photographs from all light sources (Keefe and Inch 1984:231). Do this by eliminating windows or keeping blinds drawn on existing windows, using either low wattage incandescent or UV-filtered fluorescent light bulbs, and using storage containers (Keefe and Inch 1984:232-233). Boxes will protect photographs from atmospheric pollutants and pests, provide physical support to minimize mechanical damage, and allow easy access (Keefe and Inch 1984:238). If using boxes, choose ones that are suitable to the repository's needs, use the least amount of space, and avoid overfilling them (Keefe and Inch 1984:238). In addition to boxes, storing images or individual negative strips in separate archival envelopes, sleeves, folders, or albums, protects them against damaging light, dust, handling, air pollutants, and rapid changes in temperature and RH (Keefe and Inch 1984:238; King 1985a:54; Ritzenthaler 1993:91; Schrok 1995:3).

Paper is a good material for photographic storage enclosures and interleafing. It protects photographic media from light and atmospheric pollutants, provides a labeling surface, allows harmful off-gases to escape, is easy to construct, and is reasonably priced, but researchers must remove images from enclosures to look at them (Keefe and Inch 1984:247; Schrock 1995:3). Different types of photographic media require slightly different materials. Generally, use acid-free paper that has a very low lignin amount, is made from 100% cotton rag, is 7.5-9.0 pH, and either has an inert adhesive seal along the outside edges or is adhesive-free (Bennett 1998:231; Dorrell 1994:91; Kenworthy 1985:87; Keefe and Inch 1984:235-236, 248; Ritzenthaler 1993; Schrok 1995:3). Protect images by interleafing them with acid-free tissue or bond paper (Keefe and Inch 1984:233-234; Time-Life Books 1972:108). Store negatives in acid-free paper enclosures with a high alpha-cellulose content and 7.0-7.5 pH, but without lignin, sulfur, alum, rosin, wax, plasticizers, or buffering (Keefe and Inch 1984:246; King 1985a:55). Black and white photographs prefer alkaline-buffered paper, but color photographs require pH neutral paper (Bennett 1998:231; Dorrell 1994:91; Ritzenthaler 1993; Short 1982:217).

Clear plastic is another good material for storing photographic media as researchers can view images without removing from their enclosures, but if the storage area has temperature or RH problems, use plastics carefully (Bennett 1998:232; Ritzenthaler 1993:83; Schrock 1995:4) because they will hold humidity. When envisioning plastic enclosures, people probably recognize binder pages for their ease and accessibility. If using them, store them vertically and do not put too much pressure on the pages (Keefe and Inch 1984:234-236; King 1985a:55). Be careful with them as not all contain stable plastics nor are they free of additives or surface coatings (Schrock 1995:4). Some plastics are extremely shiny so avoid these because they can damage photographs by causing ferrotyping, a process that gives prints a very glossy look (King 1985a:55).

Polyester is a good choice for photographic media storage and interleafing and is especially good for color negative storage enclosures (Short 1982:217). Interleafing is important because storing negatives in contact with one another can cause damage (King 1985a:55). Untreated polyester, like Melinex®/Mylar D®, is chemically stable, ages well, and can be used for ultrasonic or heat sealed encapsulation, which eliminates the need for adhesives (Keefe and Inch 1984:247; Kenworthy 1985:87; Schrock 1995:5; Short 1982:217; Sullivan and Childs 2003:69; Weinstein and Booth 1977:137). Encapsulation protects items from environmental conditions and physical damage, but takes time to do (Keefe and Inch 1984:235). If choosing to make ultrasonically welded polyester enclosures, purchase an ultrasonic welder along with rolls of polyester. An advantage to making enclosures is that sizes are customizable. If the institution will not need many of these enclosures, purchasing an ultrasonic welder and large amounts of polyester may not be a wise use of financial resources. In this case, one option is to buy a roll of polyester, cut pieces to size, and seal at least two sides of the enclosures with double-sided tape. Another option is to purchase pre-made enclosures. Both options allow enclosures to have L-seams, 3-sided seams, or parallel seams.

Disadvantages to polyester are it is more expensive and may be inappropriate for images in poor condition or in areas without RH control (Keefe and Inch 1984:233-234, 247; Weinstein and Booth 1977:137). Encapsulation can harm images in poor condition because it holds the image in a sleeve by static electricity and friction making safe image removal difficult. If an area has little or no RH control, use polyester encapsulation cautiously because moisture can build up inside the sleeve creating an attractive environment for pests and mold.

Polyethylene is chemically stable, easy to find in common sizes, pH neutral, and fairly transparent to see the image reasonably well without removing it (Keefe and Inch 1984:234, 247; Shafer 1997:175; Weinstein and Booth 1977:137). Disadvantages are that it crinkles, has a low melting point, is not completely transparent, can become brittle with age, and is electrostatic, which attracts dust (Keefe and Inch 1984: 234, 247; Weinstein and Booth 1977:137). Use polyethylene with caution when housing black and white negatives, especially in areas with a high RH, because water can be trapped inside and have no way of escaping; never use polyvinyl chloride (PVC) (Dorrell 1994:91; Short 1982:217).

Store photographic media vertically in steel cabinets; keep them away from heat and light, airborne particles, and mechanical equipment that creates a magnetic field; and have one cabinet for each media type (Bennett 1998:233, 234; Short 1982:217; Time-Life Books 1972:100). Separate cabinets are beneficial because each can have unique environmental conditions. Steel cabinets with a baked enamel coating are better than wood because peroxides, glues, and varnishes in wood off-gas (Keefe and Inch 1984:231, 241, 263; Time-Life Books 1972:106; Weinstein and Booth 1977:126). They also allow vertical filing for easy image retrieval (Keefe and Inch 1984:236). If large images will not fit vertically in a filing cabinet, use flat map drawers in a metal map cabinet (Keefe and Inch 1984:242).

Storage Conditions

To ensure the repository stores photographic media in the best possible conditions, separate the media from other paper-based documents then store them by material type (Kenworthy 1985:87; Ritzenthaler 1993:54; Schrok 1995:6; Time-Life Books 1972). This storage method is best because temperature and RH levels are vital to photographic media's long-term preservation (Ritzenthaler 1993:54), and each material type requires different conditions. Generally, all photographic media needs a dark, dry, cool, and stable environment that avoids fluctuations in temperature and RH (Keefe and Inch 1984:230, 231; King 1985a:52; Ruwell 1995:200; Schrock 1995:6; Sullivan and Childs 2003:67).

Table 2: Optimal Temperature and Relative Humidity Conditions for Photographic Media

Media Type	Optimal Temperature	Optimal RH
Black and white film and prints	59-70˚F	20-50%
Black and white negatives	<59˚F	15-40%
Color film and prints	<36˚F	20-50%
Color slides and negatives	<36˚F	25-30%
Long-term preservation film	Frozen at 0-9˚F	25-30%
Slides	<68˚F	30-40%
General photographic media storage	50-77ºF, never above 86ºF	30-50%, never 60%

(Applebaum 1991:40; Blackmar 2002; Craddock 1992:16; Keefe and Inch 1984:231; Kenworthy 1985:78, 80; Museums and Galleries Commission 1992:59; Paine 1992:59, 90, 91; Ritzenthaler 1993:54; Schrock 1995:6; Thomson 1986:45; Van Houten 1985:30, 49; Weinstein and Booth 1977:131; Wilson 1995:1)

Just as with paper storage, RH is the most important environmental control to regulate in photographic storage (Keefe and Inch 1984:231). High RH will increase photographic materials' deterioration by increasing the paper and emulsion's chemical reactions and promoting mold growth (Keefe and Inch 1984:231). The greater the amount of insulation in the walls, floor, and ceiling, the more stable and easily controlled the temperature and RH will be (Keefe and Inch 1984:232). Moisture barriers in the insulation, similar to those found in bathrooms, will prevent condensation from forming due to unexpected high RH (Keefe and Inch 1984:231). If the repository has high RH, place silica gel desiccant in storage cabinets (Time-Life Books 1972:110). Desiccants will eventually become full of moisture and lose their ability to dry out an area so regularly monitor their effectiveness. When they are unable to absorb additional moisture, reuse many types by baking them in an oven to dry them. When RH is too low, photographic media loses its' moisture content making it brittle (Keefe and Inch 1984:231). Try raising the RH by lowering the temperature or adding humidifiers.

Cold storage in a frost-free fridge or freezer provides ideal conditions for photographic media storage, and is especially appropriate for color film and slides

(Applebaum 1991:40; Keefe and Inch 1984:261; King 1985a:42; Ruwell 1995:201; Sullivan and Childs 2003:70). This is because color is unstable and will deteriorate faster if exposed to high temperatures or RH (Keefe and Inch 1984:231).

Air Filtration

Having an effective air filtration system in the HVAC system is vital for photographic media's long-term preservation (Keefe and Inch 1984:232; Ruwell 1995:201; Schrock 1995:6; Time-Life Books 1972:110). A good filtration system with air washers and activated charcoal filters can remove gases, e.g., nitrogen oxides, sulfur dioxide, and hydrogen sulfide (Keefe and Inch 1984:231; Weinstein and Booth 1977:131). Non-combustible fiberglass or cellulose filters can remove at least 85% of the dust and solid particles in the air (Keefe and Inch 1984:231; Weinstein and Booth 1977:131).

HOW TO PREPARE PHOTOGRAPHIC MEDIA FOR STORAGE

Archaeologists can help repository staff prepare their collections for storage, and in some instances, may have an active role in determining the best possible conditions for the collection while at the repository. Preparations include assessing the collection's research value, anticipating how much use the collection will receive, organizing and determining what and how many enclosures the collection needs, making a list of damaged items or items that need conservation treatment, removing images from poor quality enclosures, removing rubber bands and paperclips, writing identifications on enclosures or the backs of images, and choosing an appropriate space in the repository. If archaeologists have available resources, they can also purchase proper enclosures and begin placing images in them.

The first step is to assess the collection's research value and determine if photos are unique and if negatives exist (Schrok 1995:2). A collection could hold more research value if it has unique images, but could have less value if it has photographs without corresponding negatives since the photographs typically have a shorter lifespan. The second step is to anticipate the collection's use because a highly used collection will need more care (Schrok 1995:2). As part of this, make duplicates of important images and prepare a master set of images to keep in ideal storage conditions while having the duplicate available for everyday use (King 1985a:41; Schrok 1995:2).

The third step could be to organize images before giving them to the repository, but first determine if the repository's resources would be better served if staff took care of this (Keefe and Inch 1984:230). If the archaeologist does this work, that person should make a list of the types of photographic media in the collection as well as sizes and quantities of each to determine the types and quantities storage materials the repository will need (Schrok 1995:2). Also make a list of items in poor condition, and store them separately, but do not attempt conservation work (Schrok 1995:2).

The fourth and fifth steps are necessary for the archaeologist only if that person organizes the collection. These steps are to replace all acidic and unstable enclosures, e.g., Kraft paper, with acid-free and stable enclosures, remove rubber bands and paperclips, and write image identifications on the new enclosures although the archaeologist may write on the backs of images, if necessary (Keefe and Inch 1984:246; Schrok 1995:2). When writing, use a #2 or softer pencil; stable and acid-free Pigma®, Identipen® or Zig® pen; or film marking pen (Schrok 1995:2).

In most instances, the archaeologist will not be able to choose specific locations or conditions for the collection once it reaches the repository. In case the archaeologist has this opportunity or is able to discuss it, ensure the collection is not stored in an attic, basement, or directly underneath overhead pipes or sprinkler systems; is in a space where temperature, RH, and air quality is controlled easily; is stored in appropriate metal cabinets; is stored away from fire hazards; and is stored in a room without carpet or window drapes (Keefe and Inch 1984:232; Weinstein and Booth 1977:125-126).

After following these steps, there may be instances when the repository is not able to care for the collection at the highest possible standards even when the archaeologist has done everything to prepare the collection for storage. In fact, very few repositories are able to care for their holdings at the highest level. As long as the archaeologist chose a repository that is doing its best with its resources and is maintaining minimum standards, the collection should be safe and made available to researchers.

CONCLUSION

This chapter explained how archaeologists and repositories alike could care for non-digital photographic media to fulfill legal and ethical requirements. Many of the standards are the same for photographic media as they are for paper documents. The first section showed how physical and chemical damage and poor storage conditions and materials destroy photographic media. The second section discussed how to store photographic media safely. The third section explained how archaeologists could prepare photographic media for storage at a repository.

CHAPTER 6: SUBMITTING RECORDS

INTRODUCTION

Chapter 6 discusses why and how archaeologists should submit records to a repository. As with previous chapters, this information is not isolated and is necessary for the entirety of archaeological records care. It reviews what archaeologists should do before submitting records, how they should organize them, and how they can prepare them for permanent storage.

WHY SUBMIT RECORDS TO A REPOSITORY?

When finished analyzing artifacts and writing the final report, submit everything to a repository (Ewen 2003:118; Fowler and Givens 1995:100; Trimble and Marino 2003:105) for reasons similar to why archaeologists should create and save documents. There are ethical standards and federal regulations guiding these principles. The documents along with the artifacts are the only lasting pieces of a project. Without records, it would be impossible to reconstruct what occurred or how it occurred. By submitting records, they are accessible to future researchers so they can build off previous work. It also ensures the documents' preservation, allows for professional recognition, and meets contract requirements of funding agencies (Bewley et al. 1999:21-23). See chapter 3 for further discussion. The repository should be the one designated through a formal legal agreement (Sullivan and Childs 2003:88-89) at the beginning of the project. Archaeologists may keep a secondary electronic copy of records, including the final report for personal files (Sullivan and Childs 2003:89), but will need to continually migrate documents to new media to keep the format current.

WHAT TO DO BEFORE SUBMITTING RECORDS

When choosing a repository, consider one where new information will enhance its current collection, receive use, receive proper care, and have financial security (Kenworthy 1985:88; Parezo and Person 1995:169). After selecting the repository, even before beginning fieldwork, write and submit to the repository the written and signed agreements about ownership and finances between the site owner, project sponsor, archaeological contractor, and repository (Museums and Galleries Commission 1992:15). Through another written and signed document, the archaeologist and project sponsor should grant the repository rights to research, study, display, publish, and provide access to the information (Museums and Galleries Commission 1992:15). Without an agreement like this, the information will have no opportunity for research. Also grant the repository copyright through this written and signed document, which is necessary because this right does not automatically transfer with ownership; it only transfers if it is explicitly stated (Parezo and Person 1995:173). Although it will not be necessary in all cases, a third document can provide the repository with written instructions putting restrictions on any sensitive documents (Kenworthy 1985:88; Parezo and Person 1995:172, 173).

The primary investigator should be responsible for a timely transfer as part of the contract fulfillment (Museums and Galleries Commission 1992:15). Part of the preparation should be to prepare the documents by packaging, cataloging, and numbering them (Museums and Galleries Commission 1992:15). The submittal should include two copies of the final report, paper copies of any electronic media with an explanation of the programs and versions used, and two lists detailing the types of documents in the submittal so one is safely in the permanent file and the other is available to researchers (Museums and Galleries Commission 1992:16).

HOW TO ORGANIZE RECORDS

A logical organization system helps researchers understand events of a project thereby maximizing the documents' future research potential (Parezo and Person 1995:170; Ruwell 1985:1, 3). Organization can also protect documents from damage as they will be housed most appropriately and efficiently (Kenworthy 1985:85). The repository may not organize them after receiving them choosing to follow the theory of "original order" (Parezo and Person 1995:170). Original order preserves the author's original arrangement for a group of documents making a logical organization system so important. Other reasons a repository may not organize documents are a lack of staff time or funding. Because of this, logically organizing documents before they enter the repository is necessary.

Organize records based upon how archaeologists use and access the information and what supplies and equipment are available (Orna and Pettitt 1980:40-42), but the system will depend upon the type and amount of documents. Try to consider others' future needs when deciding on an organizational system. At the highest level, arrange by classification or hierarchy, which would include categories like date, type of document, project, subject, media type, institutional affiliation, location, or institutional affiliation (Parezo and Person 1995:170-171). Subject or document type can include provenience documents, analytic documents, administrative documents, and project ("published") reports (Sprague 1982 in Fowler and Givens 1995:98).

A very basic arrangement for a small group of documents may include groupings called “administrative,” “correspondence,” “field records,” “lab records,” “reports,” and “miscellaneous.” “Administrative” includes contracts, permissions, and financial records. “Correspondence” includes communication between the archaeologist and other people and institutions. “Field records” includes, but is not limited to, field methods, field notes, excavation or survey forms, plan views, provenience logs, and photographic media and photograph logs. “Lab records” may include catalogs, cataloging procedures, photographic media and photograph logs, and analysis documents. Both draft and final versions of reports along with their accompanying information are part of “Reports.” “Miscellaneous” is for documents that do not fit any of the aforementioned categories. If using this category, it is a good idea to describe what those miscellaneous documents are. At the document level, organize either alphabetically or chronologically; chronological order is most popular (Orna and Pettitt 1980:21; Parezo and Person 1995:171). If there are any questions about how to organize documents, the repository should be able to help.

HOW TO PREPARE DOCUMENTS FOR STORAGE

Many methods to prepare documents for storage are the same methods to care for them properly while actively using them. These methods will help while using the documents and will help the repository when it receives the materials. As soon as possible, repositories should think about the documents’ storage, use, handling, maintenance, conservation treatments, and disaster preparations from multiple perspectives to set priorities for resource allocation, i.e., staff time, needed supplies, and funding amounts (Ritzenthaler 1993:2).

The easiest steps to prepare documents are to remove paperclips, rubber bands and wrapping material; replace worn folders; and remove surface soil with a soft brush (Schrock and Noack 1995:5). Before the transfer, easily label boxes with enough descriptive information about the contents so repository staff can re-associate documents and boxes (Schrock and Noack 1995:5; Sullivan and Childs 2003:69). If there are any damaged documents, make a note of it and isolate them, but do not attempt to repair them (Schrock and Noack 1995:5). Instead, encapsulate each in a clear polyester sleeve or folder (Van Houten 1985:38). Encapsulation protects documents from high use, is reversible simply by removing the document from the sleeve, and is extremely safe (Van Houten 1985:38).

Unfold and flatten folded and rolled documents, including removing letters from envelopes, but be careful not to damage them (Schrock and Noack 1995:5). If the documents have been folded or rolled for a considerable time, they may need humidification to relax the fibers and allow flat storage (Schrock and Noack 1995:5). Consult a conservator or the repository before attempting document humidification. When flattening documents, store standard size documents in letter or legal folders depending on the cabinets in the repository. Place oversized documents in appropriate size folders for storage in map drawers (Kenworthy 1985:86; Ruwell 1995:201; Sullivan and Childs 2003:70). Some documents may be too large for map drawers. If this is the case, gently roll each oversized document around the outside of a pH neutral tube with acid free paper between the roll and the document or gently roll and place each document inside a pH neutral box (Kenworthy 1985:86).

Document duplication is another good step to take before submitting documents. If using documents frequently or anticipating researchers may use them frequently, have two copies of them, one for storage and one for research use (Museums and Galleries Commission 1992:53; Reibel 1997:80; Trimble and Marino 2003:105). Before doing this, assess if the documents are stable enough for photocopying, but typically photocopy newspaper and any documents with harmful or damaging inks before they deteriorate further or cause other documents to deteriorate (Ritzenthaler 1993:5; Schrock and Noack 1995:5; Van Houten 1985:20). When debating whether to photocopy a document, decide if the document is important because of its intrinsic value or because of the information contained within it (Ritzenthaler 1993:5). If photocopying a document because the document itself is important, be sure to retain the original.

One example of duplicating project records is the River Basin Surveys (RBS). These files were photocopied in triplicate. Initially, the original set was stored and never used, the second set was stored at RBS headquarters for active use, and the third set was a back-up stored at the Anthropology Department at University of Nebraska-Lincoln (Butler 2009:212; Lehmer 1971:18). The files included an index page showing the number of papers in the file, survey records, a General Feature Form for each feature, a Burial Form for each burial, a copy of the artifact catalog, copies of animal bone identifications, and prints of all field photos (Butler 2009:212; Lehmer 1971:18). Depending on funding, this may not be possible for current projects because duplication costs can be high (Ritzenthaler 1993:3). Another consideration is the amount of storage space available. It would not be a good idea to spend the time and money to photocopy documents to find out there is no space to store them.

Another option is to scan documents and store them electronically, but this can also be very time consuming and expensive as server costs can be high. As with any electronic data, update it to new formats on a regular basis. If the proper computer equipment or knowledgeable staff is not available, data recovery can be nearly impossible in future years as hardware and software change constantly. I have done some electronic records preservation by having an electronic database that lists the types of documents contained in each archaeological site file although I have not scanned the actual documents. This database is stored on a server that is backed-up regularly. Advantages to electronically storing documents with the appropriate hardware, software, and staffing, are that the repository can save physical storage space of paper documents and more easily send documents to researchers.

The last thing archaeologists should do is make sure they submit the proper documentation between them and the repository along with the archival materials. This documentation includes donation forms for the documents, photographs, and artifacts; artifact donation forms between the landowner and sponsoring agency; written documentation permitting them to collect artifacts; and any applicable local, state, and federal permits for the work. Archaeologists should receive from the repository a duplicate original of the donation form and written documentation stating any curation fees they may charge and a written and signed agreement for them.

Steps that may be difficult or out of an archaeologist's control are ensuring the HVAC system is kept running after hours to maintain a constant environment and ensuring the documents, if they are housed in a repository's cold storage, are packaged properly, preferably in thick, re-sealable, stable plastic bags (Ritzenthaler 1993:52, 53-54).

CONCLUSION

This chapter talked about submitting records to a repository. If included a section on why archaeologists should submit records to a repository and what archaeologists can do before submitting records. The next section discussed how archaeologists could organize documents to make the information more easily accessible to repository staff and researchers. The final section was a discussion of how to prepare documents for storage.

None of the information exists in isolation from the other chapters. In order for archaeologists to fulfill ethical and legal requirements for their projects, they must submit their records to a repository so its staff can care for it permanently.

CHAPTER 7: WHAT HAPPENS WHEN WORKING WITH ARCHAEOLOGICAL DOCUMENTS?

INTRODUCTION

This chapter will present five case studies giving accounts of projects with archaeological archives. Each gives examples of archaeological document care in practical situations. They show not everything works as perfectly in reality as it does in theory. The thesis lists them in order of project success defined by records preservation methods. Projects that worked well or had few problems are first and projects with multiple problems are last.

NEBRASKA STATE HISTORICAL SOCIETY, ARCHEOLOGY DIVISION, SITE FILE REHOUSING PROJECT

This case study shows how to promote records preservation, save records, plan for permanent preservation, and submit records. This was a successful project for the Nebraska State Historical Society (NSHS) because staff educated themselves on preservation techniques before and during project work.

From Fall 2001 through Summer 2002, I fulfilled an Institute of Museum and Library Services Conservation Grant by archiving the archaeological site files and associated documents for the Archeology Division of the NSHS. Under the supervision of our Archeological Collections Manager, I rehoused the site files and put documents into acid-free folders; removed all staples, paperclips, and rubber bands and inserted acid-free paper between documents groups to separate them; photocopied the most recent site form onto acid-free, lignin-free, cotton rag, alkaline buffered paper; put photographs into Mylar D®/Melinex® sleeves, negatives into acid-free paper sleeves, and slides into acid-free plastic slide pages or paper boxes; and, photocopied all newspaper articles onto archival paper. I did not retain original newspaper as the Library/Archives Division of the NSHS preserved them.

Another portion of the project was to rehouse oversized documents associated with the site files. Many oversized documents were either folded in the old site file folders or scattered in map drawers. The old system did not relate the files with the oversized documents nor allow a person to access them easily. The map drawers were in disarray. For example, documents from a single site could be found in many drawers, and there was no way of knowing where anything was located.

I divided the documents by site and put all documents from one site into one of three sizes of oversized archival folders. I also placed acid-free tissue paper between each document. Multiple folders were sometimes necessary if there were many oversized documents from one site. In a few cases, documents were too large for the map drawers so I rolled them and put each into an archival box. So archaeologists knew oversized documents were associated with a particular site, I designed a form to fill out in duplicate with one copy going in the site file and the other going with the document. The document gave the site number, a short description, and the document's location and served as a cross-reference between the two locations.

When I asked the staff archaeologists if they had any documents in their offices they wanted to incorporate into the site files, they were happy to oblige. By doing this, they cleaned their offices of old projects, but still had access to the materials. To help them with the changes I made to the previous filing system, I wrote handling and use procedures then held a training session to show them how to find documents and tell them what they would and would not be allowed to do with the documents. Overall, I received a positive response (René Botts, personal communication 2001, 2002).

The success of this project was due, in part, to the entire staff's involvement in the project. Although I did the physical work, staff helped plan the project, and I gave everyone status updates.

NATIONAL PARK SERVICE, MIDWEST ARCHEOLOGICAL CENTER

This case study shows how a repository can make mistakes with records preservation, but correct them to provide for appropriate long-term care. This was a successful project for the Midwest Archeological Center (MWAC) in Lincoln, Nebraska because, like the NSHS Archeology Division, staff educated themselves on preservation techniques before and during project work.

MWAC staff are currently rehousing their archaeological project files of lab records, correspondence, work plans, site condition assessments, photographs, negatives, and slides. This project started years ago and continues when they have funding. It began by gathering information from individual projects. Staff needed to do this because archives were not associated with artifacts, archives were mixed-up in boxes, reports were only in the library, site forms were only in site files, and contracts were only in contract files instead of combining all information together. The second step was to upgrade packaging and labeling by photocopying all field forms onto acid-free paper, purchasing acid-free bound notebooks for field use, putting project information into acid-free folders, and labeling all folders in pencil with both the accession and catalog numbers. These records are now stored in a climate and access controlled space.

MWAC previously cut apart black and white negative strips and put individual images into paper envelopes with a description of each image on the outside of the envelopes. Unfortunately, the envelopes were acidic so staff replaced them. Staff no longer cut apart negative strips, but store entire strips in plastic archival folders. They also store slides in acid-free containers and label them appropriately. Many color photographs, negatives, and slides are stored in buffered enclosures. Staff need to replace these enclosures with unbuffered ones and store them away from black and white media. Staff are now scanning all color slides to ensure images are usable because the medium is no longer available. These scans are backed-up in several locations.

Recently, the National Park Service (NPS) received funding to employ cold storage methods to acetate and color films. This funding pays for packaging and freezers, but not staff time or training. Small parks will have upright freezers and large parks will have large commercial freezers or vaults. MWAC chose to use a commercial freezer.

The NPS previously had a policy that digital photographs were not archived, but they now accept digital images. NPS employees and contractors are required to take black and white photographs using polyester film and color photos using a digital camera. NPS chose polyester film because it is a stable medium and does not require cold storage. The downfall to this film is that it is difficult to obtain. MWAC staff purchase it from a company in Germany. The digital photographs are backed-up in several locations (Jan Dial-Jones, personal communication 2002, 2010).

Although this project is ongoing, it already has successes because staff are adjusting to current standards in paper and photograph care. MWAC also has trained personnel to work on the project. The downfall is that they work on the project only when time and funding allow. Prolonging the project could cause further damage to documents and photographs that have not been archived because they are not stored appropriately.

AUGUSTANA COLLEGE & NEBRASKA STATE HISTORICAL SOCIETY, MISSOURI RIVER BLUFFS SURFACE SURVEY

The third case study shows how archaeologists can try to promote records preservation beginning with the project's planning stages, but not have it be very successful if not everyone understands its importance or agrees on the same techniques. It also shows how leadership changes can affect a project. It incorporates observations I made during a survey project I was involved in with Augustana College and the NSHS from Fall 2009 through Summer 2010.

During an early planning meeting with the original project director, we discussed the preservation of the field records, although I do not know if he made it a priority. When we conducted archival research before beginning our fieldwork, we made photocopies of any pertinent information instead of bringing original archives with us in the field. We also kept extra copies of maps, photo logs, landowner information, etc. in a plastic banker's style box to protect them from poor environmental conditions. We had a small crew while out in the field helping everyone know each other's roles. In reality, even though we had photocopies, some were of poor quality so we still brought originals in the field. We also had many different versions of the same document so it was difficult to tell which had the most current information. Back-ups are good, but not if there are so many no one knows which, if any, is current.

During the project, the crew changed several times. After the fall field season, our project director left his job at Augustana College to accept a position with the NSHS. We were fortunate that one of the crew members from Augustana College became our new project director so there was a seamless transition. We were also fortunate that the former project director was available to clarify research he completed for the project while working in his new position. The second crew change came when the project was nearly complete. One of the NSHS crew members took another position within the organization leaving two official project personnel to finish research. We continued working on the project, but needed a deadline extension because we did not have the appropriate number of personnel to complete the work on the original schedule.

This project had successes and failures. The successes were due to all project personnel understanding each other's roles and having smooth transitions when personnel changed. The failure occurred by not having a single person managing the field records. This caused personnel to not know which versions of documents were current.

NEBRASKA STATE HISTORICAL SOCIETY, ARCHEOLOGY DIVISION & BUREAU OF RECLAMATION ACCESSIONING PROJECT

This case study shows that it is necessary for archaeologists to accurately record archaeological data while in the field, organize their documentation, and submit it to a repository to have a successful project.

During 2010 and 2011, as an NSHS Archeology Division staff member I was responsible for completing accession packets for archeological collections owned by the Bureau of Reclamation and managed through their Nebraska-Kansas Area Office (NKAO). NSHS houses the majority of the collections within the NKAO and previously cataloged the collections stored in their repository. Early in the accessioning project, it became clear this task would be more complicated than originally planned. First, I have found documents relating to one project stored with documentation for another project. Second, I have found documents relating to multiple projects stored with only one of the project's documentation. Both of these scenarios occur only if the same project director worked on multiple projects for the NKAO.

Another difficulty is discovering that while NSHS believed it was curating all artifacts and associated records from certain projects, in fact, some artifacts and associated records from those projects are stored at other locations. In one instance, a repository outside the NKAO completed a project and continued to house the material. They continue to properly care for the material, but NSHS staff and NKAO were unaware of the collections until I discovered documentation discussing this part of the project. In another instance, I found documentation referring to a project whose artifacts and associated documents were not housed at NSHS although they should have been. I contacted the archaeologist about this material not knowing if she would know its location. She believed she had submitted everything to NSHS, but soon discovered the material in her residence although she completed the project decades earlier.

This project's successes are due to having personnel familiar with Reclamation's archaeological work working on their records. The failures occurred due to poor records' organization and discovering that part of a project's documentation was missing.

NEBRASKA STATE HISTORICAL SOCIETY, ARCHEOLOGY DIVISION, DUCK CREEK EXCAVATION

The fifth case study incorporates observations from an excavation I participated in during the summer of 2007. It shows how promoting records preservation in the field does not always go as planned. From the beginning of the project, I wanted to conduct observational and practical research regarding the care of archeological field records, but due to multiple circumstances, this did not work. It also shows how bad organization and a changing field crew can hurt archaeological records preservation techniques.

Our primary investigator left employment at NSHS while we were in the early project planning stages. Our archeological collections manager at the time took over some of the organizational duties of the project while the new primary investigator, already an employee of the Archeology Division at the NSHS, was briefed about the project. She knew I wanted to conduct field research for my thesis, but wanted each crew member to be in charge of a separate aspect of the project's documentation. This left one person responsible for the photo log, another responsible for the provenience number log, another responsible for the accuracy of the field bags, etc. Unfortunately, no one was responsible for the unit forms so throughout the entire project they were in a state of disarray. If people needed refer back to completed forms, they had to flip through the entire stack to find the ones they wanted.

Involving everyone in a leadership role over the documentation may have sounded like a good idea, but without one person responsible for all field generated documentation, documents were left in various places, and it was difficult to remember who was responsible for what and where they kept the papers. In short, there was no standard set for the documents' care while we were out in the field. To complicate matters further, our collections manager left the NSHS at the beginning of the fieldwork and was replaced by another employee of the Archeology Division. She had no time to learn about the methods that I was trying to employ or change any of the procedures already in place.

The first failure in this excavation occurred because no one placed a priority on the care of the projects' documents and photographs while in the field. The second failure was because there was not one person in charge of the records' care while in the field.

CONCLUSION

No archaeological project or person will treat its records perfectly. Different situations arise preventing one from doing so. That being said, as archeologists we should remember the records we generate, along with any artifacts we collect, will be the only lasting parts of our projects. I give two recommendations that may have helped the people in the case studies achieve the best-case scenario. While we may not always be able to achieve them, it will be beneficial for us and other researchers if we continually strive for it.

First, photocopy any archival/original documents used for research before taking them in the field. This will help ensure future researchers have access to them by minimizing their exposure to a potentially damaging outside environment. Documents in the field are constantly exposed to factors such as sunlight, wind, rain, dirt, and footprints. If you have multiple photocopies, know which one is the most current so everyone has up-to-date information.

Second, designate one person to be responsible for the care of all documents generated in the field. Ideally, this person would be responsible for filling out the provenience number log, photo log, and artifact bag log. Individual crew members would still be responsible for their own field notes, level forms, and feature forms. At the end of each day, completed level and feature forms should be handed in to the person responsible for the field documents for organization and temporary storage. This temporary storage should be in a container that blocks out sunlight, wind, rain, and dirt. It should be brought to the project site each day and taken inside each night. Documents kept in this container should include copies of any archival research done prior to fieldwork, project maps, a copy of the contract for research, any permits needed, and blank and completed field documents such as provenience number logs, photo logs, unit/level forms, feature forms, and graph paper.

CHAPTER 8: CONCLUSIONS AND FUTURE CONSIDERATIONS

In order for archaeologists to complete research, we must take care to preserve the entire archaeological record. Unfortunately, not all realize the archaeological record includes the documentation and photographic media. For all projects, there is a legal and ethical requirement the save the records. It is also necessary to save a project's documents and photographic media because they are irreplaceable.

This thesis explained archaeological document and photograph preservation in a focused and concise way without discussing electronic records. In chapter 1, I defined what archives and archaeological records are. Chapters 2 and 3, respectively, talked about the importance of making and saving accurate documents. The heart of the thesis is in chapters 4 and 5, which tell archaeologists how they can care for documents and photographic media. Chapter 6 discusses records submission. Chapter 7 gave several case studies as practical examples of archaeological records preservation in different project settings.

Following all the information in this thesis may seem like a daunting task, and in reality, it is. I have yet to see or be involved in a project that does everything perfectly. The point is to do the best possible helping ensure the documents and photographic media are well cared for and available in the future. Each step an archaeologist or repository takes to preserve records ensures their lasting value. If an archaeologist or repository is able to focus on only a few areas, concentrate on lowering light levels, regulating temperature and relative humidity, and ensuring archaeologists complete documents accurately.

In the future, I would like to design a records organization system that archaeologists can use while in the field, lab, and repository. This system would include a waterproof box that contains folders for each type of blank field forms and folders for each type of completed field forms. The box can also include a copy of the project proposal and contract, copies of permits, contact information for related personnel, related research, instructions for using and organizing the documents, and a list of businesses that sell archival supplies. Archaeologists could have a pre-filled, reusable box on hand to make project planning and preparation easier.

Recommended areas for future research include monitoring the digital records field and monitoring current document and photograph preservation techniques. This includes testing digital media's permanence, refining migration schedules, and watching for new media developments that may have a potential archaeological use. Because digital media standards change quickly, keeping up-to-date on best practices is important. Conservators should also continue to monitor current preservation practices to ensure methods taken today prove to be stable and long-lasting.

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