Digitization as a Preservation Method for Damaged Acetate Negatives: A Case Study

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Abstract

Digitization is widely recognized as an access tool for archival materials, but it is not universally accepted as a preservation method. In certain cases, however, digitization is the most feasible option for recovering and preserving content. Acetate photographic negatives are a case in point. Deteriorated negatives off-gas acetic acid resulting in warping and shrinkage that can cause severe damage. It can be difficult and expensive to salvage the information content of the images using traditional photographic methods. This article examines the decision made at the University of Southern Mississippi to use digitization as a preservation strategy to capture the visual content from highly damaged acetate negatives.

Digitization is a valuable access tool that allows archives, libraries, and other cultural heritage repositories to make items in their collections available to a worldwide, Internet-connected audience from anyplace at anytime. Consequently, institutions both large and small have combed through their collections, selecting materials to make available online. Digitization is considered primarily as a tool to enhance access rather than as a strategy suitable for the long-term preservation of content. Advocates assert that digitization and online access can contribute to preservation goals by reducing the handling of original materials, but the driving factor behind most digitization efforts is ready remote availability.[1]

Over the past decade, cultural heritage professionals have engaged in a rich debate over the use of digitization as a preservation strategy, primarily over the use of digitization versus microfilm for the reformatting of books and

[1] Abby Smith, *Why Digitize?* (Washington, D.C.: Council on Library and Information Resources, 1999), 6.

papers, rather than the use of digital technology to make digital copies of photographic negatives, particularly damaged acetate negatives. Although digitization is not universally accepted as a preservation strategy, in some instances, it may be the best option available to recover content from deteriorated materials, such as negatives.[2] This case study explores the decision made by archivists at the University of Southern Mississippi Libraries to use digitization as a preservation strategy for damaged negatives. The Libraries has a digital program to provide online access to special collections materials. Like many digital labs for special collections, the Libraries' facility is not staffed with expert image scientists, but nevertheless, lab personnel were able to apply existing digitization guidelines to preserve and provide access to the contents of negatives damaged beyond the point of use.

The Waller Photograph Collection: Identifying the Problem

The Robert Waller Photograph Collection is a large photograph collection housed in McCain Library and Archives, part of the University of Southern Mississippi Libraries. It was donated to the Libraries in July 1983. A basic inventory of the collection was created during the acquisition process, but the collection was never fully arranged and described, instead becoming part of a growing processing backlog. In the spring of 2008, staff members began to address growing preservation concerns about the condition of photographic materials and to increase access to a collection of high research value.

Robert Waller, a native of Hattiesburg, Mississippi, was born in 1910. He first became interested in photography while doing public relations work for the University of Southern Mississippi in the late 1930s. After serving in the military during World War II, Waller worked as a photographer and reporter for the local paper, the *Hattiesburg American*. During this time he built a darkroom in his home and took a photography correspondence course. In 1949, Waller left the newspaper to open his own photography studio, Bob Waller's Photo Service, which he ran out of his home until his death in 1977. Waller took a break from photography from 1960 until 1964, letting someone else run his studio while he served as sheriff of Forrest County, Mississippi. Following his death, Waller's photographic work remained at his home until his wife donated it to the University of Southern Mississippi in July 1983.[3]

Waller's primary business was portraiture. He photographed numerous weddings and did a substantial amount of commercial photography for local

[2] Kathleen Arthur et al., for the Association of Research Libraries, "Recognizing Digitization as a Preservation Reformatting Method," *Microform and Imaging Review* 33, no. 4 (Fall 2004).

[3] Biographical information was taken from the case file for the Robert C. Waller Photograph Collection at McCain Library and Archives at the University of Southern Mississippi.

businesses, schools, churches, organizations, and events. In addition to this work, he did copy photography and aerial photography, in some instances taking pictures out of a Cessna airplane. He also photographed local car wrecks. In this regard, the Waller Collection is a typical visual archive of a local community.

And yet, with its rich documentation of southern history, social customs, and material culture during the mid-twentieth century, the Waller Collection has a high research value beyond the interests of the Hattiesburg community where he worked and lived. The Libraries' Historical Manuscripts Collection actively collects materials relating to southern Mississippi history, and the Waller Collection is of particular significance because of its visual representation of life and culture in Hattiesburg from the 1940s through the 1970s. The commercial photographs in particular provide a wealth of information. They date primarily from the mid-1940s through the 1950s, with topics including, but not limited to, local business operations, storefronts, construction projects, school activities; events hosted by various civic, religious, and social organizations; and dances and parties, as well as floods, car wrecks, and open caskets at wakes. In addition, the photos provide insight into styles of dress for everyday activities and social occasions, as well as building and decorating styles for homes, businesses, churches, and schools. They also give a sense of the types of events and activities people thought were important enough to be documented by a professional photographer. The commercial photos also provide striking insight into the racial segregation prevalent in the South during the 1940s and 1950s. The photos were taken before the civil rights movement challenged social conventions prevalent throughout the South, and so they depict very few African Americans. Waller was a white man, and his clientele was primarily white.

The Waller Collection measures over 130 linear feet in size, with an estimated 20,000 images, and it consists primarily of negatives dating from 1947 to 1977. It contains a variety of different formats and sizes of negatives, including $2\frac{1}{4} \times 2\frac{1}{4}$-inch, 3 × 5-inch, 4 × 5-inch, and 5 × 7-inch black-and-white cut sheet negatives, 35 mm black-and-white strip negatives, $2\frac{1}{4} \times 2\frac{1}{4}$-inch color negatives, and slides. The collection does contain some prints, most of which are 4 × 5-inch proofs.

The collection retains Waller's original arrangement. He organized the negatives around several main categories, based on subject and format, such as portraits, weddings, commercial photos, aerials, copies, color photos, wrecks, 35 mm negatives, 5 × 7-inch negatives, and slides. Some of these series contain subseries according to dates. Waller maintained an index for some of the series in several ledgers, and the paper sleeves housing the negatives carry a number that corresponds to the index. Each paper sleeve also has a brief title and sometimes a date.

The negatives and prints have been stored together in their original acidic paper sleeves, which have grown increasingly fragile over the years. For many years, the sleeves were stored in cardboard trays and metal filing cabinets, but in spring 2008, the collection was rehoused into archival-quality boxes. Archives staff also began replacing the aging sleeves with acid-free buffered paper sleeves, transcribing information written on the original sleeves to the new sleeves, and creating an electronic inventory of the negatives. An online finding aid for the collection is updated as the collection is processed. Some of the images have also been digitized for display and are available online in the University of Southern Mississippi Digital Collections.[4]

As is the case with many photograph collections dating from the mid-twentieth century, preservation is an increasingly important issue. While processing the collection, the archivist became aware of several pressing preservation concerns. The collection does not include any nitrate film, but a large portion of it contains acetate film negatives, which present their own set of preservation problems. As evidenced in the initial inventory of the collection done in 1983, the Waller Collection was not immune to the problems associated with acetate film:

> Some negatives from the early 1950s are on a cellulose diacetate base but cellulose nitrate was used as the adhesive sublayer. These negatives are shrinking, the emulsion and the base are separating and gas bubbles are forming between the emulsion and the base. While these negatives are not highly combustible as nitrate-based film, these cellulose-based negatives will continue to deteriorate beyond the point of usability.[5]

In addition to the preservation concerns noted in the initial inventory, archives staff had long noticed a vinegar odor in the stacks where the collection was stored, which indicated deterioration of the negatives, but they were not aware of the extent of the damage. Diagnosing and addressing the odor were important factors that prompted the decision to process the collection.

Processing began with the commercial negatives series, approximately 60 linear feet in size, due to its high research value. As the work began, the archivist noticed that the vinegar odor was particularly strong in certain boxes. In these boxes, the archivist discovered seventy-two highly damaged negatives degraded to a point where they could not be handled by researchers under any conditions. These damaged negatives make up only a small percentage of the commercial series, less than 1 percent, and they date from the 1940s through

[4] The finding aid for the Waller Photograph Collection is available online at http://www.lib.usm.edu/spcol/collections/manuscripts/lists-of-collections/alphabetical.html. The USM Digital Collections are available online at http://digilib.usm.edu/index.php, both accessed 27 January 2010.

[5] "Information about the Waller Photograph Collection," initial inventory of the Waller Collection conducted after its acquisition in 1983.

the mid-1950s. Negatives in the collection from the late 1950s and 1960s show less evidence of "vinegar syndrome"-related damage.

The deterioration was more advanced in some of the damaged negatives than in others. Some negatives in the beginning stages of deterioration emitted a strong vinegar smell but had little visible damage. Other negatives had mild to moderate bubbling under the emulsion and the image was still relatively clear, while others had extensive bubbling that severely distorted the image. In one instance, the bubbling was so severe that the emulsion had completely pulled away from the base in the center of the negative. In other negatives, the bubbling was combined with mild to extreme channeling. In the most deteriorated negatives, embrittlement and shrinkage resulted in extensive channeling, which made it difficult to see the image. Other negatives had blue streaks across the image.

The archivist separated the seventy-two damaged negatives from the rest of the collection and was prepared to discard them, based upon the Libraries' unwritten policy of discarding items that are damaged beyond the point of usability. However, because of the subject matter of the negatives, the archivist hesitated. Sixty-one of the negatives depict the 1946–1947 university football team, and the remaining picture a local flower show, a Cub Scout baseball team, and a tire-balancing machine. Materials documenting university history are of particular importance as the Libraries prepares for the University of Southern Mississippi's upcoming centennial celebration. For this reason, the archivist looked for ways to preserve the negatives instead of discarding them.

Acetate Negatives: Researching the Problem

The first step in deciding how to best handle the damaged negatives was to understand the nature of the problem. Acetate negatives are a common format represented in large quantities in many archival photograph collections. Unlike nitrate film, acetate film, often called "safety film," is not flammable, but it poses its own set of preservation issues.

Film is made up of three layers: a base, such as acetate, which functions as the primary support; an emulsion or binder, typically gelatin; and the image material suspended in the binder, such as silver for black-and-white images. Metal, paper, and glass were all used as bases in the early stages of photography.[6] Nitrate film was introduced as the first flexible film base in the late 1880s, and the majority of all film of any format manufactured from 1889 through the

[6] Mary Lynn Ritzenthaler and Diane L. Vogt-O-Connor, *Photographs: Archival Care and Management* (Chicago: Society of American Archivists, 2006), 25.

mid-1920s had a nitrate base. Manufacturers began transitioning from nitrate to acetate film in the 1920s because of nitrate's instability and flammability.[7]

Kodak began producing sheet film with an acetate base in 1925. Other manufacturers soon followed, and the use of nitrate sheet film was uncommon after 1940. Polyester sheet film was introduced in 1955, and it is also labeled as "safety film." By the 1960s and 1970s, polyester gradually replaced acetate as the primary base for cut sheet film.[8] The timeline differs somewhat for amateur roll film, which continued to be primarily nitrate until the mid-1940s, when some acetate roll film was produced. Kodak stopped producing nitrate amateur roll film in 1950. Today, the majority of amateur roll film is still acetate.[9]

Cellulose acetate was the earliest type of acetate film produced, and, although it was not flammable, it was not very moisture resistant, and fluctuations in humidity could distort it. Cellulose diacetate film soon followed, but this also proved to have problems with distortion, shrinkage, and embrittlement. Cellulose triacetate gradually began to replace cellulose diacetate as a film base, beginning in 1947, and it is still used today.[10]

Acetate film is subject to deterioration, which manifests itself in several distinct, but interrelated ways. The first noticeable sign is typically a vinegar odor, leading to the name often attributed to the deterioration: "vinegar syndrome." As the acetate in the negative begins to break down, it produces acetic acid. This autocatalytic process progresses slowly at first and then accelerates as more acid accumulates in the negative.

In addition to the vinegar odor, negatives in the later stages of deterioration can display other distinct signs of damage. As the acetate film base degrades, it loses flexibility, becoming increasingly embrittled and prone to breakage. In addition, the film base often shrinks, sometimes as much as 10 percent. The emulsion layer does not shrink, though, and the ensuing stress causes the emulsion to separate from the acetate base, resulting in channeling, or the presence of deep grooves on the negative.[11]

During deterioration, plasticizers added to the acetate base during production begin to evaporate, resulting in the presence of small bubbles, or crystalline deposits, in the emulsion layer. Some deteriorated film may also develop pink or blue streaks caused by antihalation dyes used in the developing process

[7] James M. Reilly, *IPI Storage Guide for Acetate Film* (Rochester, N.Y.: Image Permanence Institute, 1993), 21–22.

[8] David G. Horvath, *The Acetate Negative Survey* (Louisville, Ky.: Ekstrom Library, University of Louisville, 1987), 6.

[9] Reilly, *IPI Storage Guide*, 21–22.

[10] Paul Messier, "Preserving Your Collection of Film-Based Photographic Negatives," available at http://palimpsest.stanford.edu/byauth/messier/negrmcc.html, accessed 17 June 2009.

[11] Reilly, *IPI Storage Guide*, 11.

to absorb light that could otherwise blur the image by reflecting from the base through the exposed emulsion. These colored dyes on the film backing become transparent when the film is processed; however, they can revert back to their original color in an acidic environment.[12]

The rate of deterioration is largely determined by temperature and humidity. Exposure to high temperature and humidity speeds up the onset of deterioration, and while once the process begins it can be slowed through proper storage conditions, there is no way to reverse it.[13] Affected negatives should be removed to separate storage to reduce the possibility of the deterioration affecting adjacent negatives.[14]

Digitization as a Preservation Option: Making a Decision

Because the deterioration of acetate negatives is not reversible, the traditional preservation method is to reformat through photo duplication, either by producing copy negatives or contact prints from the deteriorating source. The National Archives has specified technical requirements for reproducing black-and-white negatives to ensure that reproductions have the same essential characteristics as the original negatives.[15] Depending on the amount of damage to the negative, it can be difficult to produce a clear duplicate that does not convey signs of the damage to the original negative. In other words, when channeling and distortion are severe, photographic processes may not be able to deliver a clear image.[16] Moreover, this option can be expensive to implement on a large scale; many institutions do not have the equipment or the staff trained to carry out photo duplication or the resources to outsource photoduplication to highly specialized vendors.

In cases where the emulsion layer of the negative remains intact, solvents can be used to separate the emulsion from the base. The emulsion can then be flattened and photographed, or transferred to a new base. However, this is a time-consuming, expensive, and technically complex process that puts it beyond the means of many archival institutions.[17]

[12] Reilly, *IPI Storage Guide*, 12; Horvath, *Acetate Negative Survey*, 11.

[13] University of Kentucky Special Collections and Digital Programs, "Acetate Negative Decomposition," available at http://www.uky.edu/Libraries/libpage.php?lweb_id = 389&llib_id = 13, accessed 17 June 2009.

[14] Reilly, *IPI Storage Guide*, 14.

[15] Steve Puglia and Erin Rhodes, "Digital Imaging—How Far Have We Come and What Still Needs to Be Done?," *RLG DigiNews* 11, no. 1 (15 April 2007); Steve Puglia, "Technical Requirements for the Duplication of B&W Negatives," available at http://www.archives.gov/preservation/formats/bw-copying-specs.pdf, accessed 17 June 2009.

[16] University of Kentucky, "Acetate Negative Decomposition"; Messier, "Preserving Your Collection."

[17] Reilly, *IPI Storage Guide*, 11; Chris Woods, "The Treatment of Cellulose Diacetate Negatives," *Journal of the Society of Archivists* 13 (1992): 46.

Many institutions have explored microfilming to preserve damaged negatives, but this strategy presents many of the same challenges of photo duplication. It can be difficult to obtain a high-quality duplicate from severely damaged negatives, and the cost can be prohibitive for institutions that do not have an in-house microfilming program. Institutions can contract with outside vendors for microfilming or photo duplication, but this too can be expensive and ultimately unsatisfying for users.[18]

Microfilm has long been used to preserve archival materials. Silver halide microfilm is a standardized preservation medium with a long life expectancy and no dependence on computer technology for access. Microfilm does have its limitations, however, particularly in terms of access and user satisfaction as users become accustomed to the increasing versatility of online content. The *NINCH Guide to Good Practice* notes that user preference can lead to format obsolescence even though a given medium may still be functional from a technical standpoint. For example, the *Guide* states that "user discontent with microform readers threatens to make microfilm obsolete even though it still fulfills the original goals of its creation."[19] Digitization offers users benefits that preservation microfilm does not, such as full-text searching, color, zooming, and higher-quality printing. Plus, users can access vast quantities of digital material without having to set foot in a repository. Moreover, unlike microfilm, institutions can create additional copies of their master digital files with no loss of quality.[20]

With its many benefits for users, digitization is valuable for enhancing access to archival materials, but it has not been universally accepted as a long-term preservation tool. The debate over its suitability as a preservation method has been discussed since the early days of digitization. As many cultural institutions began digitizing their holdings in the 1990s, they explored the feasibility of using digitization in place of traditional preservation reformatting methods, such as microfilm. The benefits for access were obvious, but the shortcomings of digitization as a long-term preservation strategy, including technical obsolescence and the high rate of data loss, were equally clear. Abby Smith elaborates upon the tension between preservation and access in the 1999 publication *Why Digitize?*:

> Though digitization is sometimes loosely referred to as preservation, it is clear that, so far, digital resources are at their best when facilitating access to information and weakest when assigned the traditional library responsibility of preservation.

[18] Ruth B. Kerns, "A Positive Approach to Negatives: Preserving Photographs via Microfilm Technology," *American Archivist* 51 (Winter/Spring 1988): 111–14.

[19] National Initiative for a Networked Cultural Heritage (NINCH) and The Humanities Advanced Technology and Information Institute, University of Glasgow, "The NINCH Guide to Good Practice in the Digital Representation and Management of Cultural Heritage Materials" (2003), 202, available at http://www.ninch.org/guide.pdf, accessed 17 June 2009.

[20] Arthur et al., "Digitization as a Preservation Reformatting Method,"175.

> Regrettably, because digitization is a type of reformatting like microfilming, it is often confused with preservation microfilming and seen as a superior, if as yet more expensive, form of preservation reformatting. Digital imaging is not preservation, however. Much is gained by digitizing, but permanence and authenticity, at this juncture of development, are not among those gains.[21]

Archival institutions continue to explore the use of new technologies and methodologies to sustain digital materials into the future. Digital resources have become such an integral part of archival programs and services that archivists have a vested interest in developing digital preservation strategies. Digitization is one of several strategies that hold promise for long-term preservation. For over a decade, institutions such as the Library of Congress have explored the use of digitization as a preservation strategy, especially for severely deteriorated material that is not amenable to traditional reformatting methods.

In most instances, the original objects are retained after digital conversion, though not in all cases.[22] In 1999, the Library of Congress published "Conservation Implications of Digitization Projects," describing a project to digitize damaged cellulose diacetate black-and-white negatives that became "more readable in the digital form because the distortion was flattened out in the converted image." The paper suggests that digital images could be used to create new "hard-copy" surrogates to preserve the contents of the negatives, while the originals were placed into cold storage.[23] The Preservation Digital Reformatting Program at the Library of Congress specifies retaining an "analog version of digitally-reformatted items until the Preservation Directorate has confidence that the life-cycle management of digital data will ensure access for as long as, or longer than, the analog version."[24]

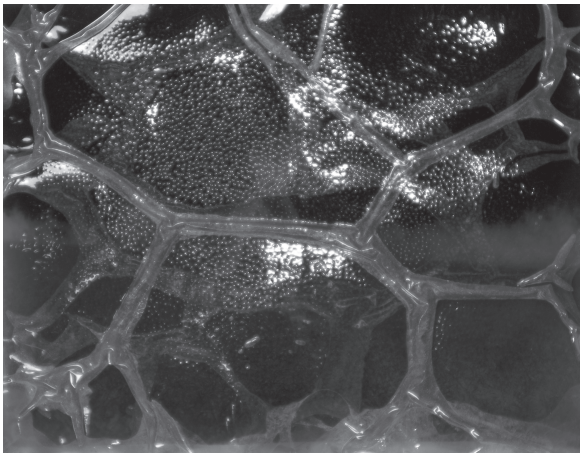
The long-term preservation of digital objects is the central unresolved issue facing archivists who wish to adopt digitization as a preservation strategy. The technology to create and deliver digital objects has evolved rapidly, but, thus far, digital preservation has not kept pace, leading to concerns about the longevity and sustainability of digital material. Objects in the digital realm are at risk of loss for a number of reasons, including technological obsolescence of hardware and software, and the deterioration and/or malfunction of the storage systems. Moreover, digital preservation requires a long-term financial and technological commitment from organizations responsible for managing

[21] Smith, "Why Digitize?," 3.

[22] NINCH, "Guide to Good Practice," 199–200.

[23] Library of Congress National Digital Library Program and the Conservation Division, "Conservation Implications of Digitization Projects" (1999), 9–10, available at http://memory.loc.gov/ammem/techdocs/conservation.html, accessed 17 June 2009.

[24] Library of Congress Preservation Reformatting Division, "Principles and Specifications for Preservation Digital Reformatting," available at http://www.loc.gov/preserv/prd/presdig/presprinciple.html, accessed 17 June 2009.



Top: Damaged acetate negative with extreme channeling.

Bottom: Digital image of the damaged acetate negative. Mississippi Southern College football player, 1946–1947 season. ***Robert Waller Photograph Collection, mus.m195.000103, available at http://digilib.usm.edu/u?/waller,705, accessed 10 March 2010.***

digital resources over time. The area is a major focus of research as institutions rise to the challenge of preserving not only the digital surrogates they have created, but also the growing number of born-digital records under their care.

A number of promising projects have been developed around the world, ranging from the LOCKSS based MetaArchive in the United States to the PLANETS project in Europe, but these solutions have yet to be implemented on a large scale.[25]

The Association of Research Libraries (ARL) recognized digitization as a viable preservation strategy in its 2004 publication, "Recognizing Digitization as a Preservation Reformatting Method." The paper outlines the advantages of digitization over microfilm, such as increased functionality and access, while acknowledging the challenges of digital preservation. ARL advocates for the use of standard file formats and established guidelines for high-quality image capture to provide "faithful representations" of original materials, as well as the use of standards for administrative and preservation metadata to facilitate the management of digital objects over time.[26]

The ARL endorsement has drawn criticism from a range of library and archives professionals. Critics recognize the value of digitization as an access tool but caution that it is too early to rely upon it as a preservation strategy due to questions surrounding the longevity of digital materials. They argue that it is best to rely upon traditional reformatting methods until digital preservation practices become more robust, reliable, and widespread.[27] However, some critics of the endorsement acknowledge that digitization is sometimes the best option for preservation. For example, Andrew Hart, preservation librarian at the University of North Carolina at Chapel Hill, notes in his critique of the ARL-endorsed policy statement that institutions should only rely on "currently available digital reformatting methods when they truly offer the best or only chance of survival for endangered information resources."[28] The choice to digitize a unique archival resource and substitute the digital for the original is a decision that should not be made lightly. If digitization is used as a preservation replacement method, standards for the creation of high-quality digital masters and preservation metadata must be followed.

After reviewing the various strategies for capturing and preserving the images on the damaged negatives in the Waller Collection, archivists decided that digitization was the best option, despite the risks involved in the long-term

[25] MetaArchive Corporation, available at http://www.metaarchive.org/, accessed 3 November 2009; PLANETS, Preserving and Long-Term Access Through Networked Services, available at http://www.planets-project.eu/, accessed 3 November 2009; LOCKSS, available at http://www.lockss.org/lockss/Home, accessed 3 November 2009. The Preserving Access to Digital Information (PADI) website by the National Library of Australia provides a wealth of information on digital preservation topics. See http://www.nla.gov.au/padi/index.html, accessed 17 June 2009.

[26] Arthur et al., "Digitization as a Preservation Reformatting Method."

[27] The fall 2004 issue of *Microform and Imaging Review* includes the ARL endorsement, as well as papers by library and archives professionals advocating for and against the use of digitization as a preservation reformatting strategy.

[28] Andrew Hart, "A Critique of 'Recognizing Digitization as a Preservation Reformatting Method'," *Microform and Imaging Review* 33, no. 4 (Fall 2004): 187.

preservation of digital files. The University of Southern Mississippi Libraries does not have a conservator on staff to treat the damaged negatives, nor does it have the equipment or staff for photo duplication. The Libraries also does not have a microfilming program, so it could not microfilm the negatives in-house, nor could it afford to outsource the work to a vendor. The Libraries does have an established digital program, though, and it is committed to the long-term maintenance of its digital resources. Moreover, if funding becomes available in the future, it is technically feasible to produce film-based copies from the original digital files. Digitization, therefore, is the most feasible option for capturing the visual content from the damaged and still-deteriorating acetate negatives.

Digitizing the Damaged Negatives: Resolving the Problem

In the first stage of the project, the archivist conducted a test by digitizing five of the seventy-two damaged negatives. Based on the outcome of the scans, the decision whether to digitize the remaining negatives would be made. Many of the negatives were in such bad condition that it was questionable how much of their images could be recovered through digitization. The results of the test scans exceeded expectations. The damage, which was overwhelmingly obvious on the negatives, was only minimally visible on the digital versions. The subject matter of each image, which could barely be seen through the damage on the negatives, was clearly visible on the scanned copies. Based on these encouraging results, the decision was made to digitize all of the damaged negatives.

The negatives were scanned in the Libraries' digital lab using a Microtek ScanMaker i900 scanner with a scanning bed specifically designed to handle negatives. They were digitally converted at a resolution of 1,200 ppi to ensure a minimum of 4,000 pixels across the longest dimension of the image. These specifications are listed in the digital lab's scanning guidelines, which comply with nationally recognized standards for digitizing negatives for access purposes, such as NARA's *Technical Guidelines for Digitizing Archival Masters for Electronic Access: Creation of Production Master Files—Raster Images.*[29] The scanned images are approximately 5,500 to 5,700 pixels across the longest side, with file sizes ranging from 65 to 70 megabytes. The negatives were scanned two at a time, and due to the high resolution, each scan of two negatives required approximately thirty minutes. At first, the negatives were scanned using 24-bit color in an RGB color space, but 8-bit grayscale proved to be the most effective color setting for scanning them.

[29] National Archives and Records Administration, *Technical Guidelines for Digitizing Archival Masters for Electronic Access: Creation of Production Master Files—Raster Images* (June 2004), available at http://www.archives.gov/preservation/technical/guidelines.html, accessed 17 June 2009.

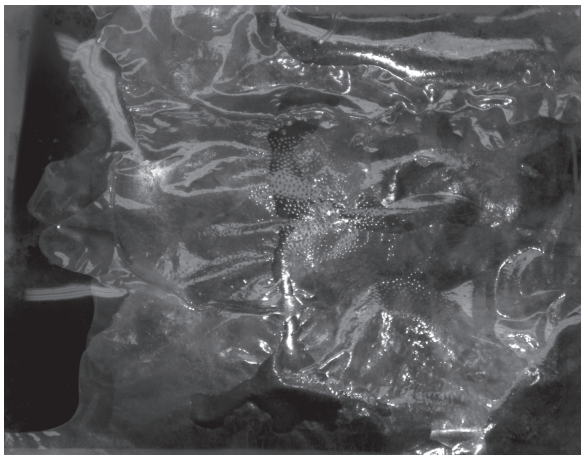
The digital images were processed using Adobe Photoshop CS3. The digital lab does minimal processing of digitized items, based upon the policy outlined in its scanning guidelines. The lab strives to create digital objects that are faithful to the originals. Processing is typically limited to cropping and rotating the image. Sometimes the color of the scan does not quite match the original item, so the contrast is adjusted by fine-tuning the levels in Photoshop. Also, the image sometimes needs to be sharpened using the unsharp mask tool to eliminate the appearance of blurriness caused during the scanning process. However, the first batch of twenty damaged negatives required one additional step to get the image closer to its original, predamaged condition. Because those negatives were scanned in 24-bit RGB color, the scans contained the blue streaks that were visible in some of the negatives. Converting those images to grayscale in Photoshop eliminated the blue tinting. That step also minimized some of the distortion resulting from the bubbling and channeling. Scanning the remaining negatives in grayscale eliminated this extra processing step.

After processing, the images were saved as 1,200-dpi uncompressed TIFF files. Access images were derived from the TIFF files and saved as 200-dpi JPEGs with no resizing. The derivatives were uploaded into the Libraries' CONTENTdm digital asset management system and made available online in the University of Southern Mississippi Libraries Digital Collections. The metadata for each image contains technical metadata based on the NISO *Technical Metadata for Digital Still Images*, although not all mandatory elements of the standard have been implemented.[30] Technical metadata for each image includes the unique identifier, scanning hardware, image processing software, master image resolution and file format, color space, bit depth, the date of creation of the digital image, and any special processing done in Photoshop, aside from rotating and cropping. Notes concerning the digitization of the damaged negatives have also been placed into the Waller Collection case file.

The master images are stored on the Libraries' digital image server, which is a RAID 5 disc array. A dedicated backup server takes daily snapshots of the digital image server, and it also makes weekly backups on a removable hard drive that is stored off-site. Tape backups are also made on a weekly basis. The Libraries is investigating digital preservation options to maintain the integrity of all digital masters.

Digitizing the deteriorated negatives was a learning experience for archives staff. At the start of the project, it was unclear if digitization would successfully recover the images on the damaged negatives. The results were better than expected, and, if additional severely deteriorated negatives of value are discovered in the Waller Collection or other archival collections, digitization will be

[30] National Information Standards Organization, *Data Dictionary: Technical Metadata for Digital Still Images* (February 2006), available at http://www.niso.org/kst/reports/standards, accessed on 3 November 2009.



Top: Emulsion pulled away from the base of acetate negative and severely distorted the image.

Bottom: Digital image of the damaged acetate negative. Cub Scout baseball players, 1947. ***Robert Waller Photograph Collection, mus.m195.000274, available at http://digilib.usm.edu/u?/waller,690, accessed 10 March 2010.***

considered as a preservation stategy. Because scanning negatives is time intensive, digitization may be prohibitive for extremely large quantities of negatives, but it is feasible for projects of fewer than several hundred. The total time needed to scan and process an image, upload it into CONTENTdm, and create metadata averages twenty-five minutes per negative. Scanning is the most time consuming part of the process, and digital lab staff can work on other tasks while the scanner is running. Future projects will need to be evaluated on a case-by-case basis to determine feasibility.

Conclusion

Digitization is a valuable tool for providing enhanced access to archival materials, but issues concerning digital preservation have limited the willingness of archivists to recognize digitization as a suitable long-term preservation strategy. Institutions are actively engaged in developing the tools to ensure the long-term preservation of the rapidly growing number of digital resources under their care, but until standard practices can be implemented on a large scale, many experts hesitate to recommend digitization for preservation purposes. In some cases, however, digitization can be the most feasible option for preserving damaged content that may otherwise be lost. This was true for the University of Southern Mississippi Libraries, where digitization was used to recover and preserve the content of seventy-two deteriorated acetate negatives.

The decision to use digitization as a preservation strategy was not made lightly, however, due to the challenges of maintaining digital materials into the future. The negatives were scanned following recognized guidelines for the creation of high-quality master images for access. The resulting images captured details obscured on the damaged negatives. Preservation metadata was also produced to document the creation and processing of the images. The Libraries recognize the importance of digital preservation and has a vested interest in ensuring the longevity of its digital resources. Moreover, as funding becomes available, the digital images can be used to create copy negatives or preservation-quality microfilm. The limitations of digitization as a preservation strategy are well recognized, but as this case study demonstrates, in select cases, it may be the best option to represent and preserve endangered visual materials.