We are at the beginning of a new age of information storage and retrieval, a beginning marked by rapid evolution and obsolescence of technologies. Libraries and archives are joining an existing community of on-line content providers, and our mission has changed to include enabling and facilitating access to this mass of available content. Part of our new role is also to make available in digital format what we have traditionally held within our walls. Libraries have been reformatting their collections for decades to better preserve information recorded on deteriorating materials, and the time is fast approaching when reformatting for preservation and reformatting for access can be the same process. Preservation by reformatting is predicated on the idea that what one is saving is the information *in* documents. There is a certain amount of information loss, but this is judged to be acceptable in cases when the original cannot be effectively saved and the new format can be reasonably expected to last for a significantly longer time.\(^1\) The concept of a hybrid microfilm and digital preservation project was developed to bridge the gap between the promise of increased access and the guarantee of permanency of digital objects.

Since the development of 35mm microfilm in the 1930s, major research institutions have used microfilm as a method of coping with their bulky, deteriorating collections. Starting with

early projects at the Library of Congress, Harvard and Yale University Libraries, and the New York Public Library, the standards of preservation microfilming began to be distinguished from the general practices of commercial microfilming. Development in this field was slow, and it was not until the early 1980s that a set of technical standards was agreed upon. These standards were developed as part of a national response to the “brittle books problem” and covered the preparation of the original material, bibliographic control of the film, exposure and processing, material specifications for the film base, and guidelines for storage of master negatives. It is generally accepted within the preservation community that a master negative produced and stored according to these standards can last about 500 years. These microfilming standards, developed through professional organizations like the Association of Research Libraries (ARL) and the Council on Library Resources, now the Council on Library and Information Resources (CLIR), also facilitate cooperative projects between institutions trying to preserve their research collections.²

Beginning in the late 1980s, library preservation professionals began to discuss the possibility of digitizing library material for preservation. The basic purpose would be similar to that of microfilming – to produce a copy (replacement) of a deteriorating original that is expected to last longer than the original. The added benefit of microfilming as a preservation strategy, the ability to generate multiple copies from a single print master, also applies to the digital copy, but digital copies make possible entirely new ways of accessing information. The modern computer age has been defined by the great power and potential of digitally manipulated information. Vannevar Bush in his landmark 1945 article, “As We May Think”, envisioned a researcher creating hypertext linkages between words and concepts within his own personal,

micrographically miniaturized desktop library – a method of knowledge synthesis that mirrors our own associative thought patterns. The modern personal computer and the growing amount of web content approach the potential of such a machine, but their rapid development and change endanger the contents of that library. A few years can witness dramatic improvements in technology, and as each generation of software and hardware changes, the older versions become out-dated and eventually obsolete. For this reason, the benefits of digitizing paper-based library materials is clearest when one considers the benefits of access. The reality of digitizing for preservation has been much debated, but it is clear this is the direction in which preservation reformatting is headed.

The earliest discussions of digital imaging as a preservation format had digital objects simply replacing microfilm in its role as the medium of choice, without much consideration of the particular problems of digital obsolescence or any discussion about the necessary metadata to ensure access to technology-dependant content. As the preservation community learned more about digital technology, there was strong resistance to abandoning the assurances of microfilm.

In 1992, Don Willis, a microfilm expert at University Microfilm International (UMI) wrote a paper, “A Hybrid Systems Approach to Preservation of Printed Materials”, published by the Commission on Preservation and Access (CPA). It advocated a new approach to preservation reformatting. He described the problems and benefits of both microfilm and digital copies and suggested a new strategy of preservation reformatting that harnessed the strengths of both methods. A hybrid microfilm and digital preservation project would produce both film and digital copies of a paper-based object. The proven permanence of the film would ensure that the

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information in the object would persist, and the digital copy would be exploited largely for access purposes. In his proposal, Willis identified several questions requiring further research and predicted that digital storage, which then made up the bulk of the cost of digitizing, would quickly become less expensive. One positive aspect of hybrid programs discussed by Willis was that if digital-to-digital conservation costs became too high, the hybrid approach would allow an institution to let forward migration lapse and, at a later point, copy the microfilm back into digital format. In other words, the hybrid system protects against benign neglect. He suggested that if and when digital preservation becomes a reality, “archival” will be redefined as “the ability to recreate an exact copy from the original medium before it degrades or the technology to read it becomes obsolete” and that forward migration would be automatically regulated by the storage technology.4

Despite the comprehensiveness of this early articulation, Willis' call for further study was much needed. The technical challenges of converting from one format to another and of maintaining digital files were not well understood. In the early 1990s, statements, naïve in retrospect, were made that “[t]he primary expense of salvaging a book is in the selection process and initial handling, while the cost of later conversion from one modern medium to another is comparatively small” and “conversion between microfilm and digital imagery is much less expensive than conversion to either form from paper.”5 Once institutions actually began to digitize their holdings, neither of these statements turned out to be accurate. In the 1990s, the National Endowment for the Humanities (NEH) funded two studies to investigate the hybrid


approach, one at Cornell University and the other at Yale University. Both attempted to answer questions about the costs of such a project, the needed technical specifications, and which approach – scan-first or film-first – was appropriate to a given set of circumstances.

The Cornell project took place between 1994 and 1996 and investigated the possibility of a scan-first approach. They selected materials for reformatting, bitonally scanned them in at 600 dpi, and produced computer-output microfilm (COM). One of the main aims of this project was to investigate COM and determine if it could be produced to the same archival standards as preservation microfilm.6 Yale’s Project Open Book was a multi-phase feasibility study that investigated production-level digital reformatting of preservation microfilm that had been created by the library in the 1980s and 1990s. This project specifically looked into issues of selection, cost, and quality. The earliest phase began in 1991 with funding from the CPA and the project concluded in 1996 with NEH funding.7 Yale scanned print master microfilm at an “effective resolution” of 600 dpi bitonal – meaning that the microfilm itself was scanned at a significantly higher resolution that was determined by the reduction ratio of the microfilm.

There are limitations to the technical capacities of both digital capture and analog filming of paper-based objects. In particular, color microfilm is not considered to be of preservation quality, and digital capture of greyscale and color images requires significantly more storage space than bitonal images. For these reasons, both the Yale and the Cornell projects (and the subsequent published guidelines for hybrid projects) were limited to high-contrast, black and

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white microfilm and to bitonal (2 bit) digital imaging to capture text-based materials with at most simple graphics.

Both projects reported successes in technical feasibility. The COM produced by Cornell was of comparable image quality and permanence to preservation microfilm and could be rescanned to produce a digital image of sufficiently high quality.\(^8\) The Yale Project also produced a collection of digital objects of acceptable quality and usability from their selected microfilm. Aside from testing the technical ability of hybrid projects to effectively capture the content of deteriorating originals, the Cornell and Yale projects were intended to begin developing standards, workflow models, and cost expectations for such projects. Both libraries took the 1992 RLG preservation microfilming standards as a starting point, but identified a number of issues unique to hybrid projects.

In the 1999 report, *Digital Imaging and Preservation Microfilm: the Future of the Hybrid Approach for the Preservation of Brittle Books*, the authors discuss the lessons learned in these and other hybrid projects, particularly the importance of articulating the intended use of the digital objects. These assessments, combined with an evaluation of the original object, inform most of the decisions necessary for a hybrid project. For example, one of the basic decisions to be made is to film-first or scan-first. The film-first approach is most appropriate when disbinding the original is not an option or when the scanned image will only be used for access purposes. The scan-first approach is most appropriate for materials that can be disbound or where the digital object is intended for preservation purposes.\(^9\) The Yale project was effectively

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the second phase of a film-first approach while the Cornell project began by scanning the material.

There are several important elements of an assessment of the original object. In order to warrant preservation by reformatting, an object is generally selected on the basis of its enduring research value and its vulnerability to destructive ageing. In other words, the information, judged to be worthwhile, will likely not be available in the future unless action is taken. It is generally accepted that text-based brittle materials with simple line art or halftones can be successfully captured onto microfilm or through bitonal scanning when appropriate benchmarks are used.\(^{10}\)

Careful articulation of the intended uses of the digital object is necessary because, more so than with microfilm, digital objects can be produced to meet a wide variety of purposes. The potential for added functionalities like full-text searchability and hypertext linkages between objects is phenomenal, but the creation of a digital object must also anticipate the inevitable need for forward migration and the potential for enhanced viewing technology (like better computer screen resolutions). A digital object must be associated with metadata that facilitates migration, and, with scan-first hybrid approaches, it must be of good enough quality to create preservation COM. As with the different generations of preservation microfilm, there should be digital access masters and digital preservation masters, each optimized for their function.\(^{11}\)

When an object is filmed according to the RLG preservation microfilming standards, there can be artifacts of that process that interfere with later scanning. Skewed pages, internal


\(^{11}\) ibid, Capabilities of Scanning Technology.
splices, high reduction ratios, and low film densities can all be corrected in the digital image, but result in higher conversion costs. The Yale and Cornell pilot projects both resulted in recommendations for revisions to the 1992 RLG preservation microfilming standards that would enable microfilm to be more easily converted to digital images.\textsuperscript{12} In 2003, the RLG released revised guidelines that described the process of creating microfilm for later digitization. These guidelines did not supersede the 1992 guidelines, but elaborate on the suggestions made by the Yale and Cornell authors. In general, these new optional guidelines are more restrictive than the 1992 guidelines, but provide clear instructions for optimizing film convertibility.\textsuperscript{13}

One of the concerns raised by early hybrid projects was the unexpectedly high price of scanning from microfilm. The authors of \textit{Digital Imaging and Preservation Microfilm} anticipated that that price could be significantly reduced by appropriate automating software. The principal areas for development were in the creation of scanners that can be automatically calibrated, improved edge-detection software that would enable a roll of microfilm to be automatically scanned as a series of single images, or post-scan processing that can break down a single scan of an entire roll of film into individual images. Page breakdown software would also need to cope with double pages that had been filmed as a single image. Part of the authors’ recommended revisions to the RLG guidelines call for standardization of the IIA (cine) orientation when the image is filmed as two facing images, but improvements in paginating software can also dramatically improve scanning efficiencies. The \textit{Digital Imaging and Preservation Microfilm} authors also recommend using a feature called blipping in the production

\footnotesize{\textsuperscript{12} ibid, Characteristics of Microfilm.}

of new preservation microfilm and in COM. Blips encode metadata into the microfilm itself and have the potential to greatly assist in automating scanning and digital metadata creation. Despite these recommendations, the authors predicted that any major improvements in scanned image quality from microfilm would be due to advances in the digital technology and that any improvements in the microfilming process would be of limited effectiveness.\(^{14}\)

The production of digital images is frequently beyond the in-house capability of smaller institutions, and, as with microfilming, outsourcing is a frequent recourse. There are a number of vendors who adhere to the established preservation microfilm guidelines and who market themselves to libraries and archives. It is an indication of the general appeal of the hybrid project that microfilm and digitization vendors have begun to market both services together. Microfilm to digital conversion seems to be the most popular offering, but a number of companies, like Northern Micrographics in Wisconsin\(^{15}\) and Hudson Microimaging in New York\(^{16}\), explicitly market microfilm as the “archival” format. Outside of the library world, there appears to be a large commercial market for hybrid microfilm and digital services.

In the six years since *Digital Imaging and Preservation Microfilm* was written, the thinking in the American preservation community has shifted towards regarding digital reformatting as preservation. In the Fall of 2004, the ARL Preservation Committee announced their move in this direction in an article entitled, “Recognizing Digitization as a Preservation

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\(^{15}\) “We can produce microforms … as a preservation/storage copy to complement digital images” Northern Micrographics webpage <http://www.normicro.com/nmigen.asp?var=micro> (4/21/2005).

\(^{16}\) “Our hybrid services provide the security of microfilm for preservation and records retention purposes as well as with the convenience of access offered by digital images” Hudson Microimaging homepage, <http://www.hudsonmicroimaging.com/> (4/21/2005).
Reformatting Method” which describes ARL’s evolving thoughts on digitization.\textsuperscript{17} Recently, several major American research institutions have also made explicit statements in favor of digitization as a preservation method.\textsuperscript{18} While there are still not firm international standards, as there were with preservation microfilming, the community is closer to achieving them. More importantly, the mass of digital and digitized material has grown and there are more stakeholders in migrating this information forward. Many major research institutions have heavily invested in digital repositories like D-space and have expressed strong commitments to keeping that information intact. Last summer, Brian Lavoie and Lorcan Dempsey, in their D-Lib article “Thirteen Ways of Looking at...Digital Preservation”, discussed how the digital preservation model has and is changing to make long-term sustainability more of a possibility. They observe that,

“Preservation traditionally proceeds in fits and starts, with extended periods of inactivity punctuated by bursts of intensive effort – witness the Brittle Book campaigns of the 1980s, or recent efforts to save movies filmed on nitrate cellulose film stock. The pattern is one in which materials are left to approach a state of crisis, at which point the situation is remedied through large-scale intervention. But digital materials generally do not afford the luxury of procrastination … as more and more digital materials come under the stewardship of collecting institutions, preservation will become less like an event occurring at discrete intervals, and more like a process, proceeding relatively continuously over time.”\textsuperscript{19}

Even for those who disagree with the statement that “the time is now”, it is clear that the time is approaching when our main method of preserving and storing our accumulated knowledge will

\textsuperscript{17} Kathleen Arthur, et al. “Recognizing Digitization as a Preservation Reformatting Method” Microform and Imaging Review 33, no.4 (Fall 2004).

\textsuperscript{18} e.g. “The Library is committed to promoting the acceptance of digitization as a reformatting option and to implementing strategies to ensure the long-term availability of digital resources”, University of Chicago website < http://www.lib.uchicago.edu/e/dl/program.php3> (4/21/2005).

\textsuperscript{19} Brian Lavoie and Lorcan Dempsey, “Thirteen Ways of Looking at...Digital Preservation”, D-Lib Magazine 10 no. 7/8 (July/August 2004).
be digitization. If that is the case, are hybrid projects merely a stage in that evolution? And have we moved beyond the necessity of providing an analog preservation copy of a digital object?

One recent project that illustrates the progress of the hybrid approach and its relevance today is being undertaken by the British Library. In 1992, the Library began an experimental project to digitize parts of its Burney Newspaper Collection. The collection consists of the originals and microfilm copies of about 700 volumes of 17th, 18th, and 19th century newspapers. This project was undertaken to explore microfilm to digital conversion but was cut short because of the high costs of digital storage and the lack of suitable OCR software. Since then, however, these technical challenges have been overcome or mitigated, and the Library has recently restarted the project.20 While the earlier phase apparently intended to produce CD-ROM copies for in-library use, the current project converts the microfilm into an on-line, full-text searchable database.21 A 2002 article in DigiNews discusses the special features of the scanning and OCR program, Olive Software's PIPEX™, that the British Library is using. This digitization software package was specifically developed to cope with digitizing microfilmed newspapers.22 A similar project at the University of Utah, The Utah Digital Newspapers Project, digitized microfilmed newspapers from around that state. In some cases, the microfilm dated from the 1950s and was in fairly poor condition; this factor contributed to the project administrator’s stated future

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intention to scan from original paper copies whenever available.\textsuperscript{23}

These two projects show the possibilities and the pitfalls of digitizing from microfilm – the last remaining copies of many of our most important texts are frequently found in this format, but early forays into the technology often produced poor quality facsimiles – unsuitable for conversion. It would be stretching the analogy to suggest that early digital images will necessarily suffer the same fate when they are obsolete, but it is not hard to imagine how, with only moderate amounts of neglect, a digital collection of marginal (or controversial) scholarly interest could disappear. I am not particularly concerned that Cornell and the University of Michigan will retreat from their firmly stated positions on maintaining their digitally reformatted collections – the wealth of their endowments and the prestige they gain from being libraries of record will forestall all but the most extreme circumstances. I am, however, concerned about institutions that have not invested heavily in the infrastructure or committed themselves to the migration requirements of a digital repository. I found it interesting that the only international comments which accompanied the Fall 2004 ARL statement, written from New Zealand, Australia,\textsuperscript{24} Singapore,\textsuperscript{25} and the Netherlands,\textsuperscript{26} all advocated a more cautious approach – an approach explicitly embodied in hybrid projects. Part of this reluctance to accept digitization as preservation comes from the newness of the field and librarians’ lack of experience with the

\textsuperscript{21}Kenning Arlitsch, L. Yapp, Karen Edge, “The Utah Digital Newspapers Project”, \textit{D-Lib Magazine} 9, no.3 (March 2003), <http://www.dlib.org/dlib/march03/arlitsch/03arlitsch.html> 4/19/2005.


\textsuperscript{25}Pitt Kuan Wah, “Digitization as a Preservation Method – A Comment from Singapore”, \textit{Microform and Imaging Review} 33, no.4 (Fall 2004).

\textsuperscript{26}“Digitization as a Preservation Method – Comments from the Netherlands”, \textit{Microform and Imaging Review} 33, no.4 (Fall 2004).
technology, but it also reflects a failure on the part of those who advocate digitization. Is it preservation because we are working on international standards? Because we are closer than we were ten years ago? Because we will learn enough in the process that standards will be unnecessary – a cumbersome relic of a pre-digital age?

This author considers hybrid microfilming and digitization projects to still be a viable option – particularly for smaller institutions and institutions who cannot make century-long financial guarantees. Even institutions that have committed themselves to storing and migrating their digital holdings have much to learn from the research that has gone into hybrid approaches. Between the 1930s and today, much of our intellectual heritage was reformatted to microfilm. In many cases, particularly with bulky serial publications like newspapers, the microfilm copy is the only one remaining. Vast quantities of originals were disposed of after microfilming in “slash and burn preservation” projects. Even when library materials were kept, the inherent vice of brittle paper is to deteriorate relatively rapidly, and the condition of the books today may not permit further handling. We microfilmed what we thought was worth saving, and so we are left with vast quantities of microfilm in our libraries. Although generally regarded as safe from immediate deterioration, this format is rapidly fading from common usage. It is not unreasonable to think that its potential for access will continue to decline, until only the most tiresless researcher will seek it out.

Resources Consulted:

“FAQ: Where are they now? Digitizing Microfilmed Newspapers”. Research Libraries Group DigiNews 6, no.3 (June 15, 2002).  


