# Restaurator
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# RESTAURATOR

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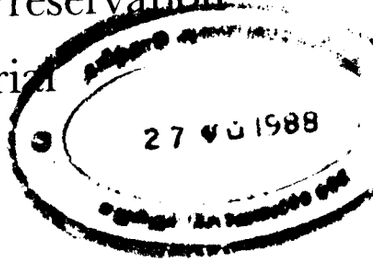


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## Preservation Photocopying in Libraries and Archives

Conference of the U.S. National Archives and Records Administration
Washington, D.C., December 9, 1986

MUNKSGAARD · COPENHAGEN

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# Preservation Photocopying in Libraries and Archives

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# Foreword

The nature and scope of archive and library preservation work are undergoing major transformations today. Even though the outcome is not clear, three particular changes are apparent. First, the increased awareness of preservation has resulted in many more people taking up preservation work. Second, new technologies are being developed and applied. Third, the rate of growth and change is accelerating.

Each of these changes suggests the necessity of more systematically communicating new knowledge in preservation work. This need is causing your Editors and Publisher to reconsider how RESTAURATOR can best serve its subscribers. The present conclusions are, on the one hand, that the emphasis of RESTAURATOR should continue to be a publication of scholarly research articles, and on the other hand, more attention should be given to providing information on solutions to important preservation problems and emerging technologies. In addition, special efforts should be made to publish solid information regarding the different opinions and results of research on controversal topics.

As a preliminary solution, RESTAURATOR plans to periodically organize one issue around selected papers from *landmark* conferences or topics. For example, this issue, Vol. 8:1, contains the papers from the very first conference on "Preservation Photocopying," U.S. National Archives and Records Administration, December 9, 1986.
RESTAURATOR, Vol. 8:2/3, will define the state of the preservation art around the world by publishing pertinent papers from the Conference of Directors of National Libraries, Vienna, April 6–10, 1986.
The new technologies of freeze-drying water-wetted books and deep-freeze (non-chemical) fumigation, i.e., recovering from floods, fires, and insect infestations will be reported through prompt publication of selected papers from the first conference on Cryobibliotherapy, School of Library Service, Columbia University, New York, NY, April 3–4, 1987.

Other responses to these needs are being investigated and will be reported upon in future issues of RESTAURATOR. During the interim, the Editors and Publisher are eager to receive your letters commenting on the accelerating ex-

pansion of preservation work. Your reactions to these proposals and suggestions for future topics and sources for informative articles are especially welcome.

*Richard D. Smith*
*Associate Editor*



# Preservation Photocopying Conference

## Introductory Remarks and Historical Perspective

*by* TERRY O. NORRIS

This brief introduction to the use of photocopying for preservation purposes touches highlights only in the history of xerography and alternate processes and closes by citing developments in the xerographic process leading to its consideration for use in preservation copying.

The development and widespread use of the photocopying processes has occurred, for the most part, in the last 25 years. It is interesting that it is now developed and refined to the point of application in preservation practices. It seems to me that it would be interesting to review some of the highlights of this development and refinement as a background to this distinguished conference. Any review of man's progress in science and technology invariably identifies major individual contributors. A review of photocopying is no exception to the rule. Let's briefly examine the history of one of the many copying processes that have been developed.

### Xerography

I believe the most significant individual contributor to photocopying technology was Chester F. Carlson, the inventor of the process that later became known as xerography. He developed an interest in graphic arts in his youth from his work in the printing industry. Later on in his work as a patent attorney, he developed a strong impatience with poor copies that were difficult to obtain and even more difficult to read, especially for someone with his weak eyes. Those of us who remember the negative photostatic copies that were standard at the time can appreciate his feelings. From his reading and studying of possible copying processes, together with his background in physics, he decided that it would be practical to combine electrostatics with photoconductivity. With this he thought he had found the right concept and needed only to reduce it to practice by developing a device capable of reproducing visible information. After many false starts this was accomplished in a small laboratory in Astoria, Queens, New York, on October 22, 1938, using a layer of pure sulfur on the surface of a zinc plate. Lycopodium powder was used as the developer. He was granted a fundamental patent to this know-how.[1] Under a license to his patent this basic beginning of a new technology was developed to the point of commercial scale application by research teams at the Haloid Corporation in

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Rochester, New York, and at Battelle Memorial Institute in Columbus, Ohio. They gave the world a new technology – electrophotography, and a new term – xerography.[2]

## Technology

The following is a description of the process that was developed, and is still used with only minor variations in most, if not in all, recent electrophotographic copiers. It was written by Dr. John H. Dessauer, who headed the research team at the Haloid Corporation during those significant historic years.

"Xerography employs a photoconductive insulating layer on a metal or other conductive support. The layer is charged electrostatically either with positive or negative ions. When the plate is exposed in a camera, those areas of the coating (or photoconductive insulating layer) subject to light lose a varying portion of the charge, depending on the intensity of the illumination. Thus the variation of the amount of charge retained on the coated metal plate is established as an electrostatic pattern of the image that may be rendered visible by sprinkling electroscopic powders over the exposed plate carrying the opposite charge of the initial charge applied to the photoconductive insulating layer. The powder adheres to those areas that have retained their charge. The print is obtained by covering the plate with paper, then applying a charge over the back of the paper of the same polarity as the initial charge applied to the photoconductive insulating layer. In this way the opposite-charged powders are transferred to the paper surface. The powder is then fused onto the paper by exposure to solvent vapors or heat to make the image permanent."[1]

The photoconductor of choice by 1950 was amorphous selenium which is still used. However, since 1950 the family of photoconductors has expanded to include metal oxides and sulfides, metal alloys and organic photoconductors. We should note at this point that developments in this industry are now world wide. Many developments in materials and equipment are familiar to us from foreign countries such as Japan, Europe, Australia, United Kingdom, etc.[3] In addition, many companies have joined Xerox in advancing the technology of electrophotographic copying. Noteworthy examples include Kodak, IBM, Savin, A. B. Dick, Multigraphics, 3M, and others. Unique developments can be identified with these companies as well as their counterparts overseas.

Early in its development the impact of the copier was described by the former archivist Mr. Everett Alldredge as follows: "Before the Xerox era every government agency had one central filing system. When anybody needed information he went to that central file. But today, with the copying of documents made so easy, many a government executive prefers to maintain files in his own



office. They are easier to reach. The result is that where we used to have a limited number of central filing places, we now have thousands, with endless duplication of papers. In the Department of State alone there are over twenty-three hundred separate files. In time, as you know, all government documents are turned over to the archives for preservation, and by law we have to keep them for years. Since the government has acquired over sixty thousand copying machines, we have had to add five hundred thousand cubic feet to our storage space every year."[1]

## Other Processes

In addition to this proliferation of copies that resulted from the growing family of copiers consideration must also be given to the overload on the archives caused by the differences in copy quality that existed between the different copying processes either already in use or under development at the time Mr. Alldredge made his observation. Many of the processes that were developed in response to the need for convenience in copying an original gave very poor copies in terms of keeping quality or long-term durability. Most often this was not a factor in the decision to use the particular copying process. As a result, the archives became the custodian of more than its share of examples of copies from each of the copying processes as they came into commercial use.

In this regard, if we set aside the somewhat older processes which required a prepared original such as diazotype, mimeograph, and spirit duplicator, we find other methods coming to the fore that did little to advance the cause of archival quality copies. These methods included the diffusion transfer and the verifax wet processes, the thermographic process that was highly regarded for a time for its seeming simplicity compared to the wet process.[4] Unfortunately, the copies made by this process are very unstable because they remain active chemically and they are physically very fragile. In my view, they are the best candidates in the archives for the earliest possible replacement.

Other process advances that were based on slightly different technology include electrofax that used a zinc oxide coated paper with liquid or powder toners to develop the image and the dual spectrum system based on heat development of a silver image.[5] While neither of these qualify, as holders of the records of our civilization for posterity, they helped bring us closer to the process that could produce archival quality copies of originals. And especially those originals found in need of replacement in the archives holdings.

## Quality and Permanence

The theme of this conference suggests that we have reached a new degree of development of copying technology and of sophistication with the use of the copier. Surely one of our goals for the conference is to explore options for applying the copier technology to serve the needs of the archives rather than to overload them further with volumes of copies of uncertain quality. This includes both copies from an original document and computer printer-generated copies using the laser driven printer coupled with the xerographic process. There is also a great deal of flexibility regarding the nature of the original that may qualify for copying including line images, alpha numeric characters, decorative designs, limited halftones, etc. It is also possible to enlarge or reduce the size of the original on many copier models. Computer printers equipped with laser-driven character generators provide the user choices of format variation through computer program selection or software. We should note in passing that copies from some computer printers such as ink jet and thermal transfer printers do not meet archival standards, and these printers should not be used to make archival records.

At all events, archival quality copies can now be produced on a number of different copiers and computer printers provided the equipment is supplied with archival paper and stable toners. The requisite paper should be described according to applicable standards such as, "ASTM D3458-75 – Copies From Office Copy Machines For Permanent Records" and produced with synthetic sizing at neutral to slightly alkaline pH and contain up to two percent calcium carbonate alkaline reserve filler in the sheet. This type of paper should be absolutely required for any copy that is intended, at the time of its creation, for archival use.[6] In addition, the pigmented thermoplastic developer or toner to be used should meet a number of basic property requirements including stable resin materials such as polystyrene, acrylics, polyesters, epoxies, copolymers of these, etc.; a stable color former such as carbon black pigment; balanced thermoplastic behavior in the fusing step in order to develop a strong bond to the paper surface; particle size and size distribution suitable for the degree of resolution required. The rule of thumb is that the finest line that can be resolved will be three to five times the finest diameter of toner particle. Toner particle size control is achieved through resin properties control, color former pigment particle size selection, compounding of color former and resin pulverizing or grinding and screening or classifying.[7] Toner standards in this regard should be clearly established with the toner supplier. We could state that liquid toners are available on some copier models, but these are not recommended for archival copies. Colored toners are also available based largely on organic dyes but are also not recommended for archival use unless stable color pigments with a known history of stability are used, such as those used to produce Winsor Newton colored paints for artists.

These marvelous new machines that combine electronics, electophotography, high-quality light exposure including lasers for reflex copying of an original or elaborate computer-generated copies, high-speed printing, automated precision paper handling including stacking, sorting and collation, stapling and all of it microprocessor-directed for precise synchronization at high operating speeds, grew out of the audacity of Chester F. Carlson's imagination.

The development of the technology has created an exciting moment for the archives. The talented speakers assembled for this program will add further to our understanding of these new systems.

## Summaries


### *Preservation Photocopying Conference. Introductory Remarks and Historical Perspective*

A survey on the different direct copying processes is given emphasizing their quality as archival or not archival. The most important of them is the "xerography" technology invented 1938 by Chester F. Carlson. Some criteria are enlistened that define a copy as permanent durable the main of which are neutral sized paper that contain some calcium carbonate, stable pigment such as carbon black and stable binders such as acrylics, polyesters, etc. in the toner.

### *Conference Preservation par Photocopie. Remarques préliminaires et perspective historique*

Une étude sur les différents processus de reproduction directe est disponible, mettant en relief leur qualité à être archivés ou non. Le plus important d'entre eux est la technologie de xérographie, inventée en 1938 par Chester F. Carlson. Certains critères définissant une copie comme durable de façon permanente ont été retenus, les principaux étant du papier de dimension neutre contenant une certaine quantité de carbonate de calcium, un pigment stable tel que le noir de carbone et des fixateurs stables au sein du régulateur de couleur tels qu'acryliques, polyesters, etc...

### *Konferenz Konservieren durch Kopieren. Einleitende Bemerkungen und historischer Ausblick*

Es wird ein Überblick über die verschiedenen Techniken der Direktkopie gegeben, und diese werden teils als "archivierfähig", d.h. dauerhaft, und teils als "nicht archivierfähig" charakterisiert. Die wichtigste einschlägige Technologie ist die von Chester F. Carlson im Jahre 1938 erfundene "Xerographie". Sodann werden einige Kriterien zusammengestellt, die erfüllt sein müssen, wenn eine Kopie dauerhaft sein soll. Die wichtigsten sind neutralgeleimtes Papier mit einem gewissen Gehalt an Calciumcarbonat sowie stabiles Pigment wie Kohlenstoff und stabile Bindemittel wie Acrylate, Polyester u.s.w. im Toner.

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# Electrophotography and Archiving

*by* MARK WEBER

## Kodak and the International Museum of Photography

I'm not an archivist. But I represent a company with close, long-term ties to the archiving community. For example, Kodak has long helped support the International Museum of Photography at the George Eastman House in Rochester.

The Museum's archives include over 600 thousand photographic prints and negatives, 6,000 motion-picture titles, and a 25,000-volume research library, as well as 11,000 cameras and related items. It's the most important combined collection of photographic material in the world.

In fact, the Museum's collection has grown so extensively that it recently threatened to outgrow both its building and its financial resources. Without resources to build larger facilities, the Museum's board was forced to consider asking the Smithsonian to take over the archive.

Then in 1985, Kodak donated its San Francisco office building to the Museum. This one-time gift was in addition to the substantial annual support Kodak provides the Eastman House.

Last June, the Museum sold the building. The sale price of 16 million dollars will serve as a permanent endowment for operations of a new archives building for the Museum.

In addition to our support of the Eastman archive, for over a hundred years, Kodak has been in the business of making images last. So while our perspectives are naturally somewhat different, we share many of your interests and concerns.

## Electrophotography

Certainly that's true when it comes to electrophotography. Archivists are interested in electrophotography for two important reasons:

First, more and more of the documents going into archives and libraries today are electrophotographic copies. That's true not only of individual documents, but of many publications.

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Many government publications, for example, are "printed" on high-speed copiers. The growing use of electronic publishing will accelerate this trend.

So archivists want to know what to expect of such documents. What kind of image and keeping qualities do they have? What are the advantages and disadvantages of differing copier technologies?

Second, electrophotography now makes it possible to replace degraded documents with copies that arrest image decay and actually improve readability.

Archivists are using copiers as tools for extending the usable life span of many documents. The National Archive, for example, expects to replace 150 million documents in the archive with copies during the next 20 years.

Like any other tool, the more we understand about copiers, the better the job they can do for us. So my role is to provide you with a kind of field guide to electrophotography.

## Technology

We'll start with a look at how this technology has evolved. Then we'll see how that familiar machine in your office converts blank paper into clean, sharp copies. We'll compare the results produced by differing copier technologies. Finally, we'll take a look down the road to see how future developments may affect document storage and reproduction.

Since its invention by Chester Carlson 49 years ago, electrophotography has grown into a 20 billion dollar industry. Today, we take this remarkable technology for granted.

Yet, only four decades ago, most copies were still produced the old-fashioned way – using typewriters, carbon paper, and mimeo. Many of the documents in your files are probably such copies.

All that changed with the introduction of the first commercial copiers. The early copiers, of course, were not very fast. They were messy, and not particularly easy to use.

In 1960, with the introduction of the Xerox 914 copier, the industry really began to take off. By 1970, IBM had entered the market, follow in 1975 by the introduction of the high speed Kodak Ektaprint copier-duplicator.

Today high-speed copier-duplicators are available which can print 100 or more pages a minute. That's more than a mile of paper in an hour.

The basis for this technology is the electrophotographic process. The physics





involved are complex, but I talked some of our engineers into giving me a description that even a marketing guy like me can understand.

Electrophotography is based on the fact that the conductivity of certain materials is affected by exposure to light. If such a photoconductor is given an electrostatic charge and then exposed to light, the exposed area will lose most of its charge.

That's the theory. Now let's see how it works in practice. We'll be using the Kodak Ektaprint Copier system as a model, but the basic steps involved are the same for all copiers.

First, a photoconductive surface is prepared to receive an electrostatic charge. Some systems use a photoreceptive drum. In the Ektaprint Copier system, the photoconductor is coated on a film loop.

The surface of the film loop is electrically erased and physically cleaned with a vacuum-assisted fiber brush. The result is a charge-free surface – an electrically "blank page."

Then the photoconductive film loop is given a uniform negative charge, using a corona charger.

Next, the image frame on the loop travels to the imaging area. There it is exposed to light reflected from the hard-copy original. This flash exposure leaves white areas of the original as relatively low-charged areas on the photoconductive surface of the film loop.

Only the areas which were shadowed by dark areas on the original are left with a charge. So the film is now carrying a charge pattern corresponding exactly to the original image.

The latent image then passes over a developer station. There the charge pattern is developed using a toner which has been given a positive charge. Because it has the opposite charge, the toner is attracted to the negatively charged latent image.

High-speed copiers take advantage of the fact that most of the carrier can be recycled. In such dual-component systems, toner is added separately when needed. The carrier needs only occasional replacement.

The toner develops the remaining charged regions of the photoconductor surface as black areas. For the first time, the charge pattern now becomes a visible image on the film.

Next, a negative DC corona charger is used to transfer the developed toner image directly to the copy paper.

Finally, the image is fixed to the copy paper using heat and pressure. A heated silicon rubber roller is used on the image face, pressing against a backup roller on the opposite side of the paper, so the toner is both pressed and melted into the paper surface. The fusing temperature of the rollers are determined by the chemical composition of the toner and the copier speed.

## Different Copier Types

It seems simple. The challenge comes in trying to tailor this basic technology to the differing needs of a wide range of markets and customers.

Today's copiers – almost without exception – produce good results. But there are differences, many of which are of special concern to archivists.

To understand these differences, we have to understand the needs of different kinds of copier users.

The copier market is highly segmented. Some industry analysts point to as many as seven distinct user segments, each with its own needs and requirements.

I won't bore you with that kind of detail. For our purposes, it's enough to point out that copier customers tend to fall into three major groups, based on the volume of their copying needs.

Low-volume users typically make fewer than 10,000 copies a month. A university archive or large library might fall into this category. So would many small businesses or government offices.

Such users don't need high copier speed – 6 to 20 copies a minute are enough. They expect good copy quality and reliability. But because their copy volume is low, a copier that delivers 7,000 to 15,000 copies between service calls will meet their needs.

Low-volume users are beginning to demand more features, such as document sorters. But they remain very price sensitive. In fact, prices for competitive low-volume systems are actually decreasing.

Mid- and high-volume users, such as business or government agencies, may produce 10,000, 70,000, or even as many as 500,000 copies per month. Such high volume demands higher reliability.

Users of high-volume systems expect to make 30,000 to 90,000 copies between service calls. Features like self-diagnostics and the Kodak "Teleassistance Network" further boost machine uptime.

At the same time, mid- and high-volume users are willing to pay more for reliability and higher copy quality. And to boost productivity, they're looking for more automated features – such as duplexing and automatic finishing.





## Image Quality

This market segmentation has a number of consequences of interest for archivists. Copier designers aim for a particular segment of the market, tailoring their products to the special needs of that group of users. In doing so, they must inevitably make trade-offs between design features.

For example, copiers today may use either liquid or dry toners. The electrophotographic process is basically the same with either. But choosing one or the other involves balancing advantages against disadvantages.

In the liquid process, toner particles are suspended in a fluid. This helps the toner penetrate into the paper, like ink. Liquid toner particles can be smaller – and manufactured from softer chemicals – which also enhances penetration. So the resulting image has good resistance to abrasion or tape peel.

Dry toners do not penetrate as deeply. Heat and pressure fuse the toner to the surface of the paper, producing a durable bond.

But the image is not as resistant to rubbing or tape peel as copies made with liquid toner.

However, liquid toner has its own limitations. Even though the liquid carrier is fast drying, it can't evaporate instantly. So liquid-based systems are inherently slower than systems using dry toner. Today's fastest liquid-toner systems produce only about 2,700 copies per hour.

In contrast, advanced high-volume copier-duplicators offer truly remarkable speed. The Kodak's Ektaprint 300 duplicator, for example, can make up to 6,000 impressions per hour.

Today's liquid-toner copiers offer good copy quality. Special papers are needed to optimize this process.

Today's high-volume units achive optimum image quality on plain copy paper.

Market segmentation forces other trade-offs, too. The market for low-volume copiers, as I said, is extremely price sensitive. Cost pressures often restrict the number, durability, and quality of features manufacturers can incorporate.

One result is that the quality of the image produced by low-volume systems –

while good – is not as good as the original. Such systems do not have the image quality latitude to restore the broad spectrum of degraded documents.

### CONTRAST IMPROVEMENT

Advanced high-volume systems, on the other hand, offer not only speed, but the best image quality available. In many cases, the quality is so good it challenges the reader to tell the copy from the original. Such copiers can significantly improve many degraded documents. They can, e.g., improve contrast and legibility of documents consisting of paper that has yellowed and the image of which has oxidized and faded. Nothing can restore the image quality that has already been lost. But today's advanced copiers can significantly improve contrast and legibility. For example, using an advanced optical copier, we can drop out the yellow and raise the contrast of the image. The result will be a very high-contrast copy with far better readability. In effect, the copy can stop time, arresting the degradation of the original. Unfortunately, you can't get something for nothing; in the case of high-contrast copies, the trade-off may be a slight graying of the background.

On the other hand, we might use an electronic copier like the Kodak IM 40 Copier. With a scanning resolution of 400 dots to the inch, the IM 40 Copier digitally scans the original. For each of those 400 dots, it assigns a value: This dot is black, that one is white, the next one is gray.

The trade-off here is slightly lower resolution. But, again, the copy not only arrests the degradation of the original, it gives a substantial gain in readability.

### OTHER FEATURES

The benefits and trade-offs we've been talking about so far are of special interest to archivists. Others are of concern not only to archivists, but to all users.

In today's market, for example, copiers at all volume levels are becoming more feature rich and, therefore, more complex in operation. That means simplicity of use has become an increasingly critical issue for manufacturers and users alike.

Many copiers on the market, including the family of Kodak Ektaprint copiers,offer a wide range of advanced features. These include:

- Automatic stapling and binding.
- Automatic duplexing.



- Chapterization, in which the copier automatically begins each chapter with the left page blank.
- Variable margin shift to accomodate stapling or punched paper.
- Edge erase to eliminate margin notes from copies of original documents.

Such features increase system capability, but they also add complexity. As a result, designers of high-volume systems have been pressed to develop copiers that are easier to operate and require minimum instruction, yet allow even the inexperienced user to take full advantage of system capabilities.

And manufacturers are responding. For example, our Ektaprint copiers deliver messages to the operator in plain English. Such copiers "talk" even inexperienced operators through the most complicated document reproduction task, simply and easily.

### FUTURE DEVELOPMENT

So far, we've been talking about electrophotography today. What about the future?

Certainly we can expect to see continuing gains in copier capability. Machine speeds will increase, new software will enable copiers to easily handle a growing variety of jobs, and copier productivity will be enhanced by growing ease of use.

Beyond such general trend, we can spot specific areas of innovation. At Kodak, for example, we recently introduced spot-color capability to the high-volume copier market.

The introduction of the AccentColor system foreshadows even more capability in the future. Full-functional color is a reality now in our development laboratories. We believe a full-color production system is a very reachable target in terms of cost, performance, and image quality.

Another area with great promise for the future is the development of even higher image quality with electrophotography. In fact, in our laboratories, we have already demonstrated the ability to produce copies that rival photographic quality.

We will also see a growing use of electronic imaging for document reproduction. Recently, for instance, Kodak introduced the Ektaprint 1392 printer.

This printer takes many of the breakthrough features of our optical-copier line – features like high image quality and automatic finishing – and combines them with the operating simplicity of electronics.

Thus, the print head of this new unity employs an array of light-emitting diodes to produce an image. This LED array uses *no* moving parts.

This trend toward electronic imaging means future copying systems will be even more reliable. At the same time, image quality will continue to improve.

For example, a 300 dot-per-inch resolution of a copy looks even better because the system's LED array produces sharply defined dots. That allows the 1392 printer to print characters with better edges, crisper graphics, and solid areas filled with blacker blacks.

## Electronic Data: the Optical Disk

Another evolving technology addresses the need for archival storage of electronic data. The enormous amount of archival information today on tape or magnetic disk systems is outgrowing the available media.

Users are increasingly aware of the gap between direct-access storage devices and back-room tape libraries. The need is for a system that provides fast, low-cost access to archival information.

Optical disk technology is aimed at meeting that need. Like Kodak's new 14-inch optical disk, this technology offers extremely high capacity coupled with rapid access to very large data bases.

Optical disk systems can serve large organizations, such as government, insurance firms, and financial institutions, with massive archival storage requirements. And, optical disk systems can do so without requiring extensive space and staff support.

## Systems Integration

Another trend – systems integration – is giving users simultaneous access to a wide range of information ... and stored on different kinds of media.

The Kodak KIMS systems integrate computer, image processing, and communications technologies. The result is a system that can provide almost instant access to information orignally received in document form – stored on film, tape, magnetic disk, and optical disk.

Despite the sophistication of the KIMS system, hard copies are produced on a simple electrophotographic printer.

Such systems provide archivists with new opportunities to streamline processing of all types of documents, minimize paper handling, and automate information management.





As these examples suggest, archivists have never had a wider range of information-management tools than they do today.

Whether we are dealing with a simple walk-up copier or the most complex electronic printer, the basic electrophotographic process is the heart of the image.

Electrophotography is an extremely versatile tool. And, at Kodak, we're looking forward to working with our customers to make it even more flexible, reliable, productive, and long lasting in the future.

## Summaries

*Electrophotography and Archiving*

A basic survey on electrophotography is presented using different Kodak photocopiers as examples. The advantages of various photocopier types are discussed with particular emphasis on aspects important to archival photocopying, e.g., contrast improvement, eliminating yellow background, and image reproduction quality. The survey closes with a report on future developments in the field of document duplication and data storage.

*Electrophotographie et archivage*

Une étude de base sur l'électrophotographie est présentée, différents types de photocopieuses Kodak étant pris comme exemples. Les avantages de ces différents types sont discutés, un accent particulier étant mis sur les aspects présentant de l'importance quant à la photocopie d'archivage, comme par exemple l'amélioration du contraste, l'élimination de fond jaune et la qualité de reproduction de l'image. L'étude se termine par une exposé des développements futurs dans le domaine de la reproduction de documents et du stockage de données.

*Elektrophotographie und Archivarbeit*

Es wird ein Überblick gegeben über die Technik der Elektrophotographie anhand von verschiedenen von Kodak angebotenen Typen von Kopiergeräten.Es werden deren besondere Eigenschaften diskutiert, vorwiegend diejenigen, die für das archivalische Kopieren interessant sind wie Kontrastverstärkung, Herausfiltern von Vergilbung und Bildqualität. Zum Schluß wird ein Ausblick auf künftige Entwicklungen auf dem Gebiet des Kopierens und Lagerns von Dokumenten gegeben.

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# Book Copiers: Past, Present, and Future

*by* HOWARD S. WHITE

In the next half hour or so, I will try to touch on some of the highlights of the past 100 years or so of making legible copies from bound volumes in libraries – obviously, some years will receive more attention than others. I will give my personalized history of library photocopying followed by a discussion of some of the problems with trying to develop a non-destructive book copier and a glimpse of the future with the description of the performance characteristics of a laser copier.

As I look over the program for today's conference, it strikes me that this conference could easily have been given 20 or 30 years ago – not to say that the topics are not up to date and very relevant – but photoreproduction has not been one of the "sexy" topics of library conferences and institutes for a couple of decades – at least. However, in the 30s and 40s, and even the 50s *photoduplication* and *library reprographics* were as much buzzwords as CD-ROM, OCLC, ONLINE, and DEZ are today. The library "hightechies" and the wunderkinds of those decades were not computer jocks but rather were the heads of photoduplication laboratories at a select group of the largest and most prestigious institutions in the US and abroad. The Photoduplication Department of the Library of Congress had all the "snap and crackle" of the MARC Office of the 60s and 70s and the Preservation Office of the 80s. When the Council on Library Resources was founded in the 50s some of its first projects and top priorities were in the field of reprography. At that time, William Hawken, for the Library Technology Project, tested and reviewed every piece of equipment that could conceivably be used for making eye-legible copies from bound volumes. A new section of ALA was also formed at this time by some of the giants in the field of library reprographics. Now known as the Reproduction of Library Materials Section (RLMS) of the Resources and technical Services Division, it is still a very active group.

## History

The history of photocopying has seen a shifting of priorities among three main performance criteria: image quality, speed, and economy – and, to a small group of dedicated librarians and bibliophiles, book handling ability. It is interesting to note that the first photocopying that occurred in libraries over 100 years ago and utilized conventional silver halide photography, offered excellent

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image quality and the possibility for gentle book handling – speed and economy were something else entirely. The invention of the Photostat machine around the turn of the century improved upon conventional photography by using a prism, photographing onto paper instead of film, and automating many of the functions so that the entire process from exposure to finished print could be done within the machine with only one skilled worker required. And, the results could be excellent. The machine itself, however, was very expensive and even though it was far more convenient than conventional photography, it required a separate room and an employee to run the machine and, with all, it still took considerable time to produce a single print. During this period, it was libraries and government agencies that were the major users of Photostat and similar machines. Most business offices could not bear the expense or be bothered with such a slow and cumbersome process for merely making copies of typed documents. Instead, their most common copying medium was carbon paper. (Libraries were also the major users of microfilm until it was discovered by business to be something more than a passive miniaturization and storage medium.)

After World War II, among the flood of new products to come to market were a procession of small contact copiers – most small enough to sit on top of a desk – that could quickly make copies of single sheets, and to a very limited extent, also could make copies of pages from bound volumes. During a 10-year period, close to 20 different processes were introduced, including a revolutionary new process based upon electrostatic technology – namely xerography. (Before 1960, however, xerography was limited to its use in a cumbersome three-step process for making individual optical copies that could also be used as masters for a Multilith offset duplicator and in another large, expensive and highly specialized machine for producing eye-legible copies from projected microfilm images – the Xerox Copyflo machine.)

Except for the Xerox machines mentioned parenthetically, the desktop contact and contact/reflex copiers for individual documents constituted the bulk of the copier market and satisfied business needs for quick and convenient copying. The machines themselves were mechanically simple and thus relatively inexpensive – the major expense was in the material used to make the copies. But even this was never more than about 15 cents per copy. And, if the copy quality was just barely ligible and if a typed letter got mangled in the rollers as occasionally happened, they were considered to be a small price for the convenience of not having to make multiple corrections on carbon copies.

## Priorities

1960 is the most important date for modern photocopying since that is the year that the Xerox 914 was introduced and became an overnight success. As good as this machine was, however, it was by no means perfect. It was easy to use and relatively fast and the copies were acceptable for line copy but terrible for continuous tone illustrations or solid black areas. It was also insensitive to certain colors – particularly light blue. The machine itself was very expensive but a new way to pay was introduced by Xerox. The Copy Service, as it was called, made it possible to rent the machine and pay according to the number of copies made thus relieving libraries and other users as well of the huge capital expense. With this new machine, economy and speed were assured and copy quality was also not bad. The Xerox 914 was a scarce commodity for several years after its introduction and only the largest libraries could justify even one machine.

The way was thus cleared for another type of machine that used a modified silver halide photographic process built into a machine that looked very similar to a modern flat-bed photocopier. However, the copies made were negative, white print on a dark background [actually, they were light grey on a darker grey background] and the prints were still damp when they emerged from the machine. These machines, under the trade names of Docustat and Vico-Matic, were marketed as public service copiers for 25 cents per copy. The vendor obtained permission to place the machine in a library or other public place, serviced it, and collected all of the money that was collected. Besides the space the only involvement that the library had was to furnish the electricity, which at that time was not a significant expense. It is interesting to note that 160 copies per week was considered to be about average use. There really was very little basis for comparison between these machines and the Xerox 914 except that they served a useful purpose and didn't cost the host library anything out-of-pocket. We had one of these machines in the Business and Economics Library of the University of Chicago for a short time during the mid-60s. It was our first public service copier and we were very pleased to have it regardless of the poor copy quality and comparatively high cost per copy.

Also during the 60s, the Electrofax copiers (direct electrostatic on zinc oxide coated paper with liquid toner) made great inroads into the copier market. If the 914 was the Cadillac of copiers during the 60s, then the Dennison, Olivetti, SCM, and other Electrofax copiers were the Fords and Chevys (and I guess the Docustats and the Vico-matics were the Edsels). As much as we may now sneer at the coated paper direct electrostatic copiers, they had a number of things going for them and were able to remain viable for many years. In fact, you may





still see some in service in drug stores and post offices. These machines achieved economy by being a less expensive piece of hardware than the 914 and were much easier to maintain. And, although the copies were on coated paper that would not accept a ball point pen, had a tendency to curl, and smelled bad, its ability to copy continuous tone and half tone illustrations – though inferior to conventional photography – was still superior to that of xerography.

## Damage Caused by Copying

In any case, most persons – librarians included – were so taken with the speed and convenience of self service copiers that they were willing to settle for legibility instead of good image quality. For libraries and archives, an added benefit of xerography was its relative permanence if produced on acid-free paper and fused properly. The Electrofax process appeared also to be relatively permanent, again depending on the paper used. The same could not be said for the prints made by the stabilization process. Those doing the photocopying were also impressed with the speed and simplicity of merely turning a book upside down on the exposure platen, pressing down on the spine to flatten the book as much as possible, and being able to make prints of two pages simultaneously. That this could cause great damage to the book's binding was of concern to only a small group of persons and since the early use of photocopiers in libraries was, at first, very limited, the benefits seemed to justify the possible damage. At this time, the library market for copiers was important enough so that some of the early self service Electrofax copiers were designed to allow bound volumes to be copied, one page at a time, without pressing the book flat.

1971 is perhaps the next most important date for library book copiers. This is the year that Xerox introduced its 4000, a machine that many thought was particularly well suited for copying from bound volumes. Its exposure platen came right up to the edge of the machine allowing individual pages to be copied without having to open the book flat. Furthermore, this machine was capable of making copies on both sides of the page so that a missing leaf could be copied and tipped into a book. Moreover, and probably of prime concern to the individual scholar was its ability to copy into the gutter of tightly bound books with narrow inner margins. The Xerox 4000 was the last copier from a major manufacturer that answered, in part at least, the unique problems of the library market in regard to copying from bound volumes. Soon after its introduction, another feature – automatic or semi-automatic document feed – came onto the market and was a very great success, especially in business offices for copying multipage unbound documents. This one feature changed the general configuration of copiers to the extent that there has never again been a true edge copier

like the Xerox 4000. And when the old 4000s started to wear out a few years ago, librarians began to panic. So much so that two development projects were undertaken – one in Great Britain and the other in the US – to produce a prototype non-destructive book copier. Both projects were successful to the extent that they demonstrated what had to be done and a commercial product, in limited supply, based on the British Library's machine, is now being marketed internationally.

Which brings us pretty much up to date, except for document scanners, image digitizers, and laser printers which appear to be a part of the next big development.

Having covered over 100 years in just a few minutes, I would now like to describe the development of one of the non-destructive book copier prototypes and finish with a discussion of the performance characteristics of a currently available laser copier.

## Minimize the Stress on Bindings

After waiting in vain for the giant copier companies to develop a new type of book copier designed to minimize the stress on bindings and also to permit readable prints from the inner margins of tightly bound volumes to be made, the library profession with the aid of some outside funding decided to see for itself if something practical could be developed. With strong encouragement from the Reproduction of Library Materials Section (RLMS) of ALA's Resources and Technical Services Division, in 1983 the Library Technology Reports unit of ALA undertook an equipment development project, funded in part by the National Endowment for the Humanities, which resulted in a prototype face-up nondestructive book copier that was exhibited at the 1984 ALA Annual Conference. It was field tested at the University of California at Berkeley and the University of Southern California in 1985. The machine received a generally favorable response from librarians but was greeted by potential manufacturers with only polite interest. About this same time, the British Library had also embarked on a similar project which also resulted in a working prototype that was tested at the British Library and is now in limited production in the UK. I was Project Director for the US machine and was also in contact with the principals involved in the development and eventual marketing of the British machine.

As with many of these projects, the original aims seemed modest enough. (We weren't trying to reinvent the photocopier; we were merely trying to improve its book handling capability.) We started by collecting information on anything that had worked previously. The Xerox 4000 and its edge copying ca-





pability came to mind rather quickly but was rejected for a number of reasons: 1) it would be difficult to adapt a production machine on account of the design of copiers in general, most of which have automatic or semiautomatic document feed mentioned above; 2) although the Xerex 4000 allowed a careful person to make a copy of a single page from a bound volume without damaging the binding, it was observed that, given the choice of copying one page at a time or making two copies simultaneously by positioning the book flat on the exposure platen, most users – including personnel of many library reprographic centers – would choose the latter. Therefore, the potential advantage of being able to make copies without pushing the volume flat on the platen was underutilized – to say the least. Furthermore, it was observed that unless the book is properly supported, it is possible to do even more damage to the hinges by allowing the heavy side of the book to hang off the end unsupported. In our design criteria, we wanted to force the user to go easy on the book being copied. Our next concern was that the copier portion of the host machine would not be materially changed so that the original manufacturer would still be able to service that portion of the machine. (Ideally we would have preferred some simple attachment that could be used with a wide variety of machines and would cost only a few hundred dollars – at most.

## Copying Face Up

Early on it was considered very desirable that the book rest face up in a book cradle similar to the improved book cradles used in microfilming the books for the Encyclopedia Britannica ultramicrofiche publishing projects of the 1960s and 1970s. The value of a face up copier had already been realized at the New York Public Library during the 60s when personnel of the photoduplication laboratory had reassembled an Electrofax copier. The optics were turned upside down and a hole was cut in the bottom of the copier. The copier was then positioned on top of a standard metal office desk with a hole cut in its top to match the hole in the bottom of the copier which also happened to be on top of the drawer. The drawer was then used as a face-up book cradle. I have never seen the device because after many years of service, it was finally retired when parts were no longer available for the host machine and no one, so far, has been able to locate a picture of this monster that apparently stood about 7 feet tall. By all reports, it was not particularly photogenic but it allowed the library to photocopy delicate books that otherwise would not have been allowed to be copied. However, this was not the sort of device we had in mind.

What we finally settled on was a book cradle that holds the book off to the side of a standard copier and has a copier head that can be gently lowered onto

the open book. This copier head has a traveling light source identical to the one in the host copier and is coordinated electronically with the movement of the copier drum. When the copier button is activated, the light in the copier head scans the page to be copied and through a series of lenses and mirrors transmits the illuminated image onto the copier drum. From then on the copier "does its thing" as if nothing unusual had occurred. A fairly sophisticated and expensive solution to what seemed to be a very simple problem.

In field testing at UC/Berkeley, the main complaint voiced by personnel in the library's photocopier service concerned the book handling portion of the device which was judged to be much less efficient than merely placing the book face down on a flat glass platen, pressing it flat, and copying both pages with one exposure!

At USC the device arrived just in time to be used for copying the title pages for a cooperative cataloging project. This group of books was in very fragile condition and would not have been allowed to be photocopied had the library's reprography department not had the face-up copier. Had they not had the machine, the thousands of title pages would have had to have been transcribed by hand. Perhaps this is why their evaluation of the machine was more favorable than that of UC/Berkeley.

The British Library's design approach was similar to that of the American machine except that the copier head is stationary and the cradle moves up and down. The book handling portion is faster but perhaps not quite as gentle or controlled. The British Library machine, called the Archivist and manufactured in the UK by Total Information, Ltd. went through at least two prototypes before being placed in production.

Looking back on our own project and with some observations gathered from the British Library's experience, I have put together a few impressions of the problems involved with developing a new type of copier that would satisfy the special needs of library book copying:

One of the major obstacles to inventing an add-on device for someone else's already-built machine is that it takes so long to merely get acquainted with the existing machine. Whereas, if the manufacturer's own R & D department were to work on the problem, this period of discovery would not be necessary.

Furthermore, there is always the concern of doing something to the host machine that would adversely effect its performance as a copier.

If a small company is formed to manufacture and market the device, the question of service arises almost immediately. With our project, we sought to solve this problem, at least to some extent, by using the same parts as the host copier, wherever possible, with the hope that the regular service person would still be able to service the modified machine.





Price is another problem. Even after the research and development costs have been underwritten by an outside agency such as NEH, the production runs tend to be small and fairly expensive. And, if all of the salaries of a small firm have to be met out of the profits of one product with limited sales, the price is likely to be rather high. Particularly when compared to the prices of standard copiers in a highly competitive market.

Another problem is finding a company to undertake the needed research and development at a fixed cost. Unfortunately, the small companies that employ some of the brightest and most innovative engineers are also undercapitalized and struggling to meet their expenses. The British Library had two contractors go bankrupt while working on their project and had to find yet a third contractor who was able to finish the project. Morgan Data Conversion Company, the designer and builder of the US machine went out of business shortly after delivering the prototype machine.

Finally it appears to me that the current practice of flattening a book down on the glass exposure platen in order to get two pages with a single exposure is so firmly entrenched that it would be very difficult to change it as a general copying practice.

Therefore, except for special situations, I doubt that we will see any great changes in the near future.

## DIGITAL SCANNING

Perhaps digital scanning coupled with laser copiers will offer some solutions.

The laser copier was introduced by Canon in 1985. The ouput of the laser copier system is xerographic (dry toner on plain paper), in concept, however, this new copier is quite different from previous copiers. (The same basic technology used in the Canon Laser Copier is also used in the Hewlett Packard Laser Jet printers used in desktop publishing systems and the new Canon 510 laser reader-printer for microforms shown at the AIIM Convention and Exposition this past spring.) Instead of the original image being transferred by analogue means – that is to say by being projected onto the printer drum as with a conventional xerographic copier – the image to be copied is first digitized by means of scanning. The resolution of the scanner used in this copier is 400 picture elements (PELS) per inch or 160,000 PELS per square inch. Thus, an 8½ × 11 inch page is broken down into nearly 15 million PELS. The digital signals generated by the scanner are then sent to the microcomputer-controlled laser printer. The laser printer uses a laser to reproduce the digitized image of the original onto an amorphous silicon drum and from then on the process is similar to that of any xerographic copier.

The main differences, in operation, between a laser copier and a conventional copier are in the impressive range of electronic functions that can be carried out on the original before the print button is pushed. These functions, which I will describe in some detail, include: framing, blanking, repositioning, separate horizontal and vertical dimensional changes, and polarity control.

The *framing function* permits the selective copying of only a portion of the original. (On a conventional copier, the operator would have to mask the unwanted portion before positioning the original on the exposure platen or cut and paste, thereby destroying the integrity of the original.) In a similar fashion, unwanted parts of the original can be *blanked-out* electronically. This blanking can be achieved either by making the unwanted area appear in the copy as all black or merely blank. Thus revisions can be made at the point of copying and selective dissemination of information can be achieved by using the same original document but selectively blanking out certain parts.

*Repositioning* refers to the ability to reposition or shift selected parts of the original. On the Canon Laser Copier, this function has three modes: center shift, which places the desired image in the center of the image area; corner shift, which shifts the image up to the upper-right corner of the copy; and manual shift, which allows movement of the image to any part of the final copy.

*Separate horizontal and vertical dimensional changes*, referred to on the Canon machine as horizontal and vertical reproduction ratio control, enable either horizontal or vertical enlargement of reduction to be done separately. In other words, you can leave the horizontal dimension the same and enlarge or reduce the vertical dimension and vice versa. The resulting distortion is vaguely reminiscent of the looking glasses in an amusement park fun house that make one appear alternately short and fat and tall and skinny. In any case, it is possible to reduce the image 50 percent and enlarge it 200 percent and this can be done in one percent increments.

*Polarity control* allows negative originals [white print on a black background – like the old photostats] to be copied as positives [black print on a white background] and vice versa – a feature that would be welcomed by libraries and archives with large collections of negative photstats.

In addition to these functions, there are *photo mode* for photographs and halftone originals; *fine photo* for halftone originals made with 64 and 100 line electronic screens; and high *contrast mode* for increasing the contrast on low contrast originals.

In addition to the forgoing controls, there is also a range of automatic functions such as automatic exposure which scans the original to determine its density and selects an appropriate exposure setting to produce an optimum print each time. Three other automatic functions included on the Canon machine





are: *centering*, *frame erasing*, and *2-page separation*. Automatic centering places the image from the original in the center of the copy, regardless of how it is positioned on the exposure platen. Automatic frame erasing removes unwanted borders. And finally, something that relates a little more directly to the topic of this speech, the 2-page separation mode makes it more convenient for copying from bound volumes pressed flat on the exposure platen because the machine can be made to copy right and left or top and bottom pages separately – not that this will help to protect the binding!

The laser copier appears to have a very promising future. In the near term, it seems clear that digitally-stored data will be able to be reproduced on some form of laser copier. A British company, under contract with the British Library has already announced the availability of an image digitizer for use with bound volumes. Its configuration is similar to that of the British Library's face-up copier. It appears, that with book copying as with almost everything else in our daily lives, the future is digital.

## SUMMARIES


### *Book Copiers: Past, Present, and Future*

A report is given on the efforts of some libraries (U.S. and GB) to construct or to initiate the construction of a direct copying machine that avoids damage to the binding as it may happen if tighly bound books with narrow inner margins are pressed face down to the glass plate of normal machines. It is necessary to construct face up copiers with books cradles, and possibly the future solution of the problem will come from the laser copier coupled with digital scanning.

### *Photocopieurs de livres: passé, présent et futur*

Une étude est disponible sur les efforts de certaines bibliothèques (américaines et anglaises) quant à la construction ou la mise en oeuvre d'une photocopieuse directe évitant la détérioration de reliures, celle-ci pouvant apparaître lorsque des livres reliés de façon serrée et à marge intérieure étroite sont posés face vers le bas sur la plaque en verre des machines usuelles. Il est nécessaire de construire des photocopieuses face vers le haut munies de berceaux pour les livres et il est possible que la solution future du problème vienne de la photocopieuse à laser couplée à un sondage digital.

### *Buchkopierer: Vergangenheit, Gegenwart und Zukunft*

Es wird über die Anstrengungen einiger Bibliotheken (amerikanischer und englischer) berichtet, einen Direktkopierer zu bauen bzw. seinen Bau anzuregen, der die Schäden vermeidet, die bei Verwendung der handelsüblichen Maschinen zu befürchten sind, weil in ihnen die Bücher umgedreht und auf die Glasplatte gedrückt werden müssen. Es geht um Kopierer mit einer über dem Buch an-

geordneten Optik oder Elektronik die außerdem mit Buchwippen ausgestattet sind. Vielleicht bringt eine Kombination des Laserkopierer mit dem Digitalscanner die endgültige Lösung des Problems.

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# Archival Quality of Xerographic Copies

*by* SYLVIA S. Y. SUBT

## Introduction

During this conference we have heard about how a copier operates and the theory of xerography or electrophotography. Now as archivists you want to know: will these new machines and technology produce copies that will last? Are our photocopies permanent and how can we be sure?

When we undertook the project, we felt there was a very simple answer. However, after testing hundreds of copies produced on many different small office copiers as well as some typical high speed machines, we are not sure if there is a clear cut answer. The basic problem is one of having xerographically produced copies that are known to be not permanent or to have failed the test of time. As in evaluating the longevity of paper, we took a similar approach in evaluating the archival quality of xerographic copies. We looked for a means to accelerate the aging of copies; we selected properties to monitor the changes that occurred in them after laboratory aging; we studied the chemical properties of the components going into producing a xerographic copy.

In June of 1985, the National Archives and Record Service asked the Government Printing Office to conduct a study on the archival quality requirements of xerographic copies. We were excited because as a large government printer and procurer of federal printing, we were already faced with the question: should we allow publications to be produced xerographically to compete with publications produced by conventional printing techniques? The question our customers raised is whether xerographically produced publications will hold up (that is, are they as durable) and will they last as long as conventional printed products? Our first response was that the copies should last as long as the paper used in the copier. This view is supported by at least two of the large copy machine manufacturers. The best approximation to the archival quality of the photocopied document may be the stability or permanence of the copy paper. As we got more involved with the development of test procedures to test for the copy quality and the technical details of the project, we realized that there was no simple answer. There were problems we did not anticipate. First, we could not satisfactorily simulate aging of the copies without altering the properties of the toner and biasing the results. As in studying paper permanence, the best method of aging paper is ultimately to use natural aging and to

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periodically monitor the deterioration in the product as we have seen in the National Bureau of Standards' study: 37 years aging study on paper.[1] This concept would be the basis of another study, and would require planning now and storing test copies for future evaluation. The second problem in evaluating archival quality of xerographic copies is, what constitutes a "failed" copy? Is it one in which the entire image has been removed because of poor paper-toner bonding or has it failed when part of the image is missing due to toner degradation?

## Approach

In our study, we established these objectives:

(1) We would develop a laboratory test for evaluating the fuse quality or adhesion of the image on the paper.
(2) We would develop a simple on-site test for determining the fuse quality or adhesion of the image onto the paper.
(3) We would investigate the stability of the materials used in a copy system. This would basically be for toners since the longevity of cellulose has been studied by many individuals and much documentation is available.
(4) We would recommend a suitable copying system for producing archival quality documents.

## Laboratory Work

Our laboratory work began by applying the ASTM Method D-3458[2] to some test copies. This document sets methods and standards for "Copies from Office Copying Machinery for Permanent Records." This standard was the product of work done in this area by the National Bureau of Standards and is also the basis for our evaluation standard in response to my earlier statement "what constitutes a failed copy?" It states that a Print Contrast retention of 80% or better is an acceptable copy after laboratory abrasion of the test copy for adhesion of the paper-toner or accelerated aging to determine toner stability. The measurement of print contrast as defined in this formula is an optical measurement of the reflectance of the toner relative to the reflectance of the background paper. In other words, what we are measuring or monitoring is the change, specifically the decrease in the density of the toner that is deposited on the paper.

The standard we used (ASTM Method D-3458) is set up in two parts. The first part defines the requirements for a permanent paper. There are three levels of permanency defined, and depending on the degree of permanency desired there are different chemical requirements imposed on the paper. The most permanent paper is called Type I in which the paper should be suitable for lasting several hundred years. The chemical requirements for the paper are that it should have a pH value between 7.5 and 9.5, that is, the paper is alkaline. It must also have a minimum of 2% $CaCO_3$ or $MgCO_3$ fillers in the paper. Type II paper is defined as a high permanence paper suitable for 100 years minimum of life with an acidity requirement of 6.5 minimum for the pH value of the paper. The least permanent of the permanent papers is a Type III paper designed for medium permanence where the documents need only have an expected life between 50 to 100 years. The acidity requirement of this paper is a minimum of 5.5 pH value.

The second part of the ASTM Method D-3458 deals with the imaged copy. This section describes methods for evaluating the quality of the copies generated. The scope of the method is for evaluating both the permanence and the durability of the copies generated on coated or uncoated papers by either a direct or indirect electrostatic copy process.

The ASTM standard describes two methods of simulating image degradation. One is to evaluate the change in image quality after a mechanical abrasion of the image or toner-paper bond and the other is to effect change in the image by heat, that is, toner stability. A Taber Abrader is used to simulate the degradation of the image on the copy. Another instrument, the Moore Business Forms Optical Character Tester, monitored the change in the density of the image before and after being subjected to the abrasion tester.

The second test method to effect deterioration of the image was to artificially age the sample xerographic copies. In our study we used two different sets of aging conditions. First, we used the ASTM specified conditions of 105°C for 72 h and also our own accelerated aging conditions using a Tenney environmental chamber. In these aging experiments we used conditions of 50°C and 50% RH which were less harsh on the toner-paper system. The 50°C was selected because it is below the glass transition temperature of most toners. To properly simulate aging, the temperature used is critical since we did not wish to alter the rheology of the toner-paper system.

## On-site Test

The ASTM test procedures can be very time consuming and difficult to perform without sophisticated laboratory equipment. This is one of the reasons for the objective to develop quick on-site methods to evaluate copy quality. In all our development work, the ASTM standard was our control test method. As the on-site methods were refined and test data generated, they were compared to results obtained for copy quality using the ASTM test procedures on the

same test copies. Simply, the main criteria of the on-site test is that the results should correlate with the requirements of ASTM Method D-3458.

## Paper Materials

In a simplified way, it can be said the quality of a copy depends on the paper, the toner, and the copy machine. For the paper component, we did not select paper that only met the Part 1 requirements of the ASTM Method, but tested copies produced on papers that represent those one might find in typical office copiers. The papers included: an acid-base, chemical wood xerographic paper; a 25% rag xerographic paper (Xerox Corp's XXV brand is often described as an archival quality paper); and an alkaline-base, chemical wood xerographic paper (Howard Paper Co.'s Permalife brand was selected which incidentally meets the ASTM Type I requirements). The results using the former two papers are reported in Tables 1 and 2.

A comment about the relationship between paper longevity and a paper's acidic content is appropriate. Laboratory tests have consistently shown that an alkaline paper will resist deterioration of its physical strength properties more than an acidic sheet. An alkaline paper is therefore more permanent than an acidic sheet. The use of $CaCO_3$ or $MgCO_3$ as a filler in paper provides a buffer in the paper to neutralize the acids. However, regardless of how acidic or alkaline a paper is, if it is not stored properly, away from ultraviolet radiation, oxidizing or reducing agents such as sulfur dioxide, ozone, peroxides, etc. found in the atmosphere, and extremes in temperature or moisture, the cellulose in the paper will degrade.

## Copy Machines

The sample xerographic copies used for testing purposes were from two sources. We obtained test copies from the small xerographic machines that are typically found in our offices. In addition, we invited over a dozen copy machine manufacturers to send in their own xerographic copies for this study. We told them we wanted xerographic samples to evaluate for archival stability that, in their opinion, would meet these criteria: [1]the copies produced are "adequately fused;"[2] copies are produced under normal equipment settings, e.g., the fusing temperature and/or pressure rollers are properly set; [3]copies are generated on a standard chemical wood xerographic bond paper, e.g., if the supplier feels that in order to produce an archival xerographic product, he must use an "archival paper," then that will be the standard paper; and [4]copies are produced using toners normally found in their copier system.





We received test copies from only four copier manufacturers which brings us directly to the second component required for producing a photocopy: the photocopier. Our test samples were produced on these copier models:

1. Pitney-Bowes Model M350
2. Ricoh FT 6085
3. Konica/Royal Model 2803 ZMK
4. Kodak Ektaprint 85

It should be noted that the Kodak Ektaprint 85 and the Canon NP 155 copiers utilize a monocomponent toner system. Except for these copiers and the Savin 7050 (which uses a liquid system), all samples were made on a copier having a dual component toner system.

To include a larger sampling and variety of small office copiers, we selected 7 other copiers. They all represent what we call the "small office copiers."

1. Canon NP 155
2. Xerox 1035
3. Mita 213 RE
4. Panasonic FP 3002
5. Savin 7050
6. 3M VQC III
7. Sharp SF 825

We also examined copies from three high speed copiers: IBM Series III Model 40, Xerox 9900, and Kodak Ektaprint 100 AF. We included these copiers, even though they are not found in offices but are used for high-volume production runs. Because of their high speeds, it was suggested that the toner is not in contact with the paper surface for a very long time and thus the toner can not adequately set or adhere as tightly to the paper surfaces as the slower speed copy machines.

## Toner

The final and third component in a copying system is the toner. For the toners, we did not attempt to identify or analyze each of the different toners in each machine; rather, we conducted a literature search to determine the composition of typical dual component toners. We also assumed that each machine had the right toners for the equipment.

## Test Methods

In developing the on-site tests, we subjected all the copy samples to the ASTM abrasion tests as well. We followed ASTM Method D-3458, except when measuring the print contrast. We used the 0.190 inch diameter rather than the 0.008 inch diameter aperture. We were able to use the larger aperture because:

1. In our studies we used a predesigned test target which no longer restricted us to the smaller aperture which is required for evaluating individual character images.
2. Also, when we used the smaller aperture, the readings were so variable and so much a function of where the tester chose to make a reading that the print contrast readings were not meaningful. The predesigned test photocopy form consists of a solid black circular ring 3/8" (ca. 1 cm) wide with a 3 3/8" (ca. 9 cm) outside diameter for use in the Taber Abrader and on-site peel test, a rectangular solid black rectangle, 2" × 4", (ca. 5 × 10 cm) for the on-site rub test, and a black strip 1" (ca. 2½) wide for the Instron tape peel test.

The ASTM standard has defined an acceptable copy as one that after accelerated aging or after abrasion, the print contrast ratio shall not decrease by more than 20% of the original value. This is the criteria against which the simple on-site copy evaluation test methods were judged. The methods used were two on-site tests and one laboratory test.

The tape peel test is used in the paint industry for evaluating the adherence of paints to surfaces. A modification of 3M's tape peel test, reported in "Pressure Fusing of Monocomponent Toners at High Speeds," by S. K. Bhuteja & J. R. Gilbert,[3] was used in this project. Our tape peel test method is very simple: cut a piece 4" (ca. 10 cm) long, 1" (ca. 2½) wide of 3M #230 drafting tape (having 20 oz./in. adhesion to steel), and apply it onto the black circular part of the test target. Rub the tape gently and lift it off the image slowly. If the outline of the circle or ring appears on the tape, the copy fails.

The rub test was adapted from a rub-type test procedure IBM Corporation used to study the variables of time and temperature in "fixing" of toner onto paper and was reported by R. Bruce Prime.[4] For our rub test, we constructed a simple apparatus consisting of a 200-g weight with two double-sized microscope slides and two pins to act as stops. The test sample is the rectangular shaped solid on the test target. It is cut out and placed face down on a white paper sandwiched between the two microscope slides with the weight on top of the slide assembly. The test copy is pulled out from between the slides, and the white paper is examined for toner smudges. The presence of smudges indicates copy failure.





In addition to the above on-site test methods for quick evaluation of copy quality, a laboratory tape peel test was developed using an Instron tester to remove the tape from the toner and paper surface. This method served as an objective laboratory method to evaluate the fusing quality of xerographic copies and support the on-site tests. The Instron tester, when equipped with the friction testing apparatus, eliminates variations in: (1) the pressure used to apply the tape (In this method, a 5# roller is used to apply the tape. The tape used is 3M #670 cellophane fiber tape 1" wide with a 40 oz./in. adhesion rating to steel. This tape is more tacky than the #230 tape used for on-site tests); (2) how the tape is pulled off the test copy (the angle and speed of the pull will always be the same); and (3) the amount of toner pulled off can be quantified. This test is recommended for use in conjunction with the ASTM abrasion test to further evaluate copies that fail the on-site tests.

The copies were also subjected to aging studies. We first aged the copies using the ASTM conditions, and the print contrast reading consistently increased. This occurred because the temperature of 105°C was too high and was altering the toner's properties. The set of conditions we finally selected was: 50°C, 50% RH, 96 h and 144 h exposure to a Xenon lamp.

## Data and Findings

The results of the first series of on-site tests are presented in Table 1. Both the tape peel test and rub test (using a 200-g weight) are found suitable on-site copy evaluation procedures. In general, both procedures can separate copies that retain 80% or more of their print contrast readings. Most of the time, the

Table 1. First series of on-site test results

| Photocopier | Paper | % PC* Retention | Test Procedure | |
|---|---|---|---|---|
| | | | tape peel | rub test |
| Xerox 1035 | XXV | 94 | pass | fail |
| Canon NP 155 | CW | 88 | pass | pass |
| Canon NP 155 | XXV | 71 | fail | pass |
| Kodak Ektaprint 100 AF | XXV | 47 | pass | fail |
| IBM Series III | XXV | 43 | fail | fail |
| IBM Series III | CW | 35 | fail | fail |

*PC = Print Contrast

copies produced on the Xerox, Canon, Kodak, and IBM copiers passed the rub and tape peel tests. The reproducibility of the six tape trials was not as good as desired. This variability was attributed to the lack of experience by the observers, such as differences in the application of the tape, amount of pressure used to apply the tape, and method and speed of tape removal.

Two of the six trials showed good repeatability because this observer was trained in the techniques for making the test. Although the tests are relatively easy to make, they still require skill and experience.

Both methods were used to examine copies produced on all paper and copier systems; and whenever possible, copies were made using each of two different paper stocks, e.g., a 25% rag content paper and a chemical wood paper stock.

The results were not as clear cut in a second series of testing for copy quality as presented in Table 2. A "pass" evaluation was not always obtained to support the ASTM Method D-3458 of "80% or better print contrast reading" which equated to an acceptable copy quality. We had hoped for much better correlation between the on-site test evaluations and the ASTM criteria for good copy quality. Even without that correlation, we believe that the tape peel test or rub test are simple and useful in-house control tests for a non-technical copier operator to use to evaluate the copies generated and to make a decision whether

Table 2. Second series of on-site test results

| | Chemical Wood Paper | | | XXV 25% Rag Paper | | |
|---|---|---|---|---|---|---|
| Copier | % PC* Retention | Rub Test | Tape Peel Test | % PC* Retention | Rub Test | Tape Peel Test |
| Pitney Bowes M-350 | 58 | Fail | Fail | – | – | – |
| Ricoh FT-6058 | 57 | Fail | Pass | – | – | – |
| Konica Royal 2803 | 96 | Pass | Pass | – | – | – |
| Savin 7050 | 90 | Fail | Fail | – | – | – |
| Canon NP 155 | 94 | Pass | Fail | 84 | Pass | Pass |
| Xerox 1035 | 77 | Fail | Pass | 79 | Pass | Fail |
| Xerox 9900 | 91 | Fail | Pass | 92 | Fail | Pass |
| Kodak 85 | 93 | Pass | Pass | 94 | Pass | Pass |
| Kodak 100 AF | 30 | Fail | Pass | 39 | Fail | Pass |
| IBM Series III | 52 | Fail | Pass | 38 | Fail | Pass |
| Mita 213 RE | 55 | Fail | Fail | 80 | Fail | Pass |
| 3M VQC III | 98 | Fail | Fail | – | – | – |
| Panasonic FP 3002 | 46 | Fail | Fail | 47 | Fail | Fail |
| Sharp SF 825 | 83 | Pass | Fail | – | – | – |

*PC = Print Contrast





the copy is suitable for archival use. It should be pointed out that the chemical wood paper did not perform better or worse than the XXV paper for toner-paper adhesion.

In the aging studies, even at the lower temperature, the results were disturbing. Because of the nature of toners, at its glass transition temperature, toners will melt and flow into and around the paper's fibers. The toner particles are irregularly shaped particles which become more spherical at the glass transition temperature. The particles merge together into larger masses which exhibit flow properties and find their way into the spaces around the individual paper fibers. In our first set of aging data, the print contrast retention for one of the two paper-copier combinations actually showed an increase. The other showed a very slight decrease.

In the second 45-day aging study in our environmental chamber, we also obtained results that were unclear. The print contrast readings for both copiers and all three papers showed increased retention. In the first few days of aging, there seemed to be a sharp increase in the retention which eventually leveled off. The results are similar for all paper and copier combinations studied, e.g., Cascade, Nekoosa, and Permalife, brand papers using Canon and IBM copiers.

Because of these results, we did not pursue artificial aging of paper and toner combinations further as a criteria for evaluating photocopy stability. Our belief is that artificial aging only sets the toner more tightly onto the paper, so the measurement of retention of print contrast under these conditions is not useful information.

Another project objective was to examine the composition of toners. The literature describes toners as a blend of amorphous thermoplastic polymers, such as a styrene-type polymer and carbon black. Carbon black makes up between 5 to 10% of the toner. The literature also states that carbon black is an extremely stable and permanent material, sometimes used as a stablizer. These properties imply a toner is relatively stable material under normal use conditions.

Since accelerated aging tests of the paper and toner did not produce meaningful results, we extracted the toner from the paper surface and conducted infrared analysis on only the toner before and after aging with various chemicals. The results of these studies are as follows: acids affect the acrylic components; UV light affects the styrene components; oxidizing fumes affect both the acrylic and styrene components; and accelerated heat aging has no effect on either chemical group.

## Conclusions and Recommendations

1. Even though the results shown have not been clear cut, the tape peel or rub tests are recommended as on-site copy evaluation techniques.
2. The toner is the more stable component of the paper and toner pair.
3. An "archival quality" paper, as defined in the Part 1 of the ASTM Method D-3458 should be used to ensure a more permanent xerographic product. Accelerated aging using heat is unsuitable for combination studies of paper and toner. Heat tends to set the toner onto the paper more. If heat is used to fix the toner more tightly on a questionable copy, be aware that heat degrades the properties of paper. That is, the strength properties tend to decrease when using heat accelerated aging techniques.
4. Keep the copier machine well maintained. In particular, the copier should operate at the optimum temperature to insure the toner will melt properly and flow into and around the cellulose fibers.
5. Because of the nature of toners (even without heat they tend to flow), copies should not be stacked with any great amount of pressure. The image will migrate from the original, especially at elevated temperatures.
6. Xerographic copies should also be kept away from vinyl surfaces as the image will migrate because of the thermoplastic nature of toner.
7. Finally, of the fourteen copying systems examined, twelve systems had mixed "pass and fail" results on each of the copy evaluation procedures. Panasonic FP 3002 consistently failed all the tests, while the Kodak Ektaprint 85 system passed all the tests.

## Summaries


### *Archival Quality of Xerographic Copies*

This paper describes two on-site test procedures and an instrumental procedure for evaluating copy quality. The results are compared to criteria defined in the ASTM Method D-3458 for copy quality. Test copies were subjected to artificial aging techniques and the copy quality evaluated.

### *Qualité d'archivage des copies xérographiques*

Cet article décrit deux procédés de test sur place et un procédé instrumental permettant d'évaluer la qualité de reproduction. Les résultats sont comparés aux critères définis par la méthode ASTM D-3458 sur la qualité de reproduction. Les copies test ont été soumises à des techniques de vieillissement artificiel et la qualité de reproduction évaluée.







### *Archivqualität von xerographischen Kopien*

Es werden zwei Testreihen samt apparativer Ausrüstung beschrieben, die das Ziel hatten, die Qualität von Kopien zu evaluieren. Die Ergelnisse werden mit den Kriterien der amerikanischer Nurm ASTM D-3458 vergleichen. Die Kopien wurden einer künstlichen Alterung ausgesetzt.



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# Preservation Decision-Making and Archival Photocopying

*by* GAY WALKER

Preservation decision-making is at the heart of the Preservation Program dealing with brittle books at the Yale University Library. One of the most attractive decision options in that Program is archival photocopying. In use since 1973, it is an economic and appropriate choice for many types of materials. Paper quality, value and rarety of the book as an object, relation to the rest of the collection, relation to teaching and research priorities, use, format, contents, and overall scholarly value are all considerations that help formulate the decision to photocopy or to select another option appropriate for that particular book. Although not endorsed by all preservation programs that deal primarily with microformats, we feel comfortable offering archival photocopying as one of our major options to decision-makers, and it is often the format of choice. I intend to describe our decision-making process, the archival photocopying program, and the rationale for embracing this form of reproduction as an important preservation option.

## Preservation Search

The goal of our Preservation Division, which handles the brittle book problem, is to make accessible the intellectual content of deteriorated items. To accomplish this, search and decision-making procedures have been developed that happen to be both labor-intensive and painstaking, but that also provide the information needed to make the most appropriate and informed decision possible on the disposition of a deteriorated item. The process starts with the identification of preservation candidates. Items in poor physical condition are sent to the Division from Circulation, so the most heavily-used items are made a priority. The title is then searched, and decisions, made by professional subject specialists in the library, are carried out by preservation staff. The options available to the decision-makers define the nature, breadth, and success of the program – success in terms of reader accessibility, the retention of necessary information in as permanent a form as possible, and appropriate matching of the material's format and its clientele. What is the decision-making process, and how is it done? Decisions are not made in a vacuum, and much information is gathered to aid the subject expert in making a decision, particularly for deteriorated materials that cannot be repaired or rebound effectively. Materials with

 Restaurator 8: 40–51 



broken bindings that *can* be identified when received and processed immediately, while those with good paper but early imprint dates are searched to gather information that might support the transfer of the item into a special collection.

The three-step preservation search on a deteriorated item is carried out by higher-level clerical searchers on the Preservation Division staff. After deteriorated materials are charged in and search cards filled out with all the pertinent bibliographic information taken from the book, the cards for about 40 titles are taken to the card catalog and searched in the first step. The search card is annotated with more information from the catalog cards, including the author's life dates, and the call numbers and specific information about all other copies, editions, volumes in a set, and collected works that include the title in question. This information reveals the relationship of the volume in hand to the collection and clearly shows the entire holdings of that title throughout the system.

## Availability Search

The second step consists of a search of the bibliographic tools listing reprints and microforms that are available commercially. Given the prejudice of both our readers and our subject specialists, the reprint catalogs are checked first: *Books in Print*, *Guide to Reprints*, and the appropriate foreign bibliographies. If the exact edition is not found, the catalogs are checked for microform availability, including *Guide to Microforms in Print*, *Serials in Microform*, *Newspapers in Microform*, the RLG Union List, the New York Public Library Negative Film List on fiche, and the *National Register of Microform Masters*. Costs and ordering information are marked where available.

The third step is a check of the physical condition of all other easily accessible editions, copies, and volumes in a set. The search card is annotated with this information and all other volumes in poor physical shape are pulled from the shelf and charged out to the Preservation Division so that an entire title may be decided upon at once. This policy saves duplication of effort by avoiding repeat searches on other editions of the same title that might come later. At this point, the subject specialist should be able to review a title and, with input from a preservation staff member, make an educated decision that is likely to maintain unique information in the collection and avoid doing irreparable harm to its essential make-up.

The decision-makers in our library are the subject specialists: the bibliographers who are selection officers for the collection; the curators of area studies and other special collections; and the head librarians of subject libraries within the system. They come to the Preservation Office to review around three

shelves full of books in sessions of about an hour with a preservation staff member. We translate the information gathered on our search cards to the specialists while they examine the books, using the stamped circulation date slips as clues to usage. We attempt to tell them information in the following order:

1. Author, title, or imprint information if this is not apparent, or the title page is missing;
2. What other editions are held, their physical condition, and where the volume in hand falls in the chronology of imprints;
3. Whether we hold other titles by the same author;
4. Whether we hold collected works of the author that include this title;
5. What is available commercially in reprint or microform; and
6. Whether the volume could be repaired easily or has a recommendation associated with it for transfer to a special collection.

The specialists must assimilate all this, determine if the paper is so brittle that the volume must be replaced or reproduced in order to save the intellectual contents effectively, compare option costs, bring to bear their knowledge of the author, that particular work, the collection, the interests of the teaching faculty and research community, and the present and likely future needs of the broader scholarly community in terms of value of information, and make a decision on each volume that resolves the conflict between preservation and access. They often ask preservation staff for recommendations on how best to save the item, or, if the volume can be repaired – what those costs might be.

## Decision Making

The decision options available to the specialist are replacement, reproduction, transfer, withdrawal, repair, rebinding, and rehousing. Volumes that contain good, flexible paper are usually repaired, rebound, or rehoused. The more severely deteriorated items require more drastic solutions. What follows is the general decision-making hierarchy along with the preferences in selection options.

Is the item worth keeping? And there are certainly cases where this question is valid.

If so, is the item valuable or important enough to merit retention as an object in its original format? Those items that must be retained in their original format are normally valuable enough to deserve extensive conservation treatment, or at least protective housing and continued shelf space. In some cases, a copy of the contents is also made available to reduce wear on the original, often by archival photocopying.

If the item is not valuable as an object, is there a hard-copy reprint available commercially, preferably printed on permanent paper? If so, a reprint of the same edition is a top choice. This option is particularly attractive for monographs and those serial titles where only a few volumes are deteriorated or missing and the title is heavily used.

Should the information represented by those titles not available in a hard copy reprint be maintained in hard copy or is a microformat sufficient?

If a hard copy is preferred, then archival photocopying is the solution selected. It provides a copy containing the same information that will be retained in the collection in a long-lasting format which is close to that of the original and is one that requires a minimal effort on the part of the reader to access and consult. It is particularly appropriate for high-use monographs, reference materials, and serial volumes needed in hard copy to complete a set. It does not work well, generally, for oversize materials, color, newspapers, or those items that are heavily ilustrated with half-tones, although that may be changing.

If a microform is sufficient, is the title available commercially in a standard microformat? If so, the purchase of that microform is made.

If unavailable, preparation of the item for in-house preservation microfilming is undertaken.

The last selection category is a catch-all for those items that do not fit within the normal parameters. It includes the more unusual options of transfer to a different, more appropriate collection and maintenance of an item in a protective box for an aesthetic reason such as a Victorian stamped binding, often with the addition of another copy for general use.

By the time the subject specialist has come to a decision, that title is *known*. It is likely to receive the fairest hearing it will ever get for maintenance within the collection and selection of the most appropriate format. This method of preservation decision-making may become too expensive, but it places the control of the collection in the hands of the curators and selection officers responsible for its growth and continuous retrospective molding, and it retains the effectiveness of that collection in relation to its primary audience, the reader.

## Unavailable and Incomplete Books

Another major use of archival photocopying within the Preservation Program is in the completion of volumes and the replacement or acquisition of titles when the editions are unavailable commercially. Mutilation, loss or non-

receipt of issues, faculty requests for titles never purchased, stolen or lost volumes all account for this significant part of the program. Depending on the volume, up to ten double-sided pages are simply photocopied and tipped-in at one location in a volume, and mutilated pages with cut-out illustrations, for instance, may be left in the volume with the photocopies tipped in beside them. Information about lost volumes that are not available in print come to Preservation as orders. Replacement pages or reproduced volumes are either ordered through Acquisitions or the volume is borrowed through Interlibrary Loan with a request for permission to photocopy. Borrowed volumes are then carefully reproduced in-house and the copies are added to the collection.

## Photocopying

This preservation decision-making structure handles deteriorated volumes through a variety of options, and one of the most often chosen is archival photocopying. Who does it and how is it done? Students do our photocopying, and generally three or more students work 10 hours a week each on this part of the program. The photocopies are collated twice, once by the operator and once by another staff member, either another student, or a searcher or secretary.

The job of photocopying covers the following areas:

*Preparation.* The search card is checked for special instructions such as keeping the binding intact, what to do with the plates, or unusual disposal of the original. If pencil markings disturb the text, they are erased. If the book is bound, it is taken apart, and the student is familiarized with binding types and how to disbind most expeditiously. Although we have access to a guillotine, it is often preferable to leave discrete sections or signatures together, and we often disbind by hand.

*Proper positioning.* Two positions for archival photocopying are used at Yale depending on the size of the original text area. A smaller opening is copied as one image to save on copying costs while larger pages are copied double-sided so that the copy is not oversize and does not require reclassification. Those volumes with text extending less than 23 cm from outer edge to outer edge are photocopied in a single-sided configuration with the inner margins in the middle of the photocopied sheet, the bottom edge of the original lined up with the bottom edge of the copy, and both pages of an opening shown at one time. The right and left edges of the pile of sheets are then trimmed, usually to the line of the original page edge. At least an inch of margin is left across the top of the sheet between the running head and the edge, and this becomes the binding edge. This format opens at the bottom edge, and two pages are read before lifting up the sheet to the next opening. The other format is the double-sided photocopy that is the normal book format. Any text that measures 23 cm or more from outer text edge to outer text edge is handled in this way. The pages are copied so that the top and outer edges are also at the edge of the photocopy and only the bottom is trimmed. The photocopy is bound along the inner edge leaving a full inch margin. The automatic duplexing capability of our photocopiers makes this option easy and efficient.





*Consistency and accuracy.* The need for perfection here is obvious. The consistency of text placement on the photocopied sheet and the absolute accuracy of capturing the contents of each page in the proper order and free from obstructions are extremely important. If the text is out of register beyond an allowable 6 mm, or inconsistently placed, it may be lost when the photocopy is trimmed prior to binding. If the photocopy is imperfect through loss of text to *any* extent, the risk of total loss of that information is great, and annoyance and inconvenience to the reader is certain.

*Special formats and materials.* Maps and fold-outs are photocopied with an overlap, trimmed where appropriate, and taped together using an acceptable pressure-sensitive tape, such as Ademco Manuscript tape available from several archival supply companies. These oversize sheets are then folded, placed correctly in the copied volume, and flagged for the binder. In an unusual case, a thin, oversize item might be copied and the partial sheets taped together, but the general limitation is the 22 × 36 cm acidfree sheet. Some illustrations present special problems. Half-tones may reproduce poorly although there are machines such as the Kodak Ektaprint and the Kodak IM40 that do a very high-quality reproduction job. Color is lost, and that problem has as yet no effective "permanent" solution. Illustrations are often printed on better paper than that used for the text, in which case they may be retained. Generally, the deteriorated book is reproduced in its entirety and the plates placed in a pocket in the back for continued access. The work is also relocated to a non-circulating collection.

*Collating.* Checking the photocopy for accuracy, completeness, and proper order is an essential step, and we have found that a double check by both the operator and another staff member is necessary to ensure that an exact duplicate is made. At the time of the first collation, the operator also annotates the search card with his or her initials, the date, and the number of photocopied sheets for record-keeping purpose. The pages in the original volume are kept in order so that missing pages or other problems in the copy may be corrected easily.

There are other practical aspects of the archival photocopying program.

*Paper.* Xerox XXV Archival Bond paper is used in both the letter and legal size. This acidfree sheet tested well at the Research Unit of the Library of Congress' Preservation Office back in the late 70s. It should last at least several

hundred years if readers do not mutilate it. It also cost less and handled better than other papers tested at that time.

*Machines and Upkeep.* We own two Xerox machines, a 4000 and a 4500, and the automatic double-sided copying capacity is used a great deal. The Océ copier is another machine that, although it does not yet have an automatic duplexing capability, makes double-sided copying easy, and there are certainly other options available. Our two Xerox machines require at least monthly maintenance with cleaning and repair calls, and though these machines are getting on in age, monthly service calls are usual in our experience. A great advantage is the possibility of adjusting the "light original" mechanism so that it eliminates the high contrast background on brown, brittle paper. The glass plates on these machines also extend to the edge, and a book need be opened only about 100° if it has a tight binding or is extremely rare.

*Cataloging.* When archival photocopying was first instituted in the mid-70s at Yale, every photocopied volume was sent to the Catalog Department for upgrading of the record and reclassifying. The copies received an "a" at the end of the call number and a note was added to the card set that read "Photocopied at Yale University Library" with the date. This slowed the processing time immensely. Towards the end of the 70s, the Library Director made the decision to avoid changing the cataloging record for the bulk of these titles. The reader's disappointment at not finding the original was extended only from the card catalog to the shelf since no notification was sent to the *National Union Catalog* or other national bibliographic database. This, of course, is easy to change in the context of RLIN and OCLC, but not all titles are input into RLIN yet. Photocopies that change in location or size, however, are always recataloged.

*Binding.* For many years, photocopies were oversewn, since oversewing was by far the strongest method of binding, and though it was highly damaging to paper that would become brittle over time and took up a significant amount of margin, the Archival Bond paper was better able to stand up to it and large inner margins were possible. We have since changed to double-fan adhesive binding for all photocopies; we are more comfortable with this method and, given the right glue and technique, these volumes should continue to stand up to heavy use. They also open more easily.

*Disposal of Originals.* In the great majority of cases, the very deteriorated, brittle, disbound original is withdrawn from the collection and often placed in a library booksale for a minimal amount. A few are handled with great care and end up in a special collection or a wraparound to preserve the original with a working copy available for circulation. Those borrowed from other units or libraries for copying are also handled with care and returned with the least amount of damage possible.





*Costs.* As for expenses and the comparison between the in-house reproduction options, it costs approximately $27.50 to film and $25 to photocopy the average 300-page large octavo book and about $14.50 to photocopy the smaller octavo book. These are the actual direct costs of the option, including the negative and positive of the film and binding of the photocopy but none of the processing. Our costs for photocopying run around $.07 an opening including the costs of student labor, monthly machine charges and repair, paper, and supplies, while filming is running at $.15 an opening. We know that our preservation microfilming carried out under the RLG Cooperative Program is coming to approximately $53 a volume for the entire processing and filming costs. The price for filming is about to go up, but the maintenance of the photocopy machines may also rise.

*Scope of need.* The need is much greater than our present abilities or techniques can address. We have a backlog of some 4,000 items awaiting photocopying. By the time we get to many of them, we will have to verify that they have not come into print since they were searched. In most cases, any hard-copy would do, whether a reprint or a Copyflo from a film, but archival photocopying is significantly more economic than a Copyflo which is usually 2 to 4 times more costly if the item must be microfilmed first.

## Commercial Copy Vendors

The use of commercial vendors to provide these one-of-a-kind archival photocopies is now a possibility. The on-demand reprint field was pioneered by University Microfilms International (UMI) of Ann Arbor, Michigan, originally Xerox University Microfilms, and the Microphoto Division of Bell and Howell in Wooster, Ohio. A master copy was made in either microfilm or paper and catalogs were produced. They, in effect, were short run reprint houses. Bell and Howell's Microphoto Division titles were purchased by UMI some time ago and most were added to their listings. UMI's "Books on Demand" program was established to fulfill a library's request for a copy of any book; UMI would attempt to borrow it, microfilm it, and produce a Copyflo hard-copy from it. That program was discontinued but UMI continues to list and add to the titles available, and they provide both Copyflo copies from films and good, sharp, two-sided paper copies from paper masters, both formats on acidfree paper. Costs run around $.25 a page. They do take care of the copyright issue, and that convenience is significant.

Within the last year or so, several companies including Teleprint,* Archival

*Teleprint has since ceased operation in this area.

Products, and Image Prints have entered the field. They basically carry out photocopying to produce a bound replacement photocopy as one might do in an in-house program.

Teleprint Publishing, Incorporated, of Charlottesville, Virginia, is an "Out-of-print Book Service for Librarians." They accept orders for any title required by a library, then verify the copyright status, request permission form the copyright holder to reprint the work, make a paper master that they hold up to six months, and produce the copies ordered. Their prices run about $.12 a page, not including royalties or permissions, and they list their turn-around time as approximately two months with a rush service possible. They use acidfree paper and double-fan adhesive binding with their double-sided copies. They borrow most titles from other libraries to reproduce.

Archival Products, a division of Library Binding Service in DesMoines, Iowa, is a "Brittle Book Replacement Service" that reproduces any volume sent to it. They offer both double-fan adhesive binding and oversewing, and always double-sided copying on acidfree paper. Their prices are slightly higher for some sizes of books, but they are able to address special problems such as fold-outs, tip-ins, encapsulation, and pockets.

Image Prints, Incorporated, in Lansing, Michigan, a section of Binding Unlimited, also offers a replacement service in both hard copy and microform. The hard copy is a reproduction on acidfree paper bound to the library's specifications.

Some other binders also offer this service to their customers but may not advertise widely.

### In-house Copying Program

Why set up an in-house photocopy program with these commercial options now available? A number of factors enter into the answer, mostly relating to time, money, and services offered. It would be possible to photocopy a volume in-house and have it bound faster, but not by much, and the great majority of items, in our case, take quite a long time to complete. The time advantages, and certainly the saving of effort, are on the side of the commercial vendors. Money is the most serious concern. Not only is the commercial route generally more expensive, Teleprint, for instance, charges $44 for a 300-page volume as opposed to our $14.5 to $27 charge (that does not include overhead), but the mode of expenditure is very different. The ability to earmark monies to pay bills from a vendor may be a more difficult matter than to pay student salaries or purchase supplies, or it may not. Maintaining physical control over holdings and control over possible distribution rights may also be of concern to the library. And it may never be cost-effective or even possible to replace missing pages or carry out other smaller but still important photocopying activities through a commercial vendor. A valuable or still-useful book that cannot be taken apart but must be copied to provide a circulating clone may be a case in point. As the services of these companies become better known, each library will need to decide on these concerns.





### Photocopy or Microform

A rationale *can* be articulated for archival photocopying in the preservation decision-making/options structure, but the photocopying option must also be contrasted to the preservation microform option. I would argue that there is a place for each technique, that preservation microfilming, and in my view, microfiching, are the current, widely-accepted techniques for preserving the intellectual content *and* addressing both local and national scholarly needs, for the present and the future. Optical discs and digitization technology are on the horizon to carry on that function when and if standardization and permanence issues are settled. An archival photocopy also preserves the intellectual content *and* addresses both local and national scholarly needs, but it does not address the national needs nearly so well. It does not provide a master from which inexpensive copies may be made, although minimum and other charges may raise the microform copy prices considerably. An archival photocopy is also a master. It can be rephotocopied, filmed, or even digitized later, and it usually provides a better physical copy given that the print can be darkened and the background lightened or eliminated, but it is a more tenuous master. If it is lost or loaned and damaged, there is no back-up. It is certainly no worse than maintaining the original, if that were possible, and in fact is much superior to the original with perhaps the exception of half-tone reproduction and other aesthetic considerations. It simply provides a one-for-one replacement in a much longer-lived format, a format that competes well with microfilm in terms of longevity.

Neither method is recommended if the goal is to avoid any damage to the original, although photocopying is slightly more damaging unless the upright copiers become widely used. Upright photocopiers, however, have positioning, margin consistency, and handling problems that might interfere with production output.

The pivotal question is one of scholarly use of hard copy as opposed to microform. The preference is clear. Bob Hayes, Dean of the Library School at UCLA, is involved in his second, more in-depth study of the magnitude and costs of the preservation problem for the Council on Library Resources, and I

understand his findings from many interviews nationwide with faculty, students, and staff are weighing heavily on the side of hard copy. If no other format is available, *then* microform is tolerated and even welcomed. In the best of all possible worlds, every library that discovers a book with brittle paper and does not find it available in a hard-copy reprint should be able either to order a copy from an out-of-print type of replacement service or to reformat it into a microform and then produce a hard copy. This latter option entails the use of Copyflo or a reader-printer. Copyflo machines are becoming scarce, no parts or official service are available, and those that are around must have mechanical wizards on hand along with a lot of chewing gum. So far as I know, few, if any, reader-printer machines are yet available that can produce permanent paper copies in a speedy, economic manner, though this does not seem an impossibility. Thus, Copyflo hard-copy with its higher costs may not be a possiblity in the near future if no novel solution is produced. This problem may be resolved somewhat if and when digitization becomes common to preserve retrospective texts, but even then the hard copy will probably hold its own.

## Outlook

Archival photocopying will continue to have a place in the library for the foreseeable future. Readers want to read books, incomplete books will need completion, some books will need the protection of an available reading copy, and some deteriorated books will be reproduced in this format. It is one of the available options, and for the time being, it is a very good one.

The preservation field is still evolving, and some of the technologies of great interest to us as possible solutions are evolving extremely quickly. By comparison, microfilming and archival photocopying are not. We know what they are, what they can do, how they act, and how to judge them. They are good interim options to an unspecified next step. They are the best we have, and archival photocopying is a very attractive format that fulfills many needs and can be one of the major options in a preservation program.

## Summaries


### *Preservation Decision-Making and Archival Photocopying*

The paper reports on and discusses five different topics in the field "copying for preservation":

1. How the selection of books in poor condition that must be repaired or replaced or photocopied is managed in Yale.
2. A Yale completion and reproduction program for books that are not available commercially.
3. What criteria are considered and followed at Yale to provide copies that can serve as substitutes for originals.
4. A survey of U.S. commercial book copying firms.
5. Advantages and disadvantages of photocopy and microform.

### *Elaboration de décision sur la préservation et photocopiage d'archive*

Les journaux rapportut et commentent cinq différents sujets de discussion dans le domaine de la photocopie pou préservation.

1. Comments opére à Yale la sélection de livres en mauvais état devant étre réparés ou remplacés.
2. A l'initiative de Yale, un programme d'acquisition et de complètement de livres non disponibles dans le commerce.
3. Quels critéres sont à Yale envisagés et réalisés affin de fournir des copies pouvant réellement servir de remplacement des originaux.
4. Un étude sur les entreprises commerciales américaines de reproduction de livres.
5. Avantages et inconvénients de la photocopie et des microfiches.

### *Entscheidungsfindung beim archivalischen Kopieren*

In dem Papier werden fünf verschiedene Gegenstände aus dem Bereich "Buchkopie zur Konservierung" diskutiert:

1. Auswahl reparatur- und aus konservatorischen Gründen kopierbedürftiger Bücher in Yale.
2. Das in Yale praktizierte Programm, unvollständige Bücher durch Kopien zu ergänzen und von Büchern, die nicht mehr im Handel sind, Kopien zu beschaffen.
3. In Yale realisierte Anforderungen an eine Kopie, die als Ersatz für ein Original dienen soll.
4. Überblick über Buchkopierfirmen in den U.S.A.
5. Vergleich der Vor- und Nachteile von Fotokopie und Mikroform.






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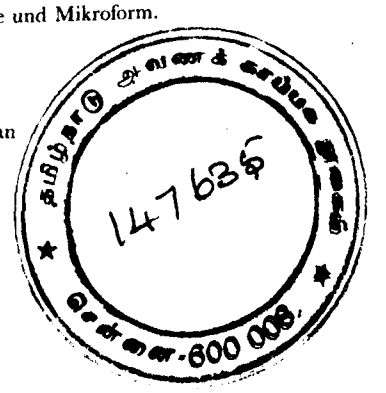

# Preservation Decision-making and Archival Photocopying: Twentieth-century Collections at the Kennedy Library*

*by* HENRY J. GWIAZDA II

## Introduction

The John F. Kennedy Library in Boston holds over 225 collections of papers comprising 32 million pages of documents. Most of these materials date from 1940 to the present, and most exemplify two fundamental characteristics of papers of mid-twentieth-century public figures: massive bulk and a low ratio of intrinsically valuable or historically significant documents relative to total volume. The library's collections and series within collections vary considerably in both size and value so that all processing decisions, including preservation decisions, must begin with an appraisal judgement. Preservation decisions, therefore, are made as only one of a variety of determinations which must take into account factors quite distinct from pure preservation issues, factors such as the quality and quantity of available labor, budgetary limits, or an appraisal of the papers in comparison with others to process. The experience of the Kennedy Library provides a good case study of how these interrelated collection, processing, and preservation decisions are made and how photocopying has become an important option in managing these materials.

## Judgement

Given finite resources in the face of an already large and growing volume of papers to process, archivists must make judgements about how much time and labor can and should go into a particular collection or series. Underlying that decision is a more or less conscious reference to the value hierarchy inherent in the collection policy. At the Kennedy Library, this process is articulated and generalized in the definition of three levels of processing, Standard Levels C, B, and A. Each succeeding level represents a greater amount of labor, and therefore for the archivist to choose a higher processing level, he or she must have appraised the unit of papers in terms of the collection policy and have assigned it a correspondingly higher level of value. This first appraisal decision operates at the collection or series level.[1] It reflects the operational decision that the processing hierarchy should be parallel to the value hierarchy of the institution.

Standard Level C represents the lowest level of processing of papers accepted for deposit in the library. Papers processed at this level are arranged into series, or the existing arrangement is perfected if it needs work. The material is reboxed into archives boxes for standardization in storage, ease of retrieval, and preservation in acid-free containers. Appraisal decisions on the item level are made to identify very valuable documents and replace them in the open files with photocopies. The material is reviewed if required by the stipulations of the deed of gift. Any items subject to closing because of national security or an individual's right to privacy are withdrawn and replaced by colored sheets identifying the item and general reason for closing to research. The final step is preparation of a register describing the materials to the level of the folder title. At Standard Level C processing the library does *not* refolder and does *not* do any preservation photocopying to replace deteriorating originals with copies made on acid-free paper. If any documents arrive loose and unfoldered, they are arranged in acid-free folders and given an appropriate location in an orderly file structure.

Standard Level B includes all the processes done at Standard Level C but adds refoldering the papers into acid-free folders and dividing the material into smaller folders where necessary. Folder level work is completed by stamping and writing folder titles and preparing a folder title list for the register. Item level processing may begin with arrangement of items within the folder when deemed appropriate. Selective preservation work includes three processes beyond photocopying the very valuable original documents: 1) removal of all metal paper clips and any corroding fasteners and restapling; 2) identifying, tabbing, and photocopying all deteriorating originals and adjacent documents sufficiently damaged by acid migration; and 3) stamping documents deemed valuable with an indelible ink on the reverse.

These preservation procedures of Standard Level B recognize a hierarchy of preservation needs and a hierarchy of values for documents beyond the routine. Bulky and corroded fasteners are removed; the staff does not remove all potentially corrosive metal, such as *all* steel staples, to be replaced with brass or stainless steel staples. Given the volume of materials awaiting processing and the size of the collections, the labor necessary for this procedure is prohibitive. The value hierarchy permits the processing archivist to make a distinction between valuable and very valuable documents with corresponding distinctions in labor to preserve the two. An example of a valuable document is a letter initialed by Robert F. Kennedy to indicate he had seen it. A document which is photocopied and removed as a very valuable item is one on which John or Robert Kennedy had written a comment and/or instructions in response to the con-

* This is an abbreviated version of the original presentation. The complete paper includes additional administrative information and will be published elsewhere.

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tent of the letter. All John F. Kennedy holograph materials are very valuable documents at the apex of the value hierarchy. After replacement with a reference copy in the original location, very valuable originals are filed in acid-free folders and boxes and retired to the security vault. The Library would send to a preservation laboratory very valuable originals that needed special treatment beyond preventative replacement with a photocopy in the open files.

Standard Level A includes all the processes of the two preceding levels and additional work necessitated by the very high value of the papers. One example is item listing national security classified documents in each folder of a series such as the President's National Security Files. A second is major preservation work for an entire series or group of folders sent to a preservation laboratory for deacidification such as with John F. Kennedy's early holograph letters. This level of processing represents one end of a continuum as does Standard Level C. At Standard Level C, there is a much greater tendency to respond to the unit of papers as a whole and to avoid work on the item and folder levels; conversely, at Standard level A, there is a conscious decision to work on the item and folder levels to a much greater extent than possible with a less important collection or series.

### Lowest Standard

The best major examples of Standard Level C processing are the subject File in the White House Central File and the White House Social Files. The Subject File is 400 linear feet or 1,010 archives boxes; the Social Files are 490 linear feet or 1,226 archives boxes. At 800 pages per box there are slightly less than one million pages in each of these files, or from another perspective each represents about 3% of the library's total holdings of over 225 separate collections.

The library recently began work on the White House Social Files. These papers consist mainly of routine correspondence to the President and Mrs. Kennedy, e.g., invitations to social occasions such as weddings or graduations; birth announcements; and requests for congratulations on one hundredth birthdays or fiftieth wedding anniversaries. The folders are replete with xerox copies used as cross references. The library has assigned all ten staff members ten boxes per quarter. The staff will review the material against deed requirements, make necessary withdrawals, and identify and photocopy very valuable original documents to be replaced by a reference copy on acid-free paper. This level of processing requires about fifteen to twenty hours per quarter per staff member and therefore allows all normal work duties to proceed while a massive group of papers is being processed over a three-year period.

In the context of a discussion on preservation, Standard Level C processing





may seem to be a dereliction of professional duty; however, it is utterly impossible with the massive volume of twentieth-century material and with limited resources to process all collections to the same high level. By not refoldering certain collections or series and by not photocopying the relatively few deteriorating originals of little or no real value, archivists accept a certain amount of acidity in these files. Consider the alternative for a moment in terms of the White House Subject File. If staff were to refolder the 1010 boxes with an average of 20 folders per box, we would be replacing 20,200 unique folders. The advantages would be to eliminate a source of acid in the box and to create the option of making smaller folders in those cases where the overly full folders do not adequately protect the documents. The disadvantage is that every folder has a unique identification that has to be either stamped and handlettered or typed specifically for each folder. Retitling 20,000 folders is a very labor-intensive and time-consuming procedure which must be justified by the value of the material and the significance of the change. For the White House Subject and Social Files, the staff concluded that the cost was greater than the benefit.

The same argument applies to removal of the small quantity of newsclips, telegrams, thermofax photocopies or other deteriorating original documents that might be in an average box of 800 pages. Photocopying these chemically unstable items removes a source of acid from the file, but the amount of time and labor to complete this procedure for a file of this size and character is too costly. The library's answer is to process and photocopy selectively and to keep the materials in an environment with temperature and humidity control. Identifying, photocopying, and removing the very valuable documents has eliminated the most valuable items that might be damaged by acid migration directly or indirectly from chemicals released within the box. Other item-level processing would have to be done at the sacrifice of working on other series or collections of a higher value or of simply attacking another part of the huge backlog of unprocessed material in demand by researchers. It should be noted that archivists can return to a collection processed at a given lower level at a future date if there are no higher priorities. However, the library currently estimates a hundred-year backlog at Standard Level B processing so that this option is not a near-term prospect, but the projection emphasizes why distinctions have to be made and why some materials must receive more selective work.

### Middle Standard

The files that are more susceptible to Standard Level B processing are smaller and have a higher value-to-volume ratio. They can be considered valuable in either or both of two respects: 1) the totality of the papers has high informa-

tional or evidentiary value in respect to the institution's collecting focus; and/or 2) there simply is a greater incidence of intrinsically or historically valuable documents in the group of papers than with a Standard Level C collection. Specific examples in the library are the papers of Ted Sorensen, staff assistant and later special counsel to the president, 45 linear feet, or the Robert F. Kennedy Attorney General's Papers, 120 linear feet. In these and similar cases, the staff photocopied both the deteriorating originals and the very valuable originals and refoldered all materials into acid-free folders.

In the Attorney General's Papers, documents of particularly notable informational value, which might expedite either reference service or research for museum exhibits, were also replaced with photocopies. Frequently and especially in correspondence files, items of interest show up in unpredictable places. The processing archivist is probably the only person who sees the totality of the file after its creation, and with this procedure he can highlight items of more than passing interest. After photocopying, the intrinsically and informationally valuable originals can be filed together parallel to the original file order. This file is retired for security, and an item list is prepared and can be added to the register as an appendix. The list provides an inventory that makes possible accountability for the intrinsically valuable documents and ready reference by staff and researchers to both types of documents. Such adaptive use of photocopying permits the archivist to highlight items of informational interest that would otherwise not be evident because the materials are described only to the folder level in the standard register.

## Highest Standard

These procedures for handling documents of more than ordinary value operate at the item level. One difference between Standard Levels C, B, and A is the extent of item-level processing that is done. At lower levels, item processing is much more selectively applied than at Standard Level A. The differences can be clarified with examples of the amount of photocopying done at Standard Level A in contrast to the less labor-intensive processing. From this perspective the most dramatic examples of preservation photocopying in the library are the creation of photocopied reference sets of the two most important and heavily-used files in the president's papers: the President's Office Files (POF) and the National Security Files (NSF). The POF is the working file which was maintained by the president's personal secretary, Mrs. Evelyn Lincoln, in the Oval Office of the White House, and it is 73 linear feet. About 55 linear feet or 138 archives boxes are currently open for research; the remainder of the files are closed under deed restrictions to protect national security or an individual's





right to privacy. The NSF is the working file of the president's special assistant for national security affairs, McGeorge Bundy, and it is 175 linear feet of which about 50 are open for research, 120 archives boxes.

After the President's Office Files had been open for research for one year, the staff observed that the intense use of the files was destroying the original documents. The decision was made to photocopy both the POF and NSF so that researchers would use the photocopies for reference. Photocopying was chosen rather than microfilming because such a large portion of both files was still closed to research use due to national security or privacy restrictions. Consequently, a temporary employee photocopied 96 out of 138 archives boxes in the POF and 95 of 120 in the NSF to create reference files for research use. This use of photocopying suggests how this technology fills a very special niche in the options of the processing archivist. The library uses microfilming to copy entire groups of papers in a fixed and final order. If we discard the originals after filming, the microfilm becomes the only documentation left of the original information. The photocopying machine expands one's preservation options to allow the creation of copies of documents that are not yet finally arranged or that would be uneconomical to copy on microfilm. It would simply not be economical to microfilm scattered deteriorating or very valuable originals, remove them from the open files, and replace them with a cross reference sheet directing one to the relevant roll and frame of the microfilm. When an archivist has to copy a larger quantity of cohesive and fully arranged and open material, microfilming becomes a viable alternative. Some of the following information on photocopying rates and costs should assist in making the decision whether to photocopy or microfilm for preservation.

## Production Rate

Photocopying on such a large scale as with the President's Office Files and the National Security Files raises legitimate questions about production rates and costs. It cost the library between $8,000 and $9,000 for the temporary employee hired for 18 months for this project. The work involved breaking down overly large folders, numbering the original documents and items on the withdrawal sheets, and then photocopying. He copied a total of 190 archives boxes with approximately 800 pages per box. He spent about 16 hours, two full days, per box, one day to unstaple and number each page and adjust the withdrawal sheets; a second day to photocopy and refile original and reference copies. Since one of the main causes of deterioration was repeated removal of staples when making photocopies for researchers' reference requests, the decision was made to number items (1, 1a, 1b, 2, 2a, 2b, etc.) to indicate the relationships within

stapled packets and to eliminate fasteners permanently. As with microfilming, once the preparatory work is done, the actual process of copying went fairly quickly, the rate of photocopying in this project being between a page and a page and a half a minute without the use of an automatic document feeder. The library paid the employee at a rate of $4.00 – $5.00 per hour. By way of comparison, an outside vendor recently submitted an estimate to microfilm 10 archives boxes of papers for $3,771, resulting in 9 rolls of negative microfilm and two positive copies.

In Standard Level B processing, where photocoping is done far more selectively, the production rate of simply photocopying ranges from 1 and 1/4 to 1 and 2/3 pages per minute. The variation depends on how much preparatory work has been done on the documents to be copied. The fastest rate is obtained be removing all staples and, if deteriorating originals, by cutting and trimming all oversize newsclips in one's work area first. A tab is then placed around the unit (packet or even folder if all are newsclips) to mark the documents to be copied. When photocopying deteriorating newsclips or any oversize document which does *not* have any intrinsic value, the processing archivist has pieces of standard size paper for the photocopying machine and measures an item against such a template. If the newsclip overhangs the template in any dimension, it is cut up to fit the most appropriate standard paper and taped together in its new form. In that these deteriorating originals have only informational value and are discarded once an acceptable copy on permalife paper has been made, no greater care has to be taken with such documents. For photocopies from these originals and especially with telegrams, wire service clips, and thermofax copies, the automatic document feeder is used when physically feasible. Moreover, in copying extensive telegrams or newsclips, one can copy two or more per page especially if the materials have been arranged such as in chronological order.

Clearly the number of pages copied per box will vary with the type of collection or series being processed. In the press files of a political campaign there will be far more deteriorating newsclips than in the average correspondence file. For example, in Robert F. Kennedy's 1968 presidential campaign papers, the press division files consist of 22 archives boxes, 8 of which are newsclips covering the senator's career from the 1950's to every facet of the 1968 campaign. These newsclips were copied because they were a unique file documenting the life and career of Robert F. Kennedy and because they served as the newsclip file for the entire 1,300 linear foot collection. Photocopying was selected instead of microfilming because of the particular labor we had available for the project. In contrast to the extensive photocopying in these press files, the number of deteriorating originals in Robert Kennedy's 1968 Senate Correspondence ranged





from 10 to 90 pages per box. This quantity represents 1 to 11 percent of the 800 page box with 3–4% being most common.

To cope with a shortage of staff relative to the volume of work, the library uses a variety of temporary outside personnel to rebox, refolder, and retitle and to identify, prepare, tab, and photocopy deteriorating originals. Concern for security suggests that only permanent staff members should identify, tab, and photocopy very valuable originals. The cost for this short-term labor varies. For unpaid interns and volunteers the only cost is the cost of supervisory time. Work/study personnel are paid an hourly rate of $3.50 – $4.50, of which the host institution only pays a percentage, usually about 20%. The Kennedy Library Foundation internships pay $6.00 per hour.

## Cost

Besides labor, the library's other major cost for photocopying is the machine and supplies. The machine used is a Xerox 3100, a model which is no longer available. It was able to copy an oversize paper 14 × 18 inches as well as the regular letter-size and legal-size papers (8.5″ × 11″ and 11″ × 14″). As photocopiers have become more standardized, however, the maximum paper available today seems to be ledger size at 11″ × 17″. A half-page of the *Boston Globe* can just be copied on this size paper. In that many of the older newspapers were not very standard in size and were larger in format than contemporary papers, photocopy reproduction with a ledger size maximum could be a problem in copying some older full pages.

The rental cost of the Xerox 3100 is $181 per month for 4,000 copies before we begin paying at the rate of $.013 per additional page. The library does not use the full 48,000 copies per year for archival work, which averages 3,000 pages per month. With this range, one container of developer costs $150 for 35,000 copies, and the necessary toner costs $123. The required amount of permalife bond paper costs $364 (70 reams at $5.20 each). The total cost per year for this equipment and consumable supplies is $2,800; or for the 35,000 copies, the cost per copy is $.08 (not including labor). With a labor cost of $4.00 per hour at a rate of 1.5 to 1.2 pages per minute, the additional cost for photocopying alone (as distinct from preparation time) would be $.044 to $.055 per copy. Added together, these costs result in a $.12 to $.14 per page cost for photocopying. Actual costs are slightly higher if time preparing the materials for photocopying are calculated and included. These figures are intended to be only suggestive because labor costs will vary and the rental rates, supply costs, and volume figures will vary depending on vendor, type of machine, features selected, and volume of archival copying. Other institutional uses of the ma-

chine, such as for reference or administration, could spread the fixed costs over a larger base.

### Machines

The features of a photocopying machine that we have found most beneficial for archival work are three trays (letter, legal, and oversize – most probably ledger size today); a contrast control; an automatic document feeder, and dry carbon toner. The Xerox 3100 has three settings for the contrast control, but present-generation machines have five, and this capacity allows the processing archivist to upgrade the quality of copy for many deteriorating or light originals. Furthermore, one may purchase various translucent colored plastic sheets to enhance hard to copy colors like blue. A yellow sheet between the document and the glass will permit the enhancement of both light black copy and blue copy. Another supply that can be purchased (or made from thin mylar) is a document carrier if one wants to protect materials when using the automatic document feeder. For photocopying of deteriorating originals without any intrinsic value, the library does not use a document carrier, an overly cautious time-consuming step for this type of material. When doing the extensive photocopying researchers request and pay for, the library has found that an automatic document feeder expedites the process significantly. Prior to opening, the processing archivists have removed the very valuable documents and have photocopied the deteriorating and/or fragile items in the most heavily-used papers so that there is little danger anything of value could be damaged. The staff member who handles photocopy orders has indicated that he regularly uses the automatic document feeder for all photocopies and has never had any problem with damage to documents.

The features of a photocopying machine that have not been of value in the library's archival processing experience are a reduction capacity and a sorter bin. If a smaller institution were trying to reduce costs to justify the expense for its volume of copying, it could well avoid these optional extras, which can add $20–30 per month per feature to the rental fee. Only one situation comes to mind in which an archival institution might need a color photocopying capacity: to make color copies of documents either for a travelling exhibit where the institution does not want to send originals or in a long-term exhibit where the documents are to be displayed more than six months and the risk of permanent damage necessitates replacement by copies. In these cases it is far less expensive for most institutions to take the documents to a commercial copier and work with the employees there to get good photocopies without damage to the originals. The cost for color photocopies is about $1.00 per page.





### Conclusion

For a processing archivist concerned with appraisal, arrangement, and preservation, activities which are inherently very labor-intensive and which have been little affected by automation, the photocopier may be as important a technological advance as the microfilm camera. Computers are an equally important innovation for description and reference. Particularly with voluminous twentieth-century papers, photocopying presents the archivist with the option of processing selectively: for example, to do preservation work on only those documents or subgroups that merit extra time and labor. The technology, therefore, is a crucial element in allowing the archivist to define a processing hierarchy such as Standard Levels C, B, and A. With this copying capacity, the archivist can work at the item level as much or as little as desired. Without the ability to photocopy and replace deteriorating and very valuable original documents scattered throughout contemporary files, there would be no efficient, inexpensive, and quick way to preserve such materials. Replacement of very valuable originals, often extricated from a mass of otherwise routine documents, enhances the security of collections and allows the archivist to have better intellectual and physical control over the more important items. Photocopying also allows selective retrieval of documents of notable informational value that would otherwise be lost in the mass of the files. Finally, the technology complements the microfilm machine by permitting extensive copying in situations where microfilming would be inappropriate or uneconomical. In short, the photocopier offers the archivist numerous advantages and options in managing contemporary papers, and no archives should be without one.

### Summaries

*Preservation Decision-Making and Archival Photocopying: Twentieth-Century Collections at the Kennedy Library*

One of the main problems in a collection of contemporary documents is the bulk of mixed materials that have different historic and/or intrinsic value and that, within the limit of given resources, must be preserved in an adequate manner. Three different processing levels and their use of photocopying for preservation are described, as well as cost and machines for these processes.

*Elaboration de décision sur la préservation et photocopiage d'archive: Collections du vingtième siècle à la bibliothèque Kennedy*

L'un des principaux problèmes que pose une collection de documents contemporains est la masse de matières diverses qui ont différentes valeurs historiques et (ou) intrinsèques et qui, dans la limite

des ressources disponibles, doivent être préservées de façon adéquate. Trois différents niveaux de traitement et leur emploi de le photocopiage pour préservation sont décrits de même que le coût et les machines relatifs à ces traitements.

### *Entscheidungsfindung beim archivalischen Kopieren: moderne Sammlungen in der Kennedy Bibliothek*

Eines der schwierigsten Probleme in einer Sammlung zeitgenössischer Dokumente ist die Masse der Objekte und ihr unterschiedlicher, rein historischer oder/und auch innerer Wert, die es gilt, mit begrenzten Mitteln in angemessener Weise zu erhalten. Es werden drei verschiedene Behandlungsebenen beschrieben und die auf ihnen unterschiedlich gehandhabte Auswahl der Stücke, die zur Konservierung kopiert werden, sodann auch die Kosten und die Geräte für diese Arbeit.

## Reference

1. Holmes, Oliver W.: *Archival Arrangement – Five Different Operations at Five Different Levels*, The American Archivist Vol. 27:21–41 (January, 1964).

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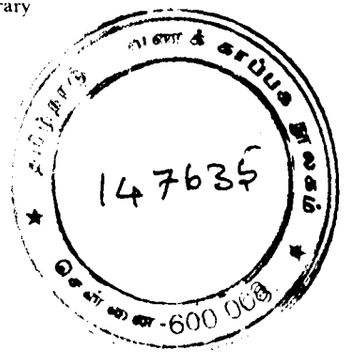






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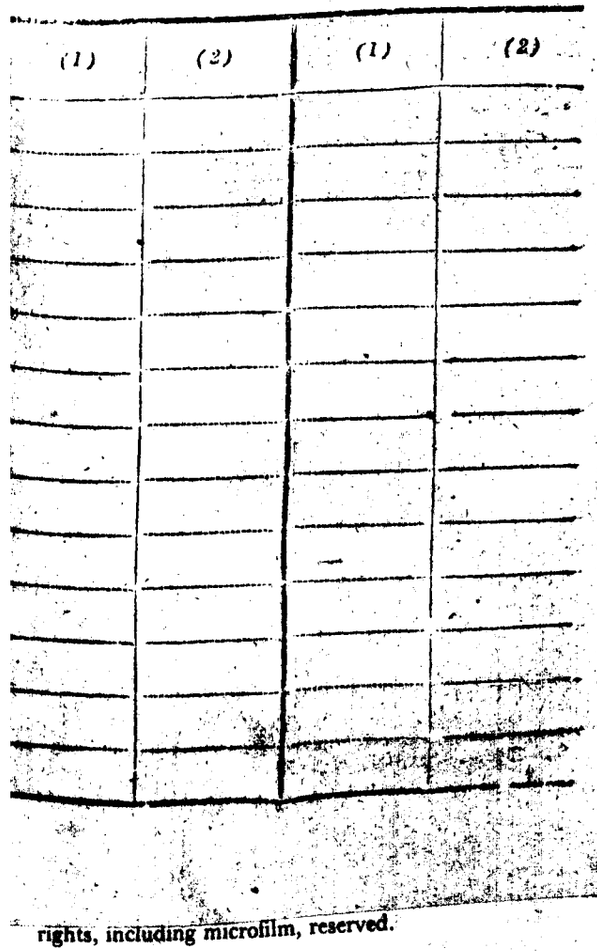




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