

Some Aspects of the Conservation Problem in Archives

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Introduction

AS WE BEGIN THE LAST QUARTER of the twentieth century the world is confronted with the possibility of losing or damaging, perhaps irreparably, some of the most important elements of its physical environment. The threat to the global environment posed by the increasing pollution of the water we drink and the air we breathe, a threat made worse by the frightening possibility (not yet proved) that we are slowly destroying the shallow envelope of atmosphere which keeps our planet habitable for mankind, is a major concern. We can note some progress in the battle to save the environment, but the threat remains a real one.

Nor is the physical environment the only endangered element in present day life. Less disastrous certainly than the potential damage to the earth's atmosphere, but nonetheless a vital factor in the quality of life as we have known it, is the threatened loss of man's cultural heritage resulting from the increasing damage sustained by the written records of our civilization in the collections of the nation's archives, libraries, historical societies, and similar repositories.

In a report entitled "America's Museums: The Belmont Report," published by the American Association of Museums in 1969, one contributor states: "I question whether even a small percentage of the museums in this country are doing anything more than presiding over the steady deterioration of that which they have been instituted to preserve."

That same statement can be applied even more appropriately to this country's archives and libraries, where the problems are not only significantly greater in magnitude but are, in some ways, more complex and more difficult of solution than those of the nation's museums and art galleries.

The Extent of the Deterioration Problem

At a 1969 conference sponsored by the Graduate Library School of the University of Chicago, on the *Deterioration and Preservation of Library Materials*, Edwin E. Williams of Harvard stated: "Everything in library collections is deteriorating today, was deteriorating yesterday, and will continue to deteriorate tomorrow." What Williams said about the nation's libraries is equally true of the nation's archives.

This is a broad generalization, however; and it will be useful to look at some actual figures of the extent of paper deterioration. No detailed investigations of the deterioration of archival records appear to have been made, but there have been a few studies of such deterioration in library collections.

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Librarians and archivists alike have long been concerned about the problem of paper deterioration. By the beginning of the present century librarians had noted that many books printed on wood pulp paper and sized with alum-rosin sizing, had become so fragile they could not be used, while thousands of others were rapidly approaching this condition. By mid-century the situation was nearing crisis proportions.

In 1959, the Virginia State Library, supported by a grant from the Council on Library Resources, asked the late William J. Barrow to undertake a study of the extent of paper deterioration. Barrow's findings, based on a sample of 500 non-fiction books printed between 1900 and 1939, indicated that 97 percent of these had a useful life of 50 years or less. The experience of librarians in the nation's research libraries, as well as that of librarians generally, suggests that Barrow's results were fully representative of actual conditions in most libraries.

At the Library of Congress, a sampling made about five years ago indicates that perhaps as many as 6 million volumes, out of some 17 million books in the total collection, are in the advanced stages of deterioration. In thousands of instances the paper has become so brittle that to turn a page is to break it off. The New York Public Library has estimated that as much as 50 percent of its collection is rapidly approaching an advanced stage of deterioration. To alleviate this condition in some degree, each library spends nearly a million dollars annually to preserve the intellectual content of the deteriorating materials in its collections.

Papers used for business records—including those we commonly call "bond" papers—carbon papers, mimeograph papers, and second sheets, i.e., those papers that ultimately find their way into the country's manuscript and archives collections, are little if any better than those used for book production. An example: some years ago a well-known manufacturer of papers used for business correspondence distributed samples of paper advertised as having been manufactured fifty years before. The blurb accompanying these samples said in effect, "Look at the quality of this paper. It has lasted 50 years." In actual fact the paper was yellow with age and when subjected to physical tests was found to have lost so much strength that it was weaker than newsprint. In the manuscript collections of the Library of Congress thousands of documents on poor paper are in the same advanced stage of deterioration as are the books in the general collections.

Nor is the problem solely restricted to the deterioration of paper. Many inks, including typewriter inks and the dyes used in carbon paper are subject to fading. In thousands of instances ribbon copies of important correspondence, carbon copies, early wet-process photocopies, manuscript copies written with dye-based inks, and similar documents have faded to, or nearly to, the point of illegibility.

There is clear evidence then that major segments of the written records in our archives and libraries are in grave danger of being lost unless appropriate action is taken while there is yet time to take it.

The Causes of Paper Deterioration

There is little to be gained by a detailed analysis of the background and causes of such deterioration, but some knowledge of the fundamental causes of paper deterioration is essential in order to understand the corrective measures that ought to be taken.

Since about the middle of the last century, when wood pulp was substituted for linen and cotton rags in the papermaking process, and when alum-rosin sizing was

substituted for gelatin sizing, there has been a steady deterioration in the quality of paper used for printing books, of paper used for business correspondence, and of printing and writing papers generally. The basic problem in the case of modern papers, i.e., those produced since about 1850, is the alum-rosin compound used to size such papers. Important contributing factors in paper deterioration include impurities, such as copper and iron, in the pulp; the temperature and humidity under which the papers are stored; light; and contamination of the environment by atmospheric pollutants.

Groundwood pulp contains lignins, complex organic compounds which decompose to form a number of components some of which are acid. In turn, these components cause darkening and embrittlement of the paper. In the past, groundwood pulps have found their principal use in newsprint. Today they are found increasingly in book papers and general printing papers.

Alum-rosin sizing is part of the general cheapening process in paper manufacture, a process which began when papermakers first used chlorine for bleaching. After chlorine was discovered by Karl Scheele in 1774, papermakers quickly discovered that the new chemical could be used for bleaching dirty or colored rags so that these could be used in making "fine" paper. Unfortunately, papermakers failed at first to understand the nature and hazards of chlorine, and their consequent failure to remove the residual chlorine after bleaching caused thousands of eighteenth and early nineteenth century volumes to undergo serious deterioration.

No sooner had papermakers learned something of the havoc wrought by bleaching with chlorine and begun to take corrective action, than a cheap substitute for gelatine sizing was discovered. Gelatine had long been used as a sheet size, applied after the paper was formed. The new combination of alum and rosin kept the sizing material in suspension and could therefore be added to the beater. This made it possible to speed the papermaking process and produce paper more economically. What papermakers did not know, as they did not know the hazards of chlorine bleach, was that alum-rosin, in combination with atmospheric moisture, produces sulphuric acid. This, in its turn, results in the deterioration, discoloration, and embrittlement of book paper, bond paper, and other papers that find their way into libraries and archives.

Recently, another important factor in the degradation of paper has been identified: oxidation catalysts which speed molecular scission of cellulose and produce discoloration and embrittlement in paper. These catalysts, principally iron and copper, are found in many papers as a result of the various machines involved in the paper making process. They may also occur naturally as a result of mineral take-up by plants from the soils in which they grow.

The degradation of paper is essentially a chemical process. As in the case of any chemical reaction it takes place at a faster rate at high temperatures and at a slower rate at low temperatures. On theoretical grounds we know that for every 10 degrees Centigrade the temperature is reduced, the life of paper can be increased at least two-fold. Humidity likewise plays a role in paper deterioration. Acid paper deteriorates much more rapidly in a humid environment than in a dry environment.

Light, too, is a factor in paper deterioration, as are such atmospheric pollutants as sulphur dioxide, ozone, nitrous oxide, hydrogen sulphide, and other products of combustion. We need not mention the effects of mold, bacteria, insects, and rodents. These factors can and often do play a part in the deterioration of library and archival

collections, but their effects are either limited in some instances, or occur as a result of improper control of the basic environment.

One major factor in the deterioration of books and manuscripts has not been mentioned: man himself. Unfortunately, archivists and librarians, as well as users, too often damage, destroy, or simply permit the destruction of the very items they are expected to preserve. Improper storage and handling resulting from ignorance, indifference, carelessness, and sheer neglect are the basic causes of far more damage than most custodians would care to admit.

The Nature of Archival Materials and Some Fundamentals of Preservation

Although the great bulk of materials held by archives are paper documents such as books, manuscripts, maps, prints, drawings, photographs, and the like, archives collect and store an increasingly wide variety of materials in other forms: motion picture film, phonograph records, magnetic tapes, and microfilm. Each poses its own peculiar preservation problems, all traceable to the basic nature of the material used and to the environment in which it is stored and used.

Given the problem of paper deterioration as outlined above and forgetting, for the moment, the problems created by other materials, it is pertinent to ask what can be done to solve the problem or to mitigate its effects. Before making specific recommendations, however, it is necessary to review the ways in which deterioration can be retarded or arrested.

We have already noted the effect of reduced temperatures on the longevity of paper. In practical terms, this means that low temperature storage is one of the most effective means now known for prolonging the life of paper documents. It can be demonstrated as well that it is the most economical method of preserving those materials which still have some useful life remaining. Thus a new book, printed on paper which might reasonably be expected to last fifty years at an average library temperature of 72 degrees Fahrenheit, will have an approximate life expectancy of some four hundred years if stored at 32 degrees.

The importance of acid in the deterioration of paper has been noted. What has not been said is that research during the last quarter century has developed several effective methods of neutralizing the acid in any given sheet of paper. Further, it is possible by alkaline buffering to protect paper against both the acid produced by oxidation, the decomposition of lignins, and the acid derived from atmospheric pollutants. Neither low temperature storage nor deacidification and alkaline buffering, however, will restore any strength to paper once this has been lost.

At the present time, the most effective deacidification techniques utilize aqueous or solvent-type solutions applied by immersion of the document, or by spraying or brushing. Still needed is a gaseous deacidification method that will make possible the effective treatment of thousands of books and documents simultaneously, without the present inconvenience and high cost of treating each document or each page individually. This problem will be discussed in more detail below.

Low temperature storage, and deacidification combined with alkaline buffering, provide effective means of arresting the deterioration process and preserving, in their original form, materials which retain some useful life. Such methods are of little value, however, in preserving materials no longer in usable condition. Some other method is necessary for the preservation of such materials. In these cases many libraries and archives routinely resort to microfilming as a means of

preserving the intellectual content of those books and documents too fragile to be used without damage, or as a means of protecting valuable materials against the wear and tear of excessive handling.

Unfortunately, we have no real assurance that microfilming is archival in nature, although it appears that, properly processed and properly stored, a silver halide master negative will probably have a very long life. We are forced to continue the use of microfilm as a preservation medium until some better material is developed.

It is important at this point to distinguish three basic classes of archival materials: (1) those which still retain some useful life and can be preserved in their original form by low temperature storage, (2) those which are so deteriorated that it is uneconomical to attempt to preserve more than the intellectual content by microfilming (or by some other reprographic process); and (3) those of such intrinsic value as to justify the cost of special conservation treatments by trained conservators to preserve and/or restore them.

The technology for low temperature storage is available and its effectiveness is well known. Its use is only a matter of funding. Moreover, we know significantly more about the optimum humidity for archival storage than was known a decade ago. Although the archival permanence of microfilm is a matter that remains in question, microfilming techniques present few problems.

When we come to the matter of conserving and restoring archival documents, however, the story is somewhat different. Conservation treatment of library and archival materials is a science, not an art. As scientific knowledge of the nature of preservation problems has increased, it has become clear that no two documents are precisely the same in their reactions to a given treatment. The treatment which preserves one document may damage the next or may do it little good. The untrained person or the half-trained conservator may, with all the best intentions, do more harm to a collection than he does good.

Unfortunately, the number of well-trained paper conservators in this country is totally inadequate for the job to be done. In a report issued in the spring of 1976, the National Conservation Advisory Council listed five major problems which must be solved if the nation is to achieve adequate conservation service. First in this list was "the need to increase the numbers of fully qualified conservators, technicians, and other conservation personnel through professional training." Further the NCAC report noted a "critical deficiency in the numbers of skilled, experienced conservators, especially senior personnel capable of establishing and directing major programs of conservation; creating and administering conservation training programs; and recommending personnel, materials, and procedures to custodians of artifacts."

The NCAC report was directed at the entire field of conservation: the conservation of museum objects, paintings, historic buildings, and textiles, as well as the conservation of library and archival materials. The situation is critical in all areas, but the shortage of trained conservators is unquestionably more acute in paper conservation than in the other areas with which the report was concerned.

The four additional problems emphasized in the NCAC report as requiring resolution if the nation is to have adequate conservation service are all applicable to the preservation problems of archives. They are:

1. The need to expand awareness and understanding of conservation problems among those administratively or curatorially responsible for the care of cultural property,
2. The need for more numerous and more adequate examination and treatment facilities,

3. The need to increase scientific support for conservation and for the study of artifact materials,
4. The need to establish recognized standards of training and of practice in conservation work.

The report noted also that "changes, to be effective, must be carried out in an orderly, planned way; overemphasis of one or two of the needs will result in an imbalance of capabilities. For instance, the rate of development of more trained conservation personnel must parallel the increase in awareness of the need for their services and of funding for their support."

Improvements and Innovations in Conservation Techniques

Within the last decade there have been some significant improvements and innovations in conservation practices and techniques. No longer, for example, is lamination with cellulose acetate and tissue considered the only acceptable treatment for every fragile or damaged document. Polyester encasement provides superior physical protection for fragile documents, can be accomplished without expensive equipment, is instantly reversible, is fully archival, and requires no heat or pressure which may damage the document. As with other conservation techniques, however, encasement has some disadvantages. It makes a somewhat thicker and heavier document than lamination, and it has a glossy surface. At the same time, the document can be photographed while encased and the transparency of the film provides complete legibility.

The important factor here is that the trained conservator no longer thinks in terms of a single treatment as the panacea for all ills. Rather, he recognizes that documents differ widely in their nature, their history, and their problems; thus, many treatment methods may be required for the effective preservation of a collection of diverse materials.

Within the last decade, there have been improvements in other areas. Although the concept has been known for several years it is only within the last few years that the leaf-casting process, as a means of repairing and restoring damaged documents, especially those with missing parts or voids, has been refined to its present state. Leaf-casting makes it possible to replace missing portions of damaged documents much more rapidly and much more effectively than can be done by manual techniques. Increasingly used in Europe, the leaf-casting process ought to be more widely used in the United States.

Improvements in deacidification methods made possible by the magnesium methoxide process of Richard Smith, and the methyl-magnesium carbonate and double decomposition processes of the Library of Congress have also increased the treatment repertoire of paper conservators.

More is known today about ink problems and methods of ink stabilization, about bleaching, about the removal of stains, the effects of light, the effects of metallic catalysts in the oxidation of cellulose, and about other conservation problems than was ever known before. Today's trained conservator has new techniques, he has a broader knowledge and a better understanding of the problems than one has ever had, even if he does not always have the answers.

Continuing Problems in Conservation

As is so often the case, however, new solutions give rise to new problems. Of critical importance is the need to develop better and more effective methods for the mass treatment of books and documents. Current methods of deacidification and alkaline

buffering were developed for the treatment of single sheets. As noted earlier in this paper, a gaseous or vapor-phase treatment that will permit the simultaneous deacidification and buffering of hundreds or thousands of books at one time is essential. In this connection it should be noted that two different investigations of vapor-phase deacidification are currently in progress: the W. J. Barrow Research Laboratory in Richmond is working with morpholine, and the Library of Congress is investigating the use of diethyl zinc. Richard Smith is working on a process using magnesium methoxide for the immersion treatment of whole books. Patents have been granted for each of the three processes, but none of the three has yet been fully proved or exhaustively tested. Until such a process is available, deacidification and buffering will continue to be a costly and time-consuming process, especially for materials in bound form.

Despite new methods of deacidification for individual documents, more information is needed about the effects of these treatments on papers and inks of different types. Additional research is needed on the treatment of papers containing lignins. There are still unsolved problems relating to photographic preservation, inactivation of metallic catalysts, washing techniques, adhesives, sizes, leather preservation, paper fixatives, dry mounting materials, enzyme treatments, effects of light, effects of solvents on paper, and other subjects.

The "phased preservation" concept developed at the Library of Congress, in which large groups of materials are given treatment intended to arrest or retard various deterioration processes until funds and personnel permit more extensive and permanent treatment, has been very successful in some cases, but more such temporary treatments are needed.

Most librarians and archivists remain only half convinced that even the best microfilm has archival qualities. Indeed, some problems which developed with microfilm a few years ago seem to indicate that the manufacture, processing, and storage of silver halide microfilm are far more critical factors in the longevity of microfilm than was previously realized. Even with the tremendous sums already invested and still being invested in microfilm records, archival permanence is hoped for but not yet proved. Despite the uncertainty as to the archival permanence of microfilm it remains the best available medium for preserving the intellectual content of deteriorating printed materials. Thus archivists and librarians alike must continue to depend upon it until final proof of its permanence or nonpermanence is available or until a better medium is developed.

Other formats give even less assurance of archival permanence than microfilm. Indeed in the case of magnetic tapes, whether used in computers, or for videotape or audio recording, there is no pretense of archival quality. Such tapes have a probable useful life of less than five years and only re-recording at great expense promises any hope of some degree of permanence. Thus, as more and more such materials find their way into the collections of libraries and archives the problems of conservation are compounded.

Without question, one of the major problems in the conservation of library and archival materials is the need for trained conservators. Only four institutions in the United States currently provide conservation education of any kind and none of these emphasize or provide in-depth training in paper conservation. Although of limited concern to archivists, it can be noted also that in the entire nation there is not one institution where a young person wishing to make a career of bookbinding can study.

At the same time, many archives and libraries are attempting to establish conservation workshops but are unable to employ the trained personnel necessary either to supervise or to man such operations. It is a disturbing situation to find that funds are available, but trained staff is not. It is even more disturbing to contemplate the damage to valuable archival documents which could result when untrained or partially trained persons are assigned conservation tasks for which they are unprepared. There has been much discussion of the regional conservation center concept, but this idea, sound though it may be in theory, must await, before it can be fully viable, the availability of fully qualified personnel to staff such centers.

Recommendations for Action

In the face of a large number of important conservation problems it is not easy to formulate specific recommendations. However, some essential needs can be identified, including the following:

1. Certainly the first priority is the establishment of an adequate educational program for paper conservators. Any such program would need to be carefully meshed with current demand in order that no more personnel are trained than can be absorbed by openings in the field.

In the opinion of the present writer, the need for an appropriate educational program for conservators is the most critical need in the field of conservation.

2. The second priority in conservation is the need for an expansion of research facilities to provide for the more rapid solution of the many still unsolved conservation problems. In this case, the link between theoretical solutions and the practical applications of such solutions is very close. It is absolutely essential in most cases that the chemist conducting research into a particular preservation problem work closely with the conservator at the bench, in order that the chemist may understand the nature of the documents to be treated, the end use of such documents, and the problems of applying particular treatment methods to different media.

3. Third, priority might well be given to a national survey to determine the condition of important archival collections and to investigate the feasibility of a program to undertake the microfilming of collections of significant national importance and to develop plans for a national archives collection where both microfilms of such materials and, ultimately, original materials would be housed under ideal conditions for their long range preservation and physical protection. This would be a difficult and complex undertaking but the intrinsic and historical value of many of the materials involved would more than justify the problems and costs involved.

4. Finally, additional research into the permanence of microfilm is suggested. This too is a complex problem, but it is important to establish more firmly than is presently the case the validity of using microfilm as the accepted medium for preserving the intellectual contents, in archives and libraries, of those printed records that cannot be preserved in their original form.

A National Preservation Program

As many readers of this paper may know, the Library of Congress held a conference in December 1976 to put forward suggestions and to elicit ideas for a National Preservation Program. This conference specifically focused on the preservation problems of libraries, but these preservation problems are little differ-

ent from those of the nation's archives. Indeed, as was emphasized in a recent volume entitled *Archive-Library Relations*, the preservation of our collections is a shared concern, with problems and solutions in our respective institutions differing only in degree.

In consequence, the above recommendations for action are equally applicable to archives and libraries. The library-archives world badly needs more trained conservators. Resolution of the microfilm permanence question is as important to libraries as to archives. The preservation research program that helps one will also help the other. Vapor-phase deacidification processes that will successfully treat the bound book will be equally useful for treating masses of manuscripts and other documents in unbound form.

In L.C.'s planning for a national preservation program for libraries, the needs of the community of archives have not been forgotten. Thus the conservation training program proposed by the Library of Congress would benefit archives and libraries alike. So too would the expanded research program proposed by the library.

As regards the microfilming of deteriorating materials, the problems are similar but not identical, although there is overlapping at some points. Libraries are largely concerned with preserving the most important segments of the deteriorating books in their collections. The archives of the nation are concerned with individual records, the bulk of which are not in bound form. In either case, both institutions must establish priorities and must make certain that what they seek to preserve is, in fact, worth the high costs involved.

Shared concerns demand shared responsibilities as well as the fullest spirit of cooperation if we are to solve any of the preservation problems to which we have addressed ourselves.