# Where are We going? Overview of Major Collaborative Conservation Research Projects and Implications for the Future Preservation of Collections

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## INTRODUCTION

In this paper I will tell you about some research and strategic projects, some of them at the end of their time and some just started. Although digitisation seems to have been a major topic in archives and libraries since the mid 1990s the vast majority of the collections are still based on traditional, i.e. analogue, media. The preservation problems much discussed prior to this still exist and still present some major hazards. What differs today from yesterday is that the technological progress has given us new means within reasonable costs to perform research and develop new tools as well as improve the monitoring of decay.

A general tendency is also to find solutions, which may be applied on larger groups of items - and preventive measures rather than emergency measures - since the costs for conservation may be quite substantial for one single object. It is necessary to find cost effective strategies, which comply with the task to preserve the cultural heritage.

What then are the preservation problems that are still persistent? When it comes to paper based media it is still the deterioration of paper and iron gall ink corrosion. Brittle paper is still a major cause for concern even though modern paper quality has improved to some extent. Parchment and its true properties are still to some extent unknown for most of us. The medium has been looked upon as almost indestructible but recent findings show we may have to take another look at this.

A major problem with studies of deterioration, have been the difficulties to find appropriate accelerated ageing tests to simulate natural ageing and to check whether the results correspond to the slow real time deterioration processes. There hasn't been any economically feasible means to measure deterioration at natural ageing speed. Analogue audio- and videotapes present a major economic problem in the near future, if not already.

How to preserve digital image files - commonly known as digital images - is a major issue these days as the problems and costs become more and more evident. This field of media has a lot of economic potential as well as it is an open field for new inventions. Thus the ways and strategies of preservation to choose from may change quickly. The need for an interface of some sort - both hardware and software - between the information and the beholder, makes these issues extremely difficult to tackle. All these issues will continue to initiate research as well as results. They will, of course, also initiate new questions.

## THE INKCOR PROJECT

Iron gall ink was probably the most widely used ink in the Middle Ages. It was used on both parchment and paper. A huge number of documents still exist in pristine condition but maybe an equally huge number suffer from - or will suffer from - iron gall ink corrosion. The problem of iron gall ink corrosion was, as far as I remember, first looked upon scientifically in Germany in the 1970s. Also copper pigments were studied at the time but only as an ingredient in blue or green colours and not in ink. De-acidification of some kind was considered as the solution.

At the end of the 1990s the thread was taken up again at a meeting in Rotterdam, which eventually resulted in the Fifth Framework EU-project InkCor - Stabilisation of iron-gall ink containing paper. The approach now was to use anti-oxidants as the remedy.

In order to make it possible to do research on the effects of stabilisation agents on material more closely related to reality than the use of modern papers and inks, the InkCor project collected numerous historical ink recipes - now available in the ICN (Instituut Collectie Nederland**)** Art Technological database - and produced historical model papers.

The properties of old inks on model paper were studied in order to obtain a better knowledge of how and why differences in deterioration occurred seemingly irrelevant of age. In-air Proton Induced X-ray Emission analysis - in short PIXE analysis - combined with the measuring of some basic properties of paper resulted in the conclusion that the stability of historical iron gall ink containing papers can be estimated with information non-destructively obtained.

Research on the problems of iron gall ink has for decades been focused on the iron content of inks. InkCor-produced results show that this was probably a simplification of the problem. Copper has long been known to be a very corrosive substance and the project has now shown it to be another major component in historical inks. As it was shown that phytate treatment - an anti-oxidant - mainly reacts with iron ions the need to find an effective anti-oxidant for the stabilisation of other metal ions is obvious. A simple identification test for iron has been developed by ICN in the Netherlands and within the InkCor a new one, aimed at identification of copper ions was developed.

Since there have been indications that gelatine may have a delaying effect on the iron gall ink corrosion of paper this well known substance is more and more implemented as a non controversial procedure by conservators. To establish whether this was an effect on the paper or the iron gall ink, an experiment was performed to evaluate the impact of gelatine as a sizing agent on the degree of polymerisation of cellulose. Samples were prepared with a lab-produced ink and some of these were afterwards immersed in water and others were treated with gelatine in three different ways - immersion, spraying and application with brush. After ageing gelatine was washed out of the samples, size exclusion chromatography (SEC) was used to determine polymerisation. No significant effect of ageing stability on iron gall ink containing paper was found.

Results from the InkCor-project have resulted in several improvements of an existing commercial mass de-acidification process implemented by Zentrum für Bucherhaltung in Germany. The impact of the results from the InkCor- project on how to deal with iron gall ink corrosion is substantial. They will also have some impact on the new PaperTreat-project, which will start this year.

**THE PAPERTREAT PROJECT**

PaperTreat - evaluation of mass de-acidification processes - is an extensive development of the research, which was done on mass de-acidification in the 1980s and 90s. In the early 1990s digitisation blacked out most preservation issues. Now things seem to have settled down to where they probably belong and the EU's 6$^{th}$ framework programme has decided to fund this project.

The strategic objects are

- to evaluate the impact of modern material and techniques on historic heritage materials,
- to undertake a comparative assessment of traditional and modern protection and conservation strategies.

The issue of brittle paper in books and documents has long been established and today about 25% of the books in general library collections are brittle and an additional 60% endangered. A variety of mass deacidification techniques have been used for more than two decades and have been shown to prolong the lifetime of treated paper by up to 300%. Mass deacidification has also been proven as a cost-effective strategy, with microfilming being about 8 and digitalisation 30 times more expensive. Consequently, mass deacidification has been incorporated into the preservation strategy of numerous institutions in the USA. Despite the recognized need for mass deacidification across Europe, it is used only by a few institutions, while numerous others plan to perform an evaluation of existing treatments, prior to opting for one.

A number of comparative evaluations of the traditional treatments had been performed in the past, however, 5 new ones were developed recently.

The specific aim of the project is to

- identify side effects of the treatments;
- enable estimation of the extension of the useful life of paper, as achieved by traditional and new treatments;
- provide cost specification for each treatment.

The results will enable a sound decision on the type of treatment best suited for certain materials.

In addition to comparative analysis of the traditional and novel mass deacidification techniques, the project will develop:

- standard model materials;
- standard evaluation criteria;
- standard quality control criteria, which will allow for superior comparative assessment of new processes with the traditional ones and considerably simplify the evaluation of emerging new technologies in the future.

**THE IDAP PROJECT**

Parchment in the form of manuscripts, scrolls, charters, book covers, and substrates for artworks, belong to the most valuable objects of European cultural heritage for they are the bearers of the history, which has shaped the development of European society over a period of many centuries. Large collections exist in public and private libraries, archives, and museums and in diverse religious foundations in varying degrees of preservation. The IDAP-project, yet another EU-funded preservation project, is developing improved damage assessment including an early warning system based on a proven analytical protocol which would contribute to extending the lifetime of these documents as well as improving methods used for their conservation. The aim is to implement procedures for improved damage assessment and preservation of historical parchment. Currently, the condition of parchment documents is assessed by conservators-restorers in terms of their visual appearance and mechanical strength. Deterioration (biological, chemical, physical), however, takes place at several levels and damage cannot always be readily visually assessed. This then poses a complex problem of preservation. That this is indeed true is shown by the results of statistically randomly sampled documents at the National Archives in Stockholm. A collection of 20,000 parchment documents had been considered as being in very good condition. The assessment showed different as quite a few were in very bad condition. The concluding report will make very interesting reading for those involved with the preservation of parchment documents. The project will finish in August 2005.

**THE PAPYLUM PROJECT: CHEMILUMINESCENCE**

For ages the task of determining the condition of a paper-based object has been based on a mixture of visual inspection and tests for which most of them require a physical sample taken from the original. The use of spectroscopic analyses and the introduction of a new tool to study chemiluminescence have taken studies of deterioration of paper to a new level. Not only is it now possible to study the physical properties of paper but also the chemical activities of oxidation.

Within the Papylum-project an instrument has been developed which makes it possible to study chemiluminescence during the oxidation of paper. Chemiluminescence is the weak light emitted by molecules as a result of chemical reaction. This means that studies of paper degradation can be studied at room temperature and seen virtually. The use of this method has among other things resulted in

- new knowledge on cellulose oxidation and the influence of carbonyl groups,
- development of a software which can be used to predict rates of degradation at room temperature,
- guidelines for conservation researchers on how to conduct studies of the photo-stability of paper,
- relative humidity apparently having an important role in the deterioration of moderately alkaline papers.

A study, emphasising the promising results above, on the correlation between polymerisation as measured with chemiluminometry and double fold - a traditional well established paper test - was presented. Observed correlations showed that further investigations into the use of chemiluminometry as an analysis tool to be used on historical papers ought to be carried out.

## THE SURVENIR PROJECT

As a continuation of Papylum this year the EU-funded project SurveNIR will start. Surveying of collections is usually done using simple physical and chemical tests, often destructive, in order to reveal the collection condition, the general conservation needs and to plan preservation activities. As the testing of a single item should take as little time as possible, the information obtained is usually only rudimentary.

By providing a near-infrared-spectroscopic instrument prototype, the end-users will be provided with a powerful survey tool allowing reagent-less multi-component low-cost analysis of items. The technique itself has recently found its way into industry as an in-line production control tool.

The spectra can be taken non-destructively in a matter of minutes, then analysed using advanced statistical methods and, as a result, data important for the preservation officer and policy maker may be provided, such as the material composition and chemical state, via a user-friendly software interface.

The result of the project will be improved tools to e.g

- determine the condition of a collection,
- assess future needs,
- identify major causes of deterioration,
- identify vulnerable areas of the collection,
- facilitate management and resources.

The tools will be tested in seven collections, thus demonstrating the relevance of the developed approach. The involvement of a SME, a university lab and two libraries, three archives, and two museums, i.e. seven end-users, ensures an efficient and directed dissemination both of knowledge and of the developed technology.

## HYPERSPECTRAL IMAGING

As we are in the realm of light I'd like to inform you of an interesting project underway in the National Archives in the Netherlands. It is a new way to use scanning within preservation. Non-destructive optical techniques have always belonged to the most important investigation methods applied in paper and writing durability research. Visual inspection of a document is a fast and inexpensive way of detecting critical areas, where for example ink corrosion occurs in an advanced state, or where discolouration or staining jeopardizes the legibility. From visual inspection alone, the experienced researcher can get a qualitative impression of the general condition of the inspected material.

However, for comparing the state of conservation of documents with each other without actually having to view them simultaneously, quantitative analytical methods are required. Besides a number of other sophisticated spectroscopic techniques, optical reflectance spectroscopy and colour measurement, has been used successfully for analysing local material properties in relation to, for example, paper degradation. Unfortunately, practically all of the quantitative optical techniques are per se non-imaging, i.e. each measurement represents the average properties only around a single point on the document.

The Dutch project has taken another approach with hyperspectral imaging (HIS). An advanced multi-spectral digital imaging system gathers optical information from a significant document area with a high spatial resolution, and can thus overcome the problems typical for single-point techniques. The term hyperspectral imaging refers to the acquisition of a series of digital images at a large number (50-100) of different, well-defined optical wavelengths in the ultra-violet, visible and near infrared. HSI results in the simultaneous, precise determination of the reflectance spectra from all areas of a document with a high spatial resolution. The reflectance spectra often show significant differences for different types of ink (or other substances), which may look identical in direct viewing or conventional RGB imaging. Using dedicated software,

the spectral properties can be exploited for distinguishing inks or areas exhibiting different degrees of paper degradation, as well as for the automatic mapping of their distribution.

This kind of equipment can be used to take “finger prints” of objects in order to study changes over time. Except for the usual studies of deterioration or other changes it could be interesting to study objects after being on display. Items on loan can be fingerprinted before being sent off and checked when they return. The possibilities are numerous. And the best of all: yet another non-destructive analysis tool.

These are just a few of the examples of research in the area of preservation. A lot of other research projects on a more local level are in progress. These include further studies in accelerated ageing and the development of non-destructive analysis tools.

**AUDIO AND VIDEO**

Analogue audio- and videotapes are potentially as great a problem as brittle paper. Millions of hours are recorded on analogue magnetic tapes, which slowly deteriorate. Magnetic information changes over time creating losses in audio and video quality. Acetate has been used as a carrier and the binding layer between carrier and magnetic layer may deteriorate with disastrous results of course. The only way to preserve this kind of information for the future is to digitize it. Actually they are the only media, which have to be digitized to have a chance to be preserved for perpetuity. This means a long-term commitment, which will cost a lot - I repeat: a lot - of money. Both for the initial transferring process, and for the continual merging from generation to generation of computer systems. Thus it is only realistic to assume that any measures taken will only be made by major institutions, probably governmental bodies like national archives and libraries.

**THE TAPE PROJECT**

To cope with the numerous small collections held outside the major national institutions the TAPE-project was started in 2004. TAPE (Training for Audiovisual Preservation in Europe), funded under the Culture 2000 programme of the EU, is a 3-year project for raising awareness and training by expert meetings, research, publications and workshops. TAPE focuses on audiovisual collections held outside the major national institutions with specific responsibilities for audiovisual heritage. Through a programme of activities TAPE aims to explore the requirements for continued access to audiovisual materials and the application of new technologies for opening up collections that provide living documentation of the world of the 20th century.

**FUTURE LIFE**

The issues above emphasize preservation as I said in the beginning. Conservation is not forgotten though. At the British Library a meeting was held in September 2004 where delegates from both sides of the Atlantic met to discuss the future of applied conservation research. A lot of ideas were put together in three priority groups:

1. Life cycle prediction, natural ageing of materials, evaluation of preservation strategies for different materials.
2. Effects of the storage environment and selection of the optimum environment for different materials.
3. Non-destructive methods for assessing damage to materials.

The British Library will take the lead in developing a coherent work programme by:

- circulating outline projects and establishing consensus with colleagues in the legal deposit libraries and national archives in the UK and Ireland, by the end of January 2005;
- fleshing these ideas out into a number of costed work strands with a clear timetable, initially for the period 2005 – 2010, by the end of April 2005;

- Involving collaborators in North America and Europe whose expertise and facilities complement those available in the UK and Ireland.

The project is restricted to paper, parchment and leather.

**IS&T ARCHIVING CONFERENCES**

An area, which combines the traditional and modern media, is photography. We use digital cameras extensively, produce digital image files equally extensively and we talk about digital images. What is a digital image? It cannot be seen unless it is analogue. Thus we have a plethora of print outs - laser prints, inkjet prints, heat transfer prints, traditional photographic prints etc.- all made from digital image files. I will not go further into this but I recommend strongly that you follow what is happening within this field. Last year the Society for Imaging Science and Technology, IS&T, held their first Archival Conference in San Antonio, Texas. A second conference was held in Washington, DC, this year and the third will be held in Ottawa, Canada, next year. Here people meet from HP, Kodak, Fuji, national archives, museums, national libraries etc. and the papers presented are the latest things related to archiving digital image files and their offspring. The two first conferences were very informative indeed. The information is the latest on what has happened or is happening, even what is supposed to happen, and since this is a very dynamic field it is crucial for the archive and library community to follow suit with discussions and development, to be able to understand the processes and the paths they are taking.

This has been a fairly short summary of just some of the activities going on within the preservation community. Next year we will follow up on the events happening and we will present it in Uppsala.

**WEB SITES REFERRED TO IN THE TEXT**

ICN - Instituut Collectie Nederland. http://www.icn.nl/

IS&T - Society for Imaging Science and Technology. http://www.imaging.org/

Nationaal Archief. http://www.en.nationaalarchief.nl/