Preventive Conservation of Information Materials
with Special Reference to Manuscripts

Editors

Dr. V. Jeyaraj & Prof. B. Ramesh Babu

National Mission for Manuscripts

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&

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FOREWORD

Information materials are the storehouse of knowledge, education, experience, cultural heritage and development of the society. Library/Information Centre collections cover a variety of information materials ranging from early writing materials such as palm-leaves, manuscripts, papers, to modern media such as magnetic recordings, film recordings, electronics resources, optical resources and web resources. The information managers need to know the nature of these materials and the methods for their preservation and conservation methods.

The present workshop has been organised by the Government Museum, Chennai which act as Manuscript Conversation Centre, Chennai under the agies of the National Mission for Manuscripts, New Delhi in association with Foundation for Information and Communication, Chennai and Indian Association for the Study of Conservation of Cultural Property, New Delhi. I am happy to note that workshop course materials by experts viz. Prof. B. Ramesh Babu, Mr. B. V. Kharbade, Mr. P. Perumal, Dr. V. Jeyaraj and Fr. Dr. A. Vijay Kiran in the field of preservation have been compiled and edited by Prof. B. Ramesh Babu and Dr. V. Jeyaraj for the use of the participants of the oneday National Workshop. The contributors to the course materials have discussed the themes of the workshop more technically with their experience in the respective fields. I believe this book would be much useful to the manuscript librarians, archivists, curators, library information profession teachers, scholars and students of library information science.

I appreciate Mr. P. Renganathan of the Mahalaxmi Enterprises, Chennai for sponsoring the book for the use of the Librarians, Archivists, Curators and those who are in-charge of information materials.

I wish the National Workshop a great success in creating awareness in conserving the information materials especially manuscripts for posterity.

Chennai-600 008,
26-7-2005.

(M.A.Siddique)

PREFACE

In the dynamic world of today, the value of information has been recognised. The role of information in the development of society has been gaining significant. On the other hand the maintenance and care of information materials has not been recognised in the same degree and spirit. Therefore, the preservation, conservation and restoration of information materials are the order of the day and it is pivotal for keeping it available for the future generation to come. At this juncture, it is necessary to bring awareness among the Library and Information Managers and Archivists, Curators, Manuscript Librarians and others who are involved in the care and maintenance of information materials. Therefore, the present workshop at National Level has been thought of by the Government Museum Manuscript Conversation Centre, Chennai which is a unit of the National Mission for Manuscripts, New Delhi in association with Foundation for Information and Communication, Chennai and Indian Association for the Study of Conservation of Cultural Property, New Delhi.

The workshop has been organized with the following objectives:

- To highlight the nature and types of information materials including manuscripts.
- To identify the factors of deterioration
- To discuss and demonstrate the Preventive Conservation Methods.

To fulfill the objectives Information Professionals were invited to contribute papers and share their experience. The facets of the workshop are: Nature of Information Materials from Stone Age to Web Age, Concepts of Preservation, Conservation and Restoration, Factors of Deterioration, Preventive Conservation: Library Materials, Preventive Conservation: Manuscripts and Preventive Conservation : Digital Resources. The workshop covers tutorials, lectures, open discussions and feedback at the Government Museum, Egmore, Chennai.

The editors would like to express deep sense of appreciation and thanks to Dr. Sudha Gopalakrishnan, Mission Director, National Mission for Manuscripts, New Delhi, Mr. M. A. Siddique, I.A.S. Director of Museums, Government Museum, Chennai for their encouragement in this publication, the contributors to the workshop course materials who have contributed to this publication. The help rendered by Rev. Fr. Dr. A Vijay Kiran, Research Scholar, Chemical Conservation and Research Laboratory of the Museum is acknowledged. We thank Mr. Renganathan, the Proprietor Mahalaxmi Enterprises, Chennai for sponsoring the book for the benefit of the Librarians, Archivists, Curators and those who handle information materials especially manuscripts. We finally thank Mr. R. Balasubramanian, Co-ordinator of the GMMCC, NMM staff Mr.N. Selvakumar and Mr. S. Sethilkumar and the Laboratory staff. Mr. J.D. Jagannathan, Mr. Raja Balachandramurugan and Mr. J. Kumaran for their help. All the help rendered by the staff of the museum in bringing out this publication are acknowledged thankfully.

Finally, we thank all those who have supported and encouraged directly and indirectly and make this event a successful one. We hope that the course material would be helpful to the Archivists, Curators and Manuscript Librarians, LIS Teachers, students, research scholars and practicing librarians.

25th June 2005,

Editors

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NATURE OF INFORMATION MATERIALS FROM STONE AGE TO WEB AGE

*A. Vijay Kiran**

Introduction

Information materials are as old as civilization. Man learnt the art of writing and applied it for recording his war songs and prayer, sacred legends and lores, the stories of his clan and achievements of royal dynasties; he also sought to preserve them for posterity in clay tablets, papyrus rolls, parchment, vellum and so on. The role of such early information materials like clay tablets, stone, metal plate, papyrus, parchment, vellum, palm-leaf, birch-bark etc., was therefore no less significant in the organization of information materials in the ancient and medieval world. Their very use was a clear indication that man had by that time leapt out of the valley of darkness and ignorance to the uplands of light and knowledge.

Information materials commonly used in ancient India was of two kinds:

1. **Durable and permanent:** Materials like stone, copper, iron, tin, gold and silver etc.
2. **Perishable by nature:** Materials like birch-bark, palm-leaves, cotton, silk cloth etc.

These may also be classified as organic and inorganic. Information materials used in ancient India radically differ from the materials used in European countries due to the availability of materials, climatic conditions and the nature of documents and socio-religious conditions.

All these writing materials concerned with the pre-paper age. After the invention of paper, which is the most fascinating writing material and which cannot be replaced with any other type of medium. However, the post-paper Age has witnessed with the advancement of technology, a variety of writing / information storage materials such as magnetic media, film media, electronic, optical and web media, which are in use in the modern world.

Durable Materials

1. Stone

To protect himself from the vagaries of weather, the earliest man, converted caves as his dwelling place and in those caves he started to record his impressions, achievements and thoughts for the posterity. He found the walls of the caves as readily available writing material. Hence stone can be called the fore-runner of any writing material. It may be mentioned here that even before the discovery of scripts men used to draw pictures of various plants and animals to which they come across during their day to day life. The stone was used to write royal edicts or proclamations, royal eulogy (prasast) treaties, agreements, dedications, commemorations, donations, grants, poetical effusions, literary works, and some time big religious works.

Example: Emperor Ashoka got his edict engraved on stones, so that they may last for longer time. Even now the stone is used for inscribing details of laying of foundation stone and opening ceremonies of temples, public buildings etc.

The technique of writing: The technique of writing on stone is that first a stone is smoothened and then it is polished by rubbing it with soft stone. Then the matter is written on its surface with ink or dye and finally the engraver incises or drills the letters.

2. Clay tablets (Bricks)

In search of suitable writing material, attention was drawn to mud or clay, which was available in abundance in his surroundings. Clay tablets were used as writing material in ancient India. Use of this new medium brought about a revolutionary change in writing materials enabling one written record to be shifted from one place to another with ease. But their use was occasional and limited to temples and other buildings of historical importance. This facility ultimately gave rise to the establishment of library in due course. Besides clay tablets (bricks), earthen wares and earthen seals were also used as medium of writing.

Example: The specimen of inscribed bricks was discovered from different parts of India by eminent archaeologists like Cunningham, Buhler and others. The specimens were found in niches of the temple or on the pedestal of images. Some specimen of first century B. C. inscribed bricks can be found in Mathura Museum.

The technique of writing: The technique of inscribing the bricks was to scratch the matter on the moist clay, which is then allowed dry in open air or sun to turn it hard. It is further hardened by burning it.

3. Wooden Boards

Wooden boards as the medium of writing had been in use in India. These writing boards were then known as *'Palakhas'* which were used by the beginners for learning of the alphabets.

Example: Since the Buddhist age, we find the reference to it both in the *'Vinayapitika'* and the *'Jatakas'*. From the works of *'Lalitavistard'* we come to know that boards made of Sandal wood were also used like slates in schools. Dashakumara Charita, a Sanskrit fiction by Dandi refers to pieces of varnished wood that were used for writing love letters. The Bodlein Library at Oxford possesses Indian manuscripts written on such wooden boards.

The Technique of Writing: The thin sheets were coated with fine layer of wax and then matter is written on the smooth surface with ink or dye and finally the engraver incises the letters with sharp chisels.

4. Metals

Metals too were used as writing materials all over the world in different periods and also in the ancient India. The use of metals continued for many years due to its convenience and availability. The different metals were used for Royal orders, declarations, documents related to gifts, old scriptures like Jatakas, religious quotations, family records, etc. The metals used for writing include gold, silver, copper, brass. Bronze, lead, iron and tin.

Example: Family records were often engraved on gold sheets by rich businessmen. Lead plates / sheets were used for copying Bible and so on.

a. Gold

According to Burnell, Cunningham and other scholars, gold was rarely used for writing. It was used only for writing royal letters, and land grants. Gold plates were also used to scribe the family records of wealthy merchants, royal edicts, poetic verses and moral maxims. In medieval India, gold plates were used for recording similar documents of permanent value. Now-a-days manpatras are awarded on gold coated plates to honour prominent persons.

Example: On the gold plate, the Buddhist formula - Ye Dhannana Hetuparabhava was inscribed, which probably belongs to fourth or fifth century A.D.

The technique of writing: Gold plates are prepared and the letters are incised on them.

b. Silver

Silver as writing material in spite of being cheaper than Gold was used very rarely in the Ancient India. Some specimens of writing on silver plates have been preserved in Taxila.

Example: Silver plates were discovered at Bhattiprolu Stupas and Taxila. Other specimens are inscribed sacred verses like Risi-Mandala Yantra, Namokara Mantras, etc.

The Technique of writing: Silver plates are prepared and the letters are incised on them.

c. Copper

Ever since man discovered Copper in the ancient past to the present day, this has been, the most commonly used metal for inscribing documents of permanent value. These documents included title deeds, land grants, commentaries on the Vedas, the Upadesa Sastra, Vinaya Vibhasa Sastra, Abhidharmavibhasa Sastra, etc. Copper plates otherwise known as

Tamarapattras are awarded to honour the freedom fighters and other eminent persons who made remarkable contributions either to the literature, art or science. The inscribed copper plates were variously called viz., tamarapattras, tamarasasna, donapattra, etc., according to the contents of the inscriptions.

Example: Fa-hien and Hiuen Tsang who traveled through India in fourth century A.D. refers to the availability of copper plates. This is also supported by the copper manuscripts available at Tripati.

The Technique of Writing: The copper plates were prepared for inscribed by hammering the thick pieces of copper into various shapes and sizes and smoothen them. Then they were cut according to desired size. The expert writer wrote on the copper plate with ink in good hand and the artist or goldsmith incises the letters with a chisel.

d. Brass, Bronze, Iron and Tin

These metals were occasionally used in Ancient India as writing materials. Among them brass and bronze were popular; iron and tin were not used for writing purposes perhaps due to the fact that they were ordinarily subject to rusting and decay. Acidity of the environment is the main enemy of copper and bronze sheets.

Example: Brass plates are found in Jain Temples; Bronze was used in manufacturing temple bells and names of the donors and dates of donation were inscribed on them; Iron: Mahrauli Iron Pillar inscription situated near the Qutub Minar, New Delhi; Tin: one Buddhist Manuscripts inscribed on tin and it is available in the British Museum, London.

The technique of writing: The expert writer wrote on these materials with ink in good hand and the artist incises the letters with a chisel.

Perishable Materials

1. Papyrus

It is one of the earliest writing materials first used in Egypt in the third millennium B.C. up to the eleventh century A. D. It was cultivated in

abundance, in the delta of the Nile in Egypt. To prepare it as writing material, the stem was cut into longitudinal strips those from the center of the plant being the broadest and made it suitable for use. The strips were laid side by side to the required width, thus forming a layer across which another layer of short strips were laid at right angles. The two layers thus woven formed a sheet was then soaked in the water. The sheet was finally hammered and dried in the sun. Any roughness was leveled by polishing with ivory or a smooth shell. To form a roll several sheets were joined together with paste, not more than twenty sheets to a roll.

Example: Incidences of the reign of Emperor Ramases II is recorded on Papyrus. This roll is now preserved in the British Museum Library, London.

The technique of writing: The writing on papyrus was done with the help of soft brush. Normally carbon ink or ink made of iron salt was used for writing on this medium which gives a permanent writing.

2. Bark

In almost every corner of the world, in one time or the other, bark of various plants and trees were used by people as writing material. One of the most commonly used writing material in Ancient India was Bhurjapatra (Birch-bark) which grows in plenty in Himalayan region. The upper layer of the bark is brown in colour, while the inner layers are whitish and have paper like texture. This inner layers called Bhurja were used as writing medium. These are usually cut into 90 cm x 120 cm (3'x4') size for convenience of use. The middle portion of the bark (layer) was left unwritten and punched a hole in order to get a string passed through them. They were fastened to two wooden plates which were of the size of the bark (layer).

Example: The earliest manuscripts on Bhurjapatra are that of the 'Khorosthi Dhammapada' which was discovered in Khotan belongs to second or third century A.D. Another manuscript 'Samyuktagama' belongs to fourth century. They are available in the Libraries at Pun, London, Oxford, Berlin, Vienna and so on.

The technique of writing: The writing was done on the bark with very soft brush using carbon ink.

3. Palm leaves

Palm leaves (Tadapatra / Talapatra) were used as writing materials almost side by side with 'bhurjapatra' or barks in India and its adjoining countries. Use of palm leaves were very popular during seventh to twelfth century, mainly in Bengal, Bihar, Orissa and in South India, where palm trees grow in abundance. Palm leaves which were used in India can be broadly divided in three groups (a) Tal, (b) Sri Tal and (c) Palm Tal.

Palm leaves were first dried, then boiled or soaked in water, and make them smooth by rubbing stone or conch shell and cut them into desired sizes i.e., one to three feet in length and from one to four inches in breadth. The leaves of small length were punched on one side in the middle and those of considerable length on both sides in the middle. Strings were passed through the holes in order to keep the leaves together.

Example: Number of palm-leaf manuscripts are available in libraries such as Government Oriental Manuscript Library, Chennai, Saraswati Mahal Library, Thanjavur and so on.

The technique of writing: Writing is made on the Palm leaf with sharp metallic needle by scratching / inscribing. For convenience in reading carbon black (charcoal powder) mixed with oil is applied on its surface for legibility.

4. Ivory

Ivory was used a writing material due to its very smooth surface. But its high price and limited availability never allowed it to become a popular medium for writing. It is not possible to write on it with ink as the same cannot penetrate its surface.

Example : Royal edicts, miniature paintings etc.

The technique of writing: Writing on the ivory is done with fine and sharp chisels. It is easy to engrave on the ivory and it is almost permanent.

5. Animal Bones

In ancient times in some areas various animal bones were used as writing medium. But it was not a popular medium.

The technique of writing: Normally scripts, drawings were engraved on it, which were very stable.

6. Leather

The use of leather was not favoured in Ancient India though it was abundantly used in Europe for a variety of reasons. One of the most important reasons why it did not attract the attention of the India people was that there was plenty of natural writing materials such as stone, bhurjapatra (bark), tadapatra (palm leaf), metal and so on. Besides it was considered impure which did not suit the temperament of the authors of those days who considered literature as something sacred and religious.

Example: The Buddhist occasionally used leather among other writing materials. The only manuscript which was written in leather is Brhajinana-Kosha and it is available in the Jain Library at Jaisalmeer.

7. Parchment

Parchment was discovered by the king of Pergamum in the year 157-159 B.C. However, some texts mention that it was being used in 1500 B.C. But it was not used extensively until beginning of the Christian era. Parchment is thin, strong writing material made from goat or sheep skin. The parchment was prepared by splitting the skin in two layers. Flash side layer of the skin was used to convert into parchment if, it was found suitable. Foul, is a coarse type of parchment made from sheep skin. It was used for manuscripts and bindings of low quality.

Example: One book on parchment has been preserved in National Library, Calcutta in the rare book collection wing. There are many parchment manuscripts available in Tamil Nadu State Archives, Chennai.

8. Vellum

Vellum is prepared from skin of unborn or newly born calves. The skin is cleared off hair, meat, fat etc., and then treated with lime solution, carefully scrapped and polished. Vellum is comparatively more durable, better in quality and more costly than parchment and is used for preparing exclusive costly books / manuscripts.

9. Cloth

Cotton and silk cloth had been in use in India for writing purposes since ancient times. It was then called 'pata' or 'patika'. Writing was done on long sheet of cloth and later one sheet is joined with another and they are preserved in the form of rolls, keeping it in earthen or wooden containers with tightly closed lids.

Example: In Maharaja Jaipur Museum, several Tantric maps, palatial architectural designs on cotton have been preserved. Most of these belong to the period 17-18 A.D. A silk band containing a list of Jain Sutras written with ink was discovered by Buhler at Jaisalmeer.

The technique of writing: Writing was done on cloth with the help of brush using vegetable ink or dyes.

10. Paper

Like all objects of antiquity, paper has also fascinating and exciting story. The invention of paper has revolutionized the very thinking of human being throughout the worked and played a greater role in the development of human culture. Paper is reported to have been invented in China by Tasi-Lun about 105 A.D. Paper is made from rags or coniferous wood or bamboo. Yet paper can be quite a complex thing - especially with the many varieties of it available for various uses. However the ordinary paper is made up of a minimum of three materials - cellulose fibres which are the chief constituents, rosin or gelatin which is called the 'size' and an inorganic, inert material like kaolin called the 'filler'. The structure and properties of paper are essentially dependent on cellulose fibre. Cellulose is a constituent of all plant material, but cellulose for paper is derived from cotton, flax, esparto grass, straw, bamboo, bagasse, pinewood. Cotton contains the purest cellulose whereas the other materials contain lignin as well.

The qualities of the paper are (1) Permanence (2) Durability (3) Watermark.

In-spite of the later developments in the writing materials that led to various writing medias up to web media, still paper enjoys the fraternity and solidarity of information creators, producers and users.

Post-Paper Age

The post-paper age has witnessed with the advancement of technology, a variety of writing / information storage materials such as magnetic media, film media, electronic, optical and web media have been in use in the modern world. There are numerous types of materials are used to record information. Different form of materials are used for different types of recording like sound (audio), images (visual), microform and optical form.

1. Sound or Audio Recordings

a. Magnetic tapes

Magnetic tapes have revolutionized the sound recording in the modern world. Audio tapes have been used to record sound of any form both vocal and instrumental. The recording on audio tapes will be erased easily and they are reusable.

Example: Audio tapes (Spool), audio cassettes or cartridges

The technique of recording: The sound vibrations are registered by mechanical or electrical means so that the sound may be reproduced.

b. Gramophone Recordings

The Gramophone records were used mostly for recording the music. They are round in shape and made up solid material. They are manufactured in different speeds and played at that particular speed for clarity. They are of permanent nature.

Example: 33, 45, 60 rpm and LP's

The technique of recording: Microscopic grooves are made and through electrical etching the sound is recorded. This is reproduced through the help of gramophone needle or stylus.

c. Computer Floppies

Computer floppies are also used for storing information both textual and graphic. They are magnetic discs with a flap.

2. Images or Visual Recordings

There are three types of visual images viz., (a) Still images, (b) Moving images and (c) Images with sound.

a. Still Images

1. **Slide:** A small unit of transparent material containing an image, mounted in rigid format, usually 2" x2", and designed to view in a slide projector or slide viewer
2. **Film Strip:** A roll of film containing a succession of images designed to be viewed one at a time.
3. **Transparency:** A sheet or combined set of sheets of transparent material, carrying information, designed for use with OHP.
4. **Wall Chart:** A large sheet of information arranged in tabular or diagrammatic order, designed for public use.
5. **Flip Chart:** An integrated graphic presentation on separate sheets hinged together in easel format.
6. **Flash Card:** A card having words, numerals or pictures, designed for rapid location / identification, with or without an integrated sound track.
7. **Art Print:** A printed reproduction of a work of art: Eg. Painting, Drawing, Sculpture.
8. **Picture or Drawing:** A two dimensional drawings, paintings portrait, photographs or a print of any of these, produced on opaque backing.

b. Moving Images :

1. **Film:** Film bearing a sequence of images which create the illusion of motion when projected and carried on an open reel. The film sizes are 8mm, 16mm, 35 mm, 70 mm, and and so on.
2. **Film Loop:** An endless loop of motion picture film usually contained in a cassette.
3. **Film Cartridge:** A length of motion picture film contained in a cartridge.

4. Video Tape: Magnetic tape carrying a series of TV images recorded magnetically, electronically or holographically [bears integral sound track].

c. Images with Sound

1. A recording of moving visual images may carry an integral sound track. For example: Sound Film.
2. A set of slides or a film strip, may be accompanied by an associated sound recording on a gramophone record or more usually a tape (referred to as tape-slide).

3. Microforms

Microforms means variety of information materials are reproduced in a miniature form of printed or other graphic matters which cannot be utilized without magnification. They are:

a. Microfilm: A length of film bearing number of micro-images in linear array. It contains both textual or graphic information. The film length is about 100 mts which can hold around 1000 frames. The microfilm size is 8 mm, 16 mm and 35 mm.

b. Microfiche: A sheet of film bearing number of micro images in a two-dimensional array. It is highly convenient for distribution of information.

c. Aperture card: A card with an opening within which a single microfilm frame is mounted.

4. Optical forms

Optical forms are very popular forms used for storing information in the modern world. They are CDs, VCDs, DVDs, Replicable Discs, Individual Discs, Laser Cards and Optical Tapes and so on.

a. Compact Discs (CD)

Compact Discs are made up of tough plastic substance material called Polycarbonate. The thickness is 1.2 mm and made as per ISO 9660 standard. Its diameter is 120 mm and a hold of 15 mm at the center. Laser beam is used for both recording and reading data from the CD. It can used

by using computer and an appropriate software. Each disc can store 600 MB of information and storage is possible on only one side.

CDs can be of many types and used for different types of purposes.

CD-ROM	: Compact Disc Read Only Memory
CD-AUDIO	: Compact Disc Audio
CD-I	: Compact Disc-Images
CD-V	: Compact Disc-Video

b. Digital Versatile Discs (DVD)

DVDs have large capacity than CD, with at least 7 times the storage capacity of CD-ROM (4.7 to 17 GB). It is similar to CD-ROM in look and dimension. They are available in different formats like: DVD-ROM, DVD-Video, DVD-Audio, DVD-R , DVD-RAM

5. Web Resources

In the 20th century, the world has experienced two revolutions viz., the industrial revolution and the information (technology) revolution due to evolutionary changes in the field of Information Technology. Information has been identified as one of the vital resources needed for the success in almost every major human endeavour. Collection, organization and dissemination of information system with economy and efficiency depend on the skills and expertise of the Librarians.

The web media has taken a lead in the storage of information comprising of text, graphic, images, full text journals, databases etc. and facilitates for the easy retrieval. Types of Web Resources:

a. Open Web - Any thing online that can be found freely with a Search Engine

b. Gated Web - Online Resources accessible by **Subscription** E.g., OED, CA, LISA, BIOSIS etc.

c. Invisible Web - Databases that are not found by Search Engines and can only be accessible through a particular page or front end.

Conclusion

The early writing materials, later the popular material paper and the latest optical materials all have one and same purpose that is to store human thought content. At different stages of human history, man has used available writing materials and preserved the information for the future generations. Nothing is static and everything is dynamic. Therefore the information materials have evolved from Stone Age period to the Web Age. The present century might even witness another dimension.

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CONCEPTS OF PRESERVATION, CONSERVATION AND RESTORATION

*V. Jeyaraj**

Introduction

Information materials are many in media and varieties. What ever may be the information materials, they should be preserved, if affected they should be conserved and if necessary they may be restored. From time memorial man used various media for writing. Rock, terracotta, natural materials such as parts of plants and trees, leather and parchment and manmade materials like cloths of jute, cotton, and silk are a few writing materials to mention here. The ancients preserved the written materials using the known methods at that time, which they learnt by experience. For the preservation of natural written materials, they used natural materials. But today we have a plenty of natural materials as written materials, which call our attention to take care. We have to understand the material science, the factors of deterioration, the preventive measures, conservation and restoration methods so that these ancient records and writings in our possession may be preserved for posterity.

Now-a-days, institutions like museums, archives, libraries take care of the valuable information materials. Museums are institutions, which preserve the hoary and glorious past through the original materials for posterity besides making the visitors to understand them and enjoy the past through the material evidence. Archives are places for keeping the public or government records. Library is a room of building for a collection of books kept there for reading. All these institutions have to take care of the possessions. Those persons in-charge of the collections should be educated to take care of the information materials. This needs the basic knowledge on the preventive conservation of the materials.

Preservation of Information Materials

Preservation is keeping the materials safe from harm or danger. The information materials need to be preserved safely from any harm or damage or from the environment of the materials. There are various methods of preservation of information materials. In the preservation of the

information materials the important factor is to preserve the information in the materials. There are many methods of preservation. They are Reprography, Photography, Microfiche, Microfilming, Digitizing etc.

Reprography is nothing but reproducing the same. Reprography is the combination of two Latin words and one Greek word. 'Re' means again (Latin); 'Pro' means in place of (Latin); and 'graphy' means writing (Greek). Reprography deals with the technique of making the copies of original documents. Reprography is necessary in the case of documents to make copies for preserving the originals. The records are preserved by photographing, microfilming, through microfiche or by digitizing.

Conservation of Information Materials

In fact conservation of information materials means remedial measures to be taken to eradicate the defects already present in the objects and protecting them from further damage by maintaining certain conditions for their better preservation. To remedy the defects present in an object and to remove the unwanted materials, one has to examine the object, diagnose the defect, documenting its condition and the type of treatment needed and then treat it. The custodians should know therefore the properties of the objects, their chemical behaviour and the effects of environment and other causes of deterioration.

The objects are better preserved when custodians, conservators, designers and administrators co-ordinate. In India most of the museums are headed by a curator who may be a specialist in a particular subject. Very few museums, archives, libraries etc., have the conservation facilities with them. Proper house keeping will help the information materials to be in a good environment. If the custodians are aware of the dangers involved and precautionary measures to be taken against them, they can preserve them better. They should know the deteriorating factors, the symptoms of deterioration, methods of handling the objects, display techniques, storage principles, packing devices, transportation, safety measures, vandalism, neglect etc., for better maintenance of his collections.

All forms of direct and indirect actions aimed at increasing the life expectancy of (an) undamaged and or damaged element(s) of cultural property is termed as conservation.

There are three types of work in the museum. They are:

1. Preventive Conservation
2. Curative Conservation
3. Restoration

1. Preventive Conservation

All forms of indirect actions aimed at increasing the life expectancy of (an) undamaged and or damaged element(s) of cultural property is termed as preventive conservation. All the collection in a museum, archives or a library are sound, stable and some are damaged. What ever may be the condition of the objects preventive conservation is essential. A team of people in a museum, archives and library may do this.

2. Curative Conservation

All forms of direct actions aimed at increasing the life expectancy of (an) undamaged and or damaged element(s) of cultural property is termed as curative conservation. In a museum, archive or a library about 2% of the collection may be in need of curative conservation. When a unique piece is actively damaged, it needs curative conservation. It is an urgent and vital process to be carried out by a trained conservator.

3. Restoration

All forms of direct actions aimed at enhancing the message(s) carried out by (an) damaged element(s) of cultural property are termed as restoration. About 10% of the objects in the collection of a museum are in a damaged condition. The priority of the treatment is secondary. A trained conservator-restorer may do Restoration. Some objects are in need of only Conservation. Some objects are only in need of restoration. There are objects, which are in need of conservation and restoration.

The sources of the information materials are varied. The information materials may come through purchase, gifts, transfer etc. Once the information materials were taken care off by their own environment/ owners. When they are brought to the museums, a very few members of staff manage a large number of information materials. The aggression due

to nature and human beings is high. In order to control the deterioration of the information materials,

1. We must be aware of the factors of deterioration or dangers;
2. The personnel of museums, archives and libraries should be competent to handle the problems; and
3. The conservators-restorers and the staff of museums, archives and libraries should be good communicators.

The message from a n information material should be communicated to the onlookers and also should be protected.

The Curators, Archivists or the Librarians or the staff concerned of the collections in a museum, archives or libraries are not much aware of the damaging factors of the information materials. There are a very few cases, where information materials are miraculously protected without the help of any direct or indirect action. If the Curators, Archivists or Librarians discuss the problems with the Conservators, most of the information materials and manuscripts will be better preserved. In order to increase the life of an object, one must know the life history of the object.

The physical integrity of the object is 100% at the time of its creation. The time taken to completely disappear is called the life expectancy. For example a palm-leaf manuscript at the time of its making has 100% physical integrity. When it completely decays, there is no core but the form of the object is maintained. Even though there is deterioration, the life expectancy is maintained further.

By the application of these acts, the life expectancy may be improved, reduced or will reduce at the rate at which it originally deteriorates.

Aggressions of Information Materials

The aggressions or the deteriorating factors of an information material can be natural or man made. They may be by the environment, building and staff. The natural aggressions may be lead to immediate destruction or progressive destruction.

Immediate Destruction

Immediate destruction to the information material may be brought about overnight by flood, fire, earthquake etc.

Progressive Destruction

Progressive destruction is also natural one. This is brought about by environmental pollution due to air, dust, moisture, heat, light, micro organisms, wind, salt and intrinsic factors like chemical changes with in the material, physical changes etc.

The man made aggressions are classified as public aggression and professional aggressions.

Public Aggression

The public aggression is mostly due to unawareness. They are such as vandalism, theft, war and terrorism, misusing the information materials.

Professional Aggression

The aggression due to the professional mishandling of the information materials is called professional aggression. This is due to the lack of awareness, planning, training, security, control and improper execution of curative conservation, restoration or, transport, storage, exhibition, support, lighting, handling, maintenance etc.

Strategy for Conservation

For better conservation of the information materials, a systematic strategy is to be adopted. There are seven steps for the conservation measures to be taken. They are:

1. Know the information materials
2. Categorise and identify the aggressors
3. Avoid the aggressors
4. Block the aggressors
5. Check or monitor the aggressors
6. React against the aggressors
7. Communicate.

Restoration of Information Materials

Restoration may be done by many ways. They are lamination by chiffon, lamination by cellulose acetate, lamination by tissue paper, etc. There are methods of encapsulation. There are also methods such as leaf casting. These are the methods, which can be adapted to paper manuscripts.

The broken palm-leaf manuscripts should be restored. The restoration can be done in many ways. Because of the cleaning process or natural means the letters become illegible. Therefore, the inscribed portions should be rubbed with *kadukkai* essence, *kovai plant leaves* or lampblack in oil. Then the mending is done. The torn portions are cut to the required size keeping similar uninscribed leaf underneath with a knife. The affected portions are now pasted at the edges with he cut leaves. At times lamination by chiffon using *maida* flour paste is done. Lamination by cellulose acetate foil and acetone is also is done but the edges are trimmed so that the leaves may breathe. Joining of the torn portions or breakage may be repaired by using polyvinyl acetate in toluene or Paraloid B72.

Conclusion

The concepts of preservation, conservation and restoration should be well known by the Curators, Archivists or Librarians to safeguard the information materials or other wise information materials such as book materials, records, manuscripts and non-book materials cannot be safeguarded for posterity. Many thousands of books, manuscripts, non-book materials are being lost every day. Therefore, it is the duty of the personnel in charge of the information materials to safeguard them from all enemies of the information materials. Methods of conservation/restoration should be well understood before the information materials are restored. All materials used in conservation, restoration etc., should be harmless, reversible and friendly with the environment. Natural materials may be preferred rather than chemicals in all these aspects. Any doubts should be clarified with experts in the field.

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CONSERVATION OF INFORMATION MATERIALS : FACTORS OF DETERIORATION

*B.V. Kharbade**

Introduction

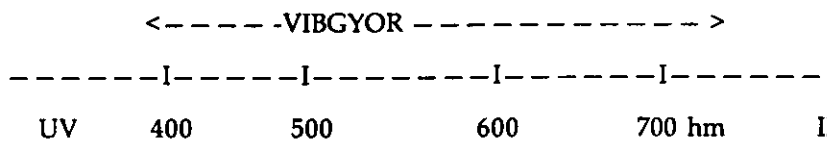
The environment means a surrounding, external conditions influencing the objects of cultural and historical importance. The factors of the environment, which affect the objects, are light, heat, humidity and air pollutants. The damaging effects of these on the manuscripts and information materials and what to do to minimize this damage are dealt in this paper at greater details. Since this paper is intended for librarians, conservators, curators, media managers other in-charges of the collections and students and trainees related to library and information materials, most of the difficult scientific terms and formulae have been avoided but some whereever necessary are kept but tried to explain in simple form.

Light

Paper, palm-leaf and birch bark manuscripts are subject to damage by light. Yellowing of paper is mainly attributed to light. Light is main factor of color fading of the illustrated and illuminated manuscripts. The miniatures and water colors get badly damaged by light only. Therefore, there is need to study what is light, its sources and how to protect the manuscripts from such damage.

Light is a kind of energy, which receives naturally from the sun or from artificial sources of light. As per Newton law, energy neither be created nor destroyed but it changes from one form to other. One can not see the object if light is eliminated, so it becomes a necessary evil. It is then necessary to make oneself conversant with the quantity and quality of the light suitable for the museum objects to keep their deterioration at the minimum. The spectrum of museum light sources (daylight, fluorescence and tungsten lamps, etc.) can be divided into three regions by wavelength; ultraviolet radiation (330-400 hm), light or visible radiation (400-760 hm) and infrared radiation (beyond 760 hm). UV radiation contains high energy and are most potent for damaging manuscripts, therefore, as far as possible this radiation should be removed from the light sources .Similarly Infrared are

heat radiation and damaging. We are now left with only visible part of the light spectrum and artificial light sources emitting good visible light should be selected for exhibiting the manuscripts.



Visible and invisible radiations

Presently there are three types of light sources suitable for general lighting in museums: tungsten, fluorescent and meal halide lamps. The tungsten lamps give out light from a coil of tungsten wire heated electrically. The tungsten-iodide lamp is a variation designed for higher efficiency. Fluorescent lamps emit light both from mercury vapour and from fluorescent powders. Some fluorescent lamp are good at colour rendering .Metal-halide lamps are mercury lamps modified with additions which give some of them good colour rendering . The maximum illuminance levels shows in Table 1, are now recommended by number of international bodies on conservation such as ICOM, ICCROM etc. To achieve these levels, there is a need to deal with UV and visible radiations as both causes deterioration of museum objects.

Control of UV Radiation

To control the UV, it is necessary to measure its content in visible radiation. The measure of UV is microwatt per lumen and UV monitor manufactured by Littlemore Scientific Co., Oxford, U.K., is used for measuring the UV. Daylight is known to contain high UV than fluorescent tube and tungsten bulb. To remove UV from daylight, it is passed through a material transparent to visible light and opaque to UV. Now a days, UV absorbing plastic filters are commercial available. The filter must be extended completely across windows, skylights or light fittings so that all light passes through them are free of UV. It is mentioned that most fluorescent lamps, tubes also emit worrying amount of UV though less strongly than daylight. Some of the diffusing plastics used in fluorescent lamp fittings act as UV filters but that must be tested by UV monitor.

Control of Visible radiation

We cannot eliminate visible radiation as UV because we would then left in darkness. We have to accept that certain amount of damage is caused by the very act of display. We have to balance by judgment, rather than by scientific formula, two incommensurables - the amount of light needed for looking at exhibits against the damage which it causes. Visible radiations can be controlled by the following:

1. Reducing illuminance: The sources of light should be selected as per the recommended level for the manuscripts i.e. 50 lux .a very low level and can be achieved by using only artificial light. Light source may be arranged to achieve 50 lux illuminance and extra light should be removed.

2. Treatment of windows: Cover the windows with thick dark colored curtain. The sun facing windows may be painted with dark paint containing UV absorbing chemical.

3. Proper positioning of artificial light sources: Illuminance can be controlled by positioning light source away from the object and using the diffracted light.

4. Reducing time of exposure: Gallery may be illuminated whenever there is visitors by that way objects can be prevented from light. Time switch adjusted with required time duration may be fitted in each gallery.

5. Arranging exhibition room's illumination wise , from higher to lower range.

If the visitor taken from high illuminated to low one, he may land in total darkness because human eyes take some time to adjust with such situation. Therefore, if visitor coming from direct sunlight then he may be allowed spent sometime in the visitor area before taking him to gallery. Lay out of the gallery may be made like that visitor will pass through higher illuminance to lower one.

Table 1. Recommended Maximum Luminance

Exhibit	Maximum Illumination
Oil and tempera painting, undyed leather, horn , bone and ivory, oriental lacquer	200 lux
Objects especially sensitive to light, such as textiles, costumes, miniatures, paintings in distemper media, wallpapers, dyed leather, most natural history exhibits, including botanical specimens, fur and feathers	50 lux
Objects insensitive to light e.g. metal, stone, glass, ceramics, jewellery, enamel and the objects in which colour change is not of high importance e.g. wood.	300 lux

Humidity

Humidity relates to presence of water vapour in the air which is essential for living as well as non living objects. Since plants and animals contain a great amount of water, it is not surprising that products made from them also need moisture to keep them in natural shape and size. Humidity effects the objects if it is very high and low, therefore its balance is required to be maintained for preserving the objects. To control the humidity, it is necessary to know about what humidity is and how it will be measured and maintain to its tolerable limit which are dealt here.

What is Humidity

It scale for measuring humidity obviously would be the amount of water contained in a given volume of air, say 10 gram per cubic meter. Hot air with $10g/m^3$ of water vapour will cause dangerous drying, whereas cold air with the same content can be so damp that the moisture condenses from it. This is because hot air has greater capacity for water than cold air. Thus this scale is called as the absolute humidity of the air, will not do for measurement of humidity. We need something that is more or less independent of temperature.

In most practical measurement, we say that if wood swells that mean that the air has got damper and vice versa. If we manage to control the air so

that the wood stays the same size we have solved the humidity control problem. We have here in fact used the scale of Relative humidity, which is what we need. This RH scale usually expressed as a percentage and it can be defined as follows:

$$RH = \frac{\text{Amount of water in a given quantity of air}}{\text{Maximum amount of water which the air can hold at that temperature}} \times 100\%$$

Air at 100 % RH is holding all the water it can, and it said to be saturated. Saturated air at 10 °C holds about $10g/m^3$ moisture, at 20 °C about $17g/m^3$ and at 30 °C over $30g/m^3$. The RH is a measure of percentage saturation of the air.

Humidity Measuring Instruments

Recording form of thermo-hygrometer is commonly sighted instrument in museums. But it is only half an instrument because it can easily slip out of calibration either through a jolt or by slow drift, so that it readings are no longer true. It becomes full equipment when other form of hygrometer whose readings van be relied on. Until recently the hygrometer for calibration has always been one of the wet-and-dry bulb instrument.

The Wet and Dry Bulb Hygrometer

It is simplest, most inexpensive type, also called as the sling or whirling hygrometer, some times called the sling psychrometer. It consists of two ordinary thermometers. The dry bulb is unmodified, and simply reads the air temperature. The wet bulb thermometer is a fabric sleeve or wick fitted over the mercury bulb. This must be kept wet with distilled water. In using the sling hygrometer, these points should be kept in mind:

1. Use distilled water only for the wick. Keep it clean and change when necessary.

2. Sling well away from the body and walk slowly round room.

3. Keep hands and breathe away from thermometer bulbs.

4. Keep strong light away from the bulbs.

5. Ensure that the wet bulb does not dry out.

6. The wet bulb temperature falls during slinging. Its true value is not reach until successive readings agree.

7. Read wet bulb quickly, before it starts to rise.

8. Read to ¼ 0c as far as possible.

Electronic and Non-mechanical Hygrometers

It is safest to regard all electronic instruments as wrong unless recently checked. There is one instrument which is simple and handy: the Nova Sina Mik 3000, manufactured by Nova Sina AG, Zurich, marketed in India by Switzer Instrument Ltd, 127, Sidco Estate, Madras. This is a hand-held instrument which measures both humidity and temperature. It has got sensor - check; cap which, when fitted over the sensor, provides it with a standard humidity, say 55%. If the instrument then reads incorrectly an adjustment can be to a recessed screw.

Humidity indicating cards consist of a series of patches impregnated with cobalt chloride. Each patch is labeled with an RH 10% step. Their color ranges from pink at the dry end to blue at the 100% end. The RH is read at he point pf change between pink and blue, or there may be a lilac patch in between. Getting the right patch or a step between two patches gives us an accuracy of 5% at best. The cards are cheap enough to be distributed in show cases, and accurate enough to serve as warning device.

Response of Museum Material to RH

There are three different modes of deterioration that are influenced by RH.

1. Change in size and shape
2. Chemical reaction.
3. Biodeterioration.

One could say these are the physical, chemical and biological modes.

1. Change is Size and Shape

All moisture-absorbent materials, such as wood, bone, ivory, parchment,

leather, textiles, basketry and matting, and adhesives, swell when the RH rises and shrink when it falls causing warping, dislocation between parts, splitting breaking of fibres, etc., especially at low RH. A bulky object will respond to a new RH very slowly from the outside inwards, so that a man-sized wooden sculpture might take two or three months to complete its response to a large change, while a sheet of paper will respond in minute.

One of the most sensitive examples is a panel painting, the paint on the picture side acts as a barrier for moisture. When the RH falls, the moisture starts releasing from the back of the panel thereby causes permanent convex warp.

The effect is of wide occurrence in wood constructions. A glue-sized canvas painting in damp conditions animal glue will always expand but the canvas thread may contract.

2. Chemical Reaction

Two quite different classes of chemical reaction are favoured by high humidity: (a) the corrosion of metals, and (b) the fading of dyes and the weakening of paper and textiles. Certain less common reactions of museum material are also known for e.g. weeping of glass and other materials.

3. Biodeterioration

We have noted that mould growth can be prevented by keeping the RH below 70%. Bacteria require even higher humidities. Most insect pests flourish at higher humidities. Very low humidities would be preventive but impracticable. We must therefore conclude that insect damage may be discouraged but cannot be prevented by humidity control.

Humidity Control

The only complete answer to humidity control is air-conditioning of both exhibition and store rooms, and this is important because air-conditioning will also remove dirt and gaseous pollution from the air.

But there are many situations where air conditioning cannot be the answer, at least for the present, most likely because of cost, but also in many cases because something has to be done quickly. For these situations we now investigate room humidity controllers.

RH Control in a Room

Packaged air-conditioning unit is a good choice in controlling temperature but humidity to certain extent . If the room has high humidity, then there is a need to install dehumidifier and in low humidity, humidifier has to be used. Both these instruments should have humidity regulating device called as humidistat. Two types of humidifiers are available: 1. atomizing type, 2. Evaporative type. Evaporative type will be suitable for museum room. Similarly, two types of dehumidifiers are also there: 1. Desiccant, 2. Refrigerant . Desiccant type of dehumidifier may be preferred for museum use.

RH Control in a Closed Case

There are two distinct non-mechanical ways of reducing RH changes in a closed container. The first is by using a buffer and the second is by using certain salts or salt solutions.

Silica gel, first suggested by Toishi and later advocated by Stolow, especially for the severe climate of Canada is a good buffer. It behaves like wood with regard to moisture. If it is a very dry condition it will take moisture out of the atmosphere, and if it is very moist it will do the reverse. It is a better buffer than wood because it does all this faster, has a larger water reservoir and it chemically inert and non-flammable. Two types of silica gel, one with indicator and without indicator. To use silica gel without indicator, it should be heated to between 110 and 250 0c, whereas indicator type changes colour from blue to pink on moisture absorption. Its drying capacity becomes exhausted during subsequent use. Silica gel with indicator is good to use in museums.

The obvious question will be how much quantity should be used. This depends upon the type of the cases . Closed cases require less quantity than the open type like exhibition case. 1 kg silica gel /m^3 in pouches

for cases used in transporting the art objects and 20kg /m^3, laying in a perforated chamber in between stand and exhibiting area of the case.

Air Pollution

The problem of solid dirt in the air of cities and acid vapors which belched out of furnaces with the smoke is not new, but the automobile has produced a distinctly modern form of pollution known as the oxidant type. The major source of air pollution is burning of fuel. To deal with air pollution we must be able to measure it, and it is simplest to adopt a universal system applicable to both solids and gases. We therefore measure the concentration of a pollutant by finding weight of it in a given volume of air. The unit commonly used is micrograms of pollutant per cubic metre of air.

There are two main categories of pollutants:

1. Particulates

Particulates are the solid particles suspended in the air. The sizes of particulates are conveniently scaled by quoting diameters in microns, abbreviated as um, 1 thousandth of a millimeter. Particles larger than: 15 or 20 microns settle near their source of origin or at worst on window sills. Particles smaller than this remain suspended until trapped on some surface. Since the particulates produced outside the building arise largely from the burning of fuels in power stations, and from vehicles and heaters there us a lot of sooty and tarry material in them. They are also usually acid from adsorbed sulphur dioxide and often contain traces of metals such as iron which can catalyse deterioration.

Inside the museum the furnishings and human occupants provide a quota of textile fibres and fragments of skin. These may be chemically harmless but are biologically attractive as food sources.

Particulate concentrations in all the major cities of India are alarmingly high. Museums situated in cities need to take measures to keep the level of particulates inside the galleries at a tolerable limit or best choice would be absolutely free from particulates.

The control of particulates is a very expensive job. It requires air conditioning system with high efficiency filters which could remove the particulates up to .01 um.

2. Gaseous Pollution

Three main pollutant gases everywhere in the industrialized world are sulphur dioxide, nitrogen dioxide and ozone. The main source of sulphur dioxide is burning of fossil fuels (coal, coal gas, petroleum, oil and natural gas). When the fuel is burnt the sulphur combines with oxygen in the air to form sulphur dioxide which readily combine with oxygen to form sulphur trioxide. As soon as this is formed it immediately combines with the ever-present water molecules to form sulphuric acid which is a very strong and corrosive chemical.

Calcium carbonate materials, chalk, lime stone, marble, frescoes, alkaline sandstones, are badly affected by sulphur pollutants. All cellulose, whether paper, cotton or linen, is attacked by sulphur dioxide. Light and UV radiation increases the damage. Poor quality paper deteriorates more quickly than rag paper, as it contains more acid materials introduced during manufacture and absorbs gaseous pollution more strongly because of the lignin also present. Many other materials silk, iron, steel, leather, parchment and wool, bronze alloys, synthetic rubbers, dyes and textiles may be affected.

3. Pollution through Storage Conditions

Hydrogen sulphide, and formic, acetic and hydrochloric acids may be introduced in to the air surrounding the exhibit by incorrect storage. Some woods emit organic acids. Polyvinyl acetate emulsions may also give out acetic acid but not polyvinyl solution. Lead objects affect very badly by these organic vapours. Unusual tarnishing of silver is suspected to be the materials of the case. Volatile sulphides are the enemy which may be given off by rubbers, composite boards, and even by textiles. The following table gives the list of the harmful and safe materials:

Table - List of harmful and safe materials for museum use

Wood (some types)	-	Organic acids
Protein based glues, wool, vulcanized rubber	-	volatile sulphides
Cellulose nitrate	-	oxide of nitrogen
Polyvinyl chloride	-	hydrochloric acid

Safe materials

Metal, glass, ceramic, inorganic pigment,

Polyethylene, polypropylene, acrylic, polycarbonate and

Polystyrene sheet, acrylic solutions, polyester fibres, cotton and linen.

Based on research findings.

APPENDIX-1

Museum Environmental Specifications

CLASS 1

LIGHT

Limitation of illuminance

Moderately sensitive materials (e.g. oil paintings)	200 plus minus 50 lux
Daylight or artificial light at alternatively an annual exposure of not more than	650 kilolux-h
Sensitive material (e.g. textiles); Artificial light at	50 lux
Alternatively an annual exposure of not more than	200 kilolux-h

Picture galleries ; highest to lowest illuminance over the whole picture-hanging area to be within a 2: 1 ratio.

Restoration	2000 lux
Photography and television: tungsten lamps	1000 lux
Metal-halide lamps	2500 lux
Flash exposure	f22 ad 100ASA (20lux-min)
Colour rendering of museum light source	Ra about 90 or better Worst R about 80 or better Crawford Class A, B, or C

UV RADIATION

Proportion of UV in the light source (UV content) not to exceed 75uW/lm

RELATIVE HUMIDITY	
Day and night throughout the year	50 or 55 + - 5 %RH
TEMPERATURE	
Winter	19 ± 1 0c
Summer	24 ± 1 0c
AIR POLLUTION	
Particulates removed to	80% efficiency on Eurovent 4/5
Sulphur dioxide and nitrogen dioxide each removed to	below 10 $\mu g/m^3$
Ozonw to	below 2 $\mu g/m^3$
Air flow rate : ceiling height under 3m	8 air changes /h
Under 4-5 m	6
Under 6-8 m	4
Noise	NR35

CLASS 2

Light

Moderately sensitive materials: Absolutely no direct sunlight

Sensitive material : As for class 1

UV radiation : As for class 1

Relative humidity : to be kept with in the danger limit 40% and 70%.

Temperature : should be reasonably constant to stabilize RH.

Air pollution : special areas and cases can be kept free of air pollution.

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PREVENTIVE CONSERVATION : LIBRARY MATERIALS

*-P.Perumal**

Human experience and knowledge are the base for the development of culture and Civilization. In early dates face-to-face communication was done through body gestures, symbols and sounds. Later it was systematically developed as language. Necessity arouse to record human experience and knowledge for the benefit of others and future generation. At first, the material used for writing was rock. The Cultural developments are the reason for urge to write and lead to search new writing materials, such as clay tablets, metal sheets, wooden planks, barks and leaves of trees, papyrus, leather, parchment, vellum, cloth and paper. After invention of paper it replaced all other writing materials.

Except few libraries, all others have paper based reading materials in the form of manuscripts, books, periodicals, prints, maps etc., the paper based Library materials are organic nature, which are subject to deterioration by some living organisms, Atmospheric change and other factors of deterioration. The art of preservation is not new. It was known from the inception of writing materials. In ancient days people used some indigenous materials for preservation. The development of science and Technology pave the way for better conservation techniques for the library materials and other cultural properties.

1. Preventive Conservation

Conservation is a concept, which includes two aspects viz., Preventive Conservation and Curative Conservation. Preventive Conservation means any action taken to prevent or stop or retard deterioration. Curative Conservation means any action taken to treat objects for the purpose of correcting any alterations they have undergone. It is obvious that Preventive Conservation makes an attempt to maintain the object in a physical and chemical condition. It is therefore an unending process. For better conservation we should know basic constituents of the Library materials, its Character, method of preparation, factors of deterioration, proper storage preservation and restoration techniques. So Librarians and other books

lovers should have the knowledge of paper and factors of deterioration for proper preservation.

2. Paper

Paper is a basic thing for Library Materials. The Art of papermaking was invented by China in 105 AD and which did Moguls spread in India during 12th and 13th century. Paper is being made from plant fibers. According to the fibers used, the paper can be classified as.

1. Cotton group- Cotton, rags etc.,
2. Grass group- rice straw, bamboo, sugarcane etc.,
3. Bast or Rope group- hemp, Jute and mulberry etc.,
4. Wood pulp group

Paper technology was started with tedious hard process. Since the invention of hand made paper, the paper technology has attained a great development. Using modern techniques is producing now-a-days different types of papers.

Paper is formed with the mating and felting of fibers. To make fiber bonds some sizing materials like alum or Rosin or Starch are used. The fiber bond and lock gives strength and flexibility to paper. Paper is a hygroscope material, which absorbs moisture. Because of this property, paper fibers easily accept inks, dyes and pigments. Loading materials like Titanium oxide, Calcium Carbonate, Calcium Powder and other fillers can reduce the absorbency of a sheet of paper. Paper expands when it is moistened and contracts when it is dried. Paper comprises not only cellulose fibers but also other impurities like resin, lignin, and residue of Bleaching chemicals, sizing materials and loading materials. So the raw materials and composition of impurities play a predominant role in the permanence of paper.

Before invention of printing machine, human knowledge and thoughts were recorded through handwriting. These hand written materials are called as manuscript. In early day's pen made up of wood, bamboo, quill of vulture or goose was used to write on paper. There were two type of Inks

used for writing such as Black Ink or Indian Ink, which was prepared by mixing of the lamp shoot of caster oil mixed with gum acacia and required amount of rain water. The other one is Iron Gall Ink, which is permanent nature. The Iron Gall Ink was prepared with the mixture of Gall powder, Iron Sulphate, Gum acacia and rainwater.

3. Books

Unlike the hand written records, the books are complex nature, which consists of straw board, calico, or leather, cloth, thread, paste etc., Tropical countries like India need much care and steps to preserve the Library materials from various factors of deterioration.

4. FACTORS OF DETERIORATION

Deterioration is a change of original state by interaction between the object and factors of destruction. Generally Library materials are considered to be susceptible to deterioration by the following factors such as

1. Physical factors like light, heat, moisture, water and fire.
2. Biological factors: Fungus, Insects and Rodents.
3. Chemical factors: Acidity, Pollution, Atmospheric gases and dust.
4. Human factors.

4.1.CAUSES BY PHYSICAL FACTORS:

a. Light

It can be broadly classified into natural light and artificial light. The Natural light consists of cosmic rays, gama rays, X-rays, Ultra Violet rays, infra red rays, visible light rays etc. The ultra violet rays coming directly from the sun and other sources affect the cellulose bond of the paper. It makes the paper brittleness and discoloration. The colours of pictures, photographs, and writing ink are also faded and darkened by the Ultra violet rays. Light not only affects the paper directly, but also indirectly it activates the chemical deterioration.

b. Heat

Generally all materials have 15% moisture content. It gives flexibility and strength to cellulose bond of the paper. If the temperature increased more than 40°C causes evaporation of moisture in the paper, which leads to dryness, brittleness in paper and alters the physical size of the paper. Heat also affects the binding materials and dried out adhesives.

c. Humidity

It is he amount of moisture in the atmospheric air. Humidity should be constant in the stack room. Because of the absorbency property, the paper absorbs more moisture when humidity increases. By absorbing moisture it expands which causes the strength of the paper. The increase of humidity accelerate bio deterioration, weakens the adhesives and sizing materials. It also makes to stick the paper one another. So the relative humidity to the stock should be 50 % to 60% R.H.

d. Water and Fire

Destruction caused by water and fire is not common but accidental. Fire not only damages the Books and manuscripts, but also the whole stack room. Water both in liquid form and as a vapour form accelerate chemical process of deterioration, which affects the cellulose, bonds of the paper and loss its strength. It may be wrapped when it dries. The sizing and loading materials may be affected by water. The inks used for writing and drawing is also affected.

4.2. CAUSES BY BIOLOGICAL FACTORS

Deterioration brought by biological agents is generally referred as " Bio deterioration". The problem of bio deterioration is a matter of considerable significance of tropical-humid climate. The Climate conditions accelerate the growth and multiplication of living organisms. The common biological agents for deterioration of papers are fungus, insects and rodents.

a. Fungus

Fungus is a group of vegetable organisms and more than a hundred variations of fungi attack paper and paper materials. Fungus is gray to dark brown in colour. Cellulose provide as a good medium of fungus

growth. High humidity is helpful for the growth of fungus. It germinates spores on paper and other reading materials, which makes black and brown stains on paper. The enzymes and mend the sheets one another. Which also affect the physical strength of he paper and fiber bonds.

b. Insects

The most common insects, which attack library materials, are silver fish, book lice, cockroaches, termites, bookworm, beetles, crickets etc. Accumulation of dust with moisture is the basic reason for formation of insects.

i. Silver Fish

Silver fish is silvery carrot shapes insect, also called as silver moth or sugar moth commonly seen in walls, back of calendar book stack etc., The adult is wing less. Silver fish is a surface feeder. The mouthparts are adopted for biting. Silver fish generally affects the edges and it eats binding materials, glue, and gelatin in the photos and makes irregular patches.

ii. Cockroaches

They are common in all over the world, which are in Brown, in Black colour. Old Books, bookbinding and other paper materials are good food for cockroaches. Generally they attack the edges and spine of the book materials. They usually active in damp and dark place and hide away in light.

iii. Book Lice

It is a small tiny white or grey colour insect. Mostly they come to eat the fungus formed in between the edges of inner cover. There will not be many problems by this but presence of large number will affect the books.

iv. Book Worms

The bookworms are gastrallus indicus, which are the larva of 300 spices of insects. The larva is about 3 to 4 mm long and has white semi cylindrical crescent shaped body with thorax to swallow. Deterioration by bookworms to archival materials has seen throughout the world. The bookworm eats the cellulose fibres and binding materials. Generally they travel from the

surface to down the bulk of the volume and cause damage in the form of pinholes of 1 to 1.5 mm in width running in all directions. The enzymes produced by the larva stick the paper one another.

v. Termites

Termites are known as white ants. Termite attacks the paper materials as well as the wooden container and other packing materials. They eat whatever cross in their way and cause irreparable damage to materials.

4.3 Causes by Chemical Factors

The impurities in the atmospheric gases such as hydrogen sulphide, sulphur- di-oxide, carbon-monoxide, ozone, moisture, dust and other susceptible impurities are the main chemical factors, materials deposit over the Books will accelerate deterioration. The oxides of sulphur and atmospheric moisture forms acidity in the Library materials. Acidity break the cellulose bonds and makes the paper brittle and colour change. Acidity also affects the Ink and other colour drawings.

4.4 Human Factors

Damages caused by human being are due to innocence and negligence. Books and other reading materials are torn by rough handling and improper storage. Using moisture for turning the pages soften the edges and makes curls and folds. Repairing of paper with scorch tapes, cello tapes and other commercially available adhesive sheets make stains on books and stick the adjacent sheets. The careless handling and negligence may cause ink and coffee stains. Dog marking and marking by ball pen also cause damage to the books.

5. Control Measures

We can take the preservation measures, if we have the knowledge of causes of deterioration, by physical, biological and chemical factors.

5.1. Control Measures for fhe Physical Factors

Direct sunlight should be avoided on Book stack or other storage area by east west arrangement, fixing sunshade, curtains to window etc., other artificial lightning can be controlled with UV filter sheets. Heat and

humidity can be controlled by Air conditioning the stack room. The air-conditioned stack room can be kept an ideal proportion of 21°-25° C and to 55% of relative humidity. Air conditioning is also protective measure against microorganisms, insects and dryness. But the air conditioning should be round the clock with thermostat control of required heat and humidity. Otherwise the tropical climate leads to high fluctuation in heat and humidity, which deteriorate worse than ordinary condition. If we could not provide 24 hours Air conditioning we can adopt other methods to control the heat and humidity by khus-khus screen to windows, water buckets in the corners, Humidifiers etc.

Humidity can be controlled in winter season by using Dehydrating agents like anhydrous calcium chloride, silica gel, carpet, dehumidifier, electric fan with heater can be used to maintain the required conditions. Much care should be taken for fire and flood damages.

5.2. Control Measures for Physical Factors

Climate is he main factor for the growth of fungus and insects. They can be controlled by maintaining requires humidity, proper light and ventilation. In ancient days, Books and manuscripts were concrete with Red or yellow cloth for the purpose of preservation. The cloth cover protects them from light, dust and humidity. The Red colour acts as insect repellent. Some of the indigenous materials like cedar oil, neem leaves, and neem seed powder, tobacco, sweet flag, camphor etc were used as insect and fungus repellent. In the Thanjavur Sarasvati Mahal Library, a powder mixture of sweet flag (1 part), black cumin (1 part), Bark of cinnamon (1 part), pepper (1/4 part), cloves (1/4 part) and 5 to 10 gm of camphor. The mixture is made as small bundles, which are effective for six months.

Library materials are treated with fungicide and insecticide by fumigation method to control fungus and insects. Fumigation is a process to treat the affected books in airtight chamber with wire mesh support by using evaporating chemicals of fungicide or insecticide. Mostly thymol is used as fungicide and Para di-chloro-benzene is used as insecticide as well as fungicide. Some other chemicals like Naphthalene balls and Naphthalene bricks are used as Insect repellent.

5.2. Control Measures for Chemical Factors

The dust accumulated over the object should be removed with fine brushes or vacuum cleaner. If the air pollution is controlled there will not be any external acidity in the paper materials. Presence of acidity can be tested with moist blue litmus paper, pH paper, pH pen, and pH meter. If acidity is present in present in paper materials, it should be neutralised. The process of neutralising the acidity is called as deacidification.

6. Restoration Process

The de-acidification and other process will not give strength to the paper. So the brittle papers need strengthening, which can be done by mending process or Lamination process. In mending process chiffon cloth or any transparent silk cloth can be man with the paper using starch paste. Using Japan tissue and cellulose acetate foil with heat or solvent process can laminate the hand written materials and brittle sheets.

7. Care and Maintenance

This is also called as pre-conservation work, which reduces the deterioration process of any book material. The following steps have to be kept in mind for proper preservation.

1. The stack room should be with proper light and ventilation.
2. Provision must be made to control direct sunlight and humidity.
3. Periodic cleaning and Verification is necessary to find any deterioration.
4. The affected Library materials should be separated from other materials.
5. Library materials should be handled properly.
6. In order to control the insects, keeping foodstuffs in the stack room should be avoided.
7. Books and manuscripts are to be cleaned with soft brushes or soft cloth.

8. Spraying of insecticide to container every year may control the Insect attack.
9. Minor damages must be repaired immediately.
10. Using of metallic pins, covering with acidic papers, marking with ball pen should be avoided.

8. Conclusion

"Prevention is better than cure "is a common proverb in conservation. The cultural properties like manuscripts, inscriptions, paintings, stucco works sculptures, bronzes, temples, palaces, toms and other architectural sites have to be maintained with constant care and under keen observation. There are various methods and techniques to control the deterioration factors. It is a must for every citizen to pass his historical tradition to the future inhabitants. The field of conservation is new to the younger generation and it should be included in all the courses for the sake of mankind.

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PREVENTIVE CONSERVATION : MANUSCRIPTS

*V. Jeyaraj**

History of Manuscripts

People expressed their feelings, thoughts and ideas in two ways. They are speech and writing. Ancient man, who knew writing on the walls of the caves, could not take those writings from a place to place. Therefore from time immemorial materials like stone, clay tablets, metal, bark, leather, bone, wood, ivory, conch, shell, cloth, papyrus (a type of grass) leaves, cane etc., had been used for writing purposes. Those expressed in writing are permanent. Inscriptions are not easily destroyed in course of time. The writings on leaves, paper, bark, cloth, leather etc., are very easily destroyed. These are called manuscripts. Manuscript means symbol. Since the scripts are symbols of sound spoken, they are called manuscripts. These manuscripts are not printed but hand written. The manuscripts on leaves are called leaf manuscripts (*Yettuchuvadi*) in Tamilnadu, *Purja Pathra* in north India and *Thala pathra* in Deccan.

Palm-Leaf Manuscripts

In South and South-east Asian countries palm-leaves were very largely used to prepare manuscripts. In Nepal, there are a large number of very old palm-leaf manuscripts belonging to 7th Century A.D. Palm tree is supposed to have been brought from Africa to India. It is learnt that there are about 4000 types of palm trees exist. Among these, Tala tree, which is called as the country palm tree (*Borasus flabellifer*), Sritala tree, which is in Tamil called as Koonthatpanai (*Coripha umbracalifera*) and Lanthar palm tree (*Coripha uran*) only were used fro writing purposes.

Preparation of Palm-Leaf Manuscripts

Palm-leaf manuscripts were made in various methods. Two month old palm-leaves were cut from the trees and dried under shade. They were seasoned either by cooking them in turmeric solution, milk or steam; soaking them in *gingeli* oil after smearing the oil on the leaves; keeping buried in marshy land.

The palm-leaves were incised with stylus or written with pen. In order to make the incised letters legible, the incised portions were rubbed with

lamp black or green leaves. In North India, the manuscripts were written using the ink prepared by mixing the powdered conch char coal with rain water and gum Arabic. There are illustrated manuscripts drawn with paints. Even today the tradition of writing on palm-leaves exists in some parts of North India.

Paper Manuscripts

The word paper was derived from the Greek word papyrus. Paper, which was manufactured in China in 105 A.D., came to India later. The barks of mulberry, straw, old clothes etc were used to make paper. Hand-made paper manuscripts were long lived. Machine-made paper involved the use of chemicals and therefore they very easily got affected due to acidity.

Bark Manuscripts

Tree barks, especially, barks of birch tree (Bhoj) were used to write. It is learnt that from 2nd century A.D. onwards the barks had been used for writing purposes. These barks have layers of sheets like paper. Barks were written with ink.

Deterioration of Palm-leaf Manuscripts

Manuscripts deteriorate by various means. They are,

- Eaten by insects such as termites, silver fish, and book lice.
- Stuck due to insect attack, oils, varnish.
- Warping of leaves takes place because the palm-leaves were not kept tightly between wooden boards and due to uncontrolled drying in the sunlight.
- Edges get broken due to insect attack, mishandling by users and when wooden boards are smaller than the manuscript.
- Brittle leaves break when the atmosphere becomes very dry and the leaves lose their moisture. Light inside showcases dry up the leaves and make them brittle.
- Stains and pen marks are formed when the users and the custodians become careless.

- Leaves get damaged at string holes because of constant uncontrolled movement of the leaves.
- Fire can destroy thousands of manuscripts in a few hours.
- Flaking of paint occurs due to rubbing of the palm leaves against each other when they are loosely bound.

Damage Due to Improper Air-Conditioning

If air conditioning in the area where manuscripts are stored is switched on and off, then the fluctuating temperature and relative humidity cause expansion and contraction of the manuscripts causing them to weaken and break. Fungus grows in high humidity. Leaves tear horizontally.

Damages Due to Human Factors

Theft, vandalism, improper storage, carelessness in the part of staff and users, all lead to a loss of palm-leaf manuscripts.

Protection of Palm-leaf Manuscripts

- When one receives or acquires a manuscript, it should not be kept immediately with other manuscripts, because if it is infected by fungus and insects, it will pass on the infection to the unaffected manuscripts. It may be cleaned by brushing it gently and removing any insect larvae that may be noticed.
- Wood powder falling out of holes in wooden boards indicates insect attack. The boards should be replaced and specialist treatment should be sought.
- Palm-leaves should not be tied in the centre only.
- Keep leaves tightly pressed between boards by tying with a cord to apply even pressure.
- Store the manuscript bundles neatly, if possible in closed racks, boxes or cupboards.
- Wrap the manuscript in a thick cotton cloth.

- Keep important manuscripts in small strong boxes which should be the first to be removed to a predetermined safe place in case of an emergency or disaster.
- Handle the leaves gently when turning them over.
- Do not mark or underline on the original leaf.
- People in-charge of collections must document and publish the contents of the manuscripts. Instead of the original manuscript, copes or microfilms should be made available to scholars for reference. Condition reports should be prepared.
- Most of the damage takes place in storage. Regular inspection is a must and any damage should be immediately reported to the concerned authority who must take action to preserve the collection and its contents.
- Responsibility should be placed on someone to look after the manuscripts.

Protection of Manuscripts from Dust and Atmospheric Pollution

- Dust and atmospheric pollution should first of all be eliminated by not having the collection in a dusty or polluted area.
- The building should be made dust free by planting grass and trees.
- Important collections should be in the inner rooms.
- The windows should be closed when possible.
- An air curtain could be provided at the entrance.
- A series of door mats should be placed along the way to the collection room. These mats should be cleaned regularly.
- Manuscripts should be kept in closed showcases of boxes.
- A distance should be maintained between the visitor and the object.
- Room furniture should be cleaned with a damp cloth or vacuum cleaner.

- Do not clean the manuscripts with a vacuum cleaner.
- Sweep floors slowly with broom hugging the ground.
- The air intake in AC plants should be high up and should be in the least polluted side of the building e.g. the side not facing the traffic.
- For eliminating sulphur dioxide and dust, fine water sprays can be used to wash the air before it is brought into the air conditioning system.
- The manuscripts should be covered when not being used or viewed.

Protecting Manuscripts from Light

- Light bulbs inside closed showcases heat and dry up the air causing the manuscript to become brittle and break easily.
- Manuscripts should be displayed at a light intensity of not more than 50 lux. The Lux meter should be placed parallel to the displayed manuscript.
- If light intensity is higher than 50 lux, bring it down to 40 lux by switching off extra lights or by dimming them using a dimmer switch. Light intensity can also be decreased by increasing the distance between the light source and the manuscripts on display.
- Sunlight and tube light weakens the manuscript because the ultraviolet rays damage the leaves. Block sunlight by closing windows or by putting curtains on windows or over objects.
- Ultraviolet filters can be put over window panes and tube lights to cut off these harmful rays.
- Zinc oxide or titanium oxide, which absorbs UV rays, should be used to paint the walls and ceilings and the light from fluorescent tubes can be reflected off them.
- The manuscripts should be covered when they are not viewed by the visitors.
- Lights should be switched off when there are no visitors seeing the manuscripts, or the manuscripts can be covered.

Protection from Manuscripts from Insects

- Healthy manuscripts should be kept in closed boxes or cupboards.
- Natural insect repellents like neem leaves can be placed along with the manuscripts.
- Insects in the larva stage eat away the manuscripts. Newly acquired manuscripts may contain insect eggs and larvae which will infect the healthy collections. Therefore the infected manuscripts or newly acquired manuscripts should not be kept with the healthy manuscript collection.
- The insect eaten wooden covers of manuscripts should be replaced with new ones.
- Food should not be brought near the collection storage and gallery to avoid pest attack.
- The cloth to be used to cover should be made acid free and starch free and this should be effected by thorough washing.
- Regular inspection of the gallery and storage of the manuscripts should be made and if powder formation is noticed, it should be immediately reported to the authorities for rectification.
- The infested manuscripts should be removed from the collection and treated separately.
- If a fumigation chamber is available with appropriate chemicals the insect infestation may be removed with the help of a trained staff in this. If nitrogen fumigation is done, then it is not injurious to both men and the manuscripts.
- The windows should be closed during nights. In order to avoid insects and avoid other vandalism, a mesh or net may be fixed to the windows.
- The premises should be kept clean.
- If a new building is to be constructed for storing or displaying manuscripts, it should be treated for anti-termite attack. Old buildings should be treated for termites once a year.

- The collection cupboards should be away from the walls and the contact points such as the legs of the cupboards should be treated with insecticides.

Protection from Temperature and Relative Humidity

- Temperature and relative humidity should be constant as much as possible by keeping the manuscripts wrapped in de-starched cotton cloth in an inner room and moisture absorbing materials such as cotton curtains, wooden furniture etc., should be around the collections. These buffer materials absorb and release moisture slowly thus decreasing the harmful effects of fluctuations.
- If air-conditioners are used, it should be 24 hours and 365 days a year. It is better to have been undisturbed rather than air-conditioning only during office hours.
- If manuscripts have paintings on them, the leaves should be intervened with tissue paper to avoid abrasion and also to act as a buffer.
- The temperature and relative humidity should be recorded for future assessment purposes so that corrective steps may be taken at the appropriate times in the future.
- Movement of visitors should be regulated. Too much crowd may not be allowed at a time.
- No pipe lines, wash basin, toilets or water accumulation should be allowed.
- Silica gel with self indicator may be used to control relative humidity. Fluctuations in the relative humidity will break or make the manuscripts got wrinkled.
- There should be air circulation to avoid fungal growth in the collection.
- Exhaust fans may be used to exhaust damp air from the room.
- Wet manuscripts should never be dried under sun but under shade.

Storage and Display of Manuscripts

- Storage area should be well ventilated, lighted and clean.
- The manuscripts should be neatly stacked in boxes.
- The lowest storage shelf of the stack should be at least 9 inches above the floor level.
- There should be space between the wall and the stacks to avoid moisture transfer from the wall and to avoid insect attack.
- The manuscripts should be aired regularly while inspecting them.
- The manuscripts should be well documented for their easy retrieval.
- Electricity controls, fuse boxes etc., should be installed outside the room.
- Inflammable materials like paints, chemicals etc., should be kept outside the storage room.
- Open fire and smoking should be strictly prohibited inside the storage.
- Displayed manuscripts should be well supported on a flat surface.
- Light, relative humidity, dust, temperature should be controlled in the storage.
- The manuscripts should be changed with other manuscripts to avoid fading.

Conservation of Paper Manuscripts

Among many manuscripts available with us some are paper manuscripts. Valuable paper documents or records may be available in libraries, religious institutions, academies, voluntary organizations and with individuals.

In order to save the manuscripts and records, one should

- Understand the mechanism of their making.
- Know the causes of deterioration.
- Know how to protect manuscripts from enemies.

- Know how to take proper care.
- Take care and vigilance in handling.

Mechanism of Paper-making

Paper is a pulp made from wood, cotton rags, straw, grass, jute, bamboo etc., and is prepared by hand or by machine. The basic component of paper is cellulose. Cellulose fibres are flexible and capable of absorbing water. While making paper, various alkaline and acidic chemicals are used to purify the pulp. Mostly cellulose, lignin and gum are present in these fibres. Acidic chemicals and lignin which are found in wood are harmful ingredients of paper. On the contrary, hand-made paper made of cellulose fibre is much strong, flexible and stable. That is why the old manuscripts are found in good state of conservation even today, while present day papers deteriorate quickly.

If these manuscripts are destroyed, all these memories of human progress will be lost forever. Therefore, it is important that we learn how to preserve these manuscripts. And the first step to do that is to know how palm leaf manuscripts are made.

Causes of Deterioration Paper Manuscripts

Materials used in the manuscripts and books are paper, board, thread, adhesive, leather, cloth for binding cover. Usually they are destroyed due to high temperature, humidity, light, biological agents like fungi, insects like termites and improper house-keeping. Furthermore, some manuscripts deteriorate due to acidic pigments and inks. Verdigris affects paper very much and eats away the paper. Ink is converted to dark brown and later gets charred. So we should understand these causes first:

- Due to high temperature paper becomes yellow and brown.
- Fungus grows on paper due to moisture in the manuscripts.
- Presence of fungi and insects are found due to lack of proper ventilation.
- Light affects the strength and colour of manuscripts.
- Insects eat away manuscripts.

- Improper material in manuscripts causes deterioration.
- Improper book binding is harmful.

Care of Storage

Proper storage is very important in the preservation of manuscripts and books. Manuscripts should not be kept in the open because this can cause great loss to manuscripts and also invite dust and dirt. Important manuscripts can be kept in specially prepared boxes. We should use good quality wood for almyrah. The cheap wood could be affected by insect much easily. So we should use insecticide repellent for furniture before keeping the collection.

To safeguard these valuable manuscripts, documents and books, we should be cautious from the enemies of manuscripts and as mentioned earlier we should follow the control measures. In this way we can protect our rich heritage and culture.

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PREVENTIVE CONSERVATION : DIGITAL RESOURCES

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Introduction

Libraries and archives play a critical role in organizing, preserving and providing access to the cultural and historical heritage of the society. In the relatively stable world of printing, hand-written and mechanically reproduced information, libraries and archives managed to preserve this rich heritage for specialized scholars and for the general public. The introduction of digital technologies into the process of production, distribution and storage of information challenges the capacity of libraries and archives to carry out their responsibilities for preservation. Information Management covers the whole spectrum of information handling activities, technology, covering methods of inputting, storing, retrieving and distributing information. Its function incorporates a wide range of disparate activities including records management, library management, printing, reprography and micrography. The present day Information Society has witnessed by the widespread transition of knowledge from print format to electronic format, which has also given rise to the problem of its preservation in digital form. The problem of preservation is further complicated by the rapid obsolescence of the hardware and software required to interpret and present digital documents. Ensuring continued access to digital information necessarily involves copying or transforming digital documents to run on current media, software, hardware and operating systems.

Digital Resources

The creation of digital libraries presupposes the creation of electronic or digital resources and conversion or digitization of the existing resources into digital forms. In its simplest connotation, digital resources refer to any source, which is in digitized form, which can be read and scanned by means of electronic media. Unlike conventional form, digital resources do not require separate space in a library, as these can be stored in a computer locally or remotely. Digital resources include a wide range of materials such as:

- Collections in which complete contents of documents are created or converted into machine readable form for online access;
- Scanned images, images of photographic or printed texts etc;
- Online databases and CD ROM information products;
- Computer storage devices such as optical discs, juke boxes, CDROM/ DVD-ROM;
- Databases accessible through INTERNET and other networks;
- Meta documents;
- Digital audio, video clips or full length movies.

Reasons for the loss of Digital Information

- Changes in an organisation
- Content reorganization
- Cessation of sponsorship
- Technology obsolescence
- Content format obsolescence
- Hacking and sabotage
- Disaster, whether natural or man-made

Digital Preservation

Digital preservation is concerned with ensuring that records which are created electronically using today's computer system and application remain available, usable and authentic in future use, so digital preservation consist of preserving more than just the record's bit stream for interpret the survival of the records without interpretation the bit steam is nothing more than a meaning less series of 0's and 1's (Haag; 2001). During preservation question of record context, content, structure, appearance and behaviour must be taken in to account, which can be solved by the standardizing the context, structure, appearance, etc. "Digital Preservation" or "Digital Archiving" essentially aims at taking steps to ensure the longevity of electronic documents. It applies to documents that are either "born digital" and stored on-line (or on CD-ROM, diskettes or other physical carriers) or

to the products of analog-to-digital conversion, if long-term access is intended.

In the words of Russel (1999), "The storage, maintenance and accessibility of digital object (include any digital material such as, a text document, an image file, a multimedia CD-ROM or a database) over long term, usually as a consequence of applying one or more digital preservation strategies". Digital Preservation or Digital Archiving means taking steps to ensure long term access to the digital resources or documents. The preservation policy of digital resources is of prime importance and should take care of the following aspects:

- Preservation of digital resources at different levels depending on its usability, functionalities;
- Continuous reviewing of the digital resources ensuring long-term access to them;
- Weeding out obsolete information and invalid websites.

Digital preservation as a self-contained problem, focusing on the technical obstacles that must be overcome in order to secure the long-term persistence of digital materials. Digital preservation is not an isolated process, but instead, one component of a broad aggregation of interconnected services, policies, and stakeholders, which together constitute a digital information environment. Digital preservation issues worked their way into the consciousness of cultural heritage institutions in the form of a sense of imminent crisis. While it is true that digital materials are inherently more fragile than analog materials, the degree of risk varies widely across classes of resources: there is appreciable risk, for example, that a Web site available today may be gone tomorrow, but there is little indication that the corpus of commercially published electronic journal content is under the same threat. Digital preservation not just as a mechanism for ensuring bit sequences created today are renderable tomorrow, but as a process operating in concert with the full range of services supporting digital information environments, as well as the overarching economic, legal, and social contexts.

Digital preservation concerns two types of documents: namely 'born-digital documents' and 'digitally created' documents. *Born digital documents*: These refer to those materials that were initially created using some form of digital technology. They are often termed as 'electronic records'. *Digitally created documents*: These refer to those materials, which have been transformed from analog to digital form through some reproductive means such as rekeying the information or scanning the document or object etc. Digital preservation means taking steps to ensure the longevity of the electronic document in terms of the following (Mark et.al. ; 1999)

- Data (this might be for text, image, video or audio stored in variety of formats and standards);
- Index to the data;
- Link to other data;
- Metadata;
- Software (relies upon hardware and operating system); and
- Storage medium, etc.

Digital Preservation Tasks

According to Hendley (1998), at a basic level all digital preservation strategies involve the following tasks:

- ***Preservation of digital medium*** that holds digital information by storing it in the correct environment and following agreed storage and handling procedures.
- ***Preservation of the technology*** by conserving the hardware and software environment used to create and use the resource.
- ***Preservation of intellectual content*** by preserving the integrity of the digital information during *the* copying process.

Physical Storage Conditions Required for Digital Objects

The digital objects should be stored in a functional room, which provide thermal comfort so that constant temperature and humidity can be maintained. The Temperature set point: as low as 5° C and Relative Humidity: as low as 20 % RH, Temperature Variations: not to exceed 4° C

and Humidity Variations: not to exceed 10% RH. Ideally, light would be artificial and if there are windows in the storeroom then the north facing position is best to avoid direct sunlight. Similarly, the lighting in the storeroom should have diffuse lighting. The digital objects should be kept away from water, heat, and strong magnetic fields. The digital objects should be stored in a vertical position in appropriate containers and extra care must be taken for effective handling of tapes, cassettes, or disks, etc. The environment must be kept clean free from dust and smoke (pollution free). To reduce wear and tear from use: make an access copy for frequently used materials and keep playback equipments clean and in good running condition. Whenever problems arise while handling the digital objects, professionally trained personnel shall be asked to tackle the problem instead of allowing the users or library staff. This would minimize problem in handling digital information resources.

Digital Preservation Strategies

Effective digital preservation requires life-cycle management of digital information from the point of creation and storage. There are different strategies of preservation of digital materials such as refreshing, migration, technology preservation and emulation.

Technology Preservation: The older technology can be preserved for viewing digital objects in their original formats but it is not feasible in long term due to cost, space and technical requirements: e.g. Hardware. This option can only be described as untenable. There are several nuances to technology preservation that one might not think of it first. The hardware and software for digital media changes so rapidly that it would be impossible to keep an up-to-date technology, for instance, the Web page designed for Netscape 1.0 with low bandwidth cannot be used on any of the high-speed 21st century programmes. The Web page, as an archival artifact, ceases to exist almost as soon as it is created.

Refreshing: Refreshing involves transferring digital materials to a new medium, for instance, changing from 5 ¼-inch floppies to CD-ROM, or CD-ROM to DVD. A wide variety of practices are used for refreshing digital information. The refreshing cycles range as often as daily or weekly as part of the routine operations of a hierarchical storage management system

to as infrequently as once every 10 years. The most common refreshing cycle is in the range of once every three to six years.

Technology Emulation: It refers to creating new software that copies the operations of older hardware and software thus ensuring its originality in terms of physical presence, content and functionality. Some digital resources are highly dependant on particular hardware or software. Emulation techniques can be useful in such cases. However, emulation for preserving digital resources over the long-term has not been tested. Emulation involves retaining information about how a digital collection was created and accessed so that future access can be accurately and faithfully reproduced. Jeff Rothenberg - probably the leading proponent of this option - writes, "For digital documents, retaining an original may not mean retaining the original medium....but it should mean retaining the functionality, look and feel of the original document". This option seems most suitable for documents that are "born digital" and proves problematic for the representation of the original that we are digitizing.

Data Migration: Migration is a set of organized tasks designed to achieve the periodic transfer of digital materials from one hardware/software configuration to another, or from one generation of computer technology to a subsequent generation. The purpose of migration is to preserve the integrity of digital objects and to retain the ability for clients to retrieve, display and otherwise use them in the face of constantly changing technology, for instance, WordPerfect 7 document as a new Word 97 file or dBASE III file to Foxpro or Oracle. Migration covers a range of activities to periodically copy, convert or transfer digital information from a medium that is becoming obsolete or physically deteriorating to a newer one (e.g. Floppy disc to CD ROM) and/ or converting from one format to another (e.g. Microsoft word to ASCII) and / or moving documents from one platform to another (e.g. VAX to UNIX). Migration certainly preserves the physical presence and the content of the digital object. However it may not preserve presentation, functionality and context.

Data Archaeology: Includes methods and procedures to rescue content from damaged media or from obsolete or damaged hardware and software environments.

Standards for Preservation

In order to have better results in the digital preservation is to adherence on the standards. In this context the following principles are to be considered:

- Adopt the available standards to create digital objects such as ASCII for text materials; JPEG and TIFF for images and HTML, SGML for encoding documents.
- Monitor standards as they change to incorporate 'value added'.
- Migrate to the new standards as they evolve.

The strategy of preservation is only for the one aspect i.e. access to the digital documents for the future. Other aspects are legislative, procedural and organizational aspects. These different aspects should be reflected in the development of new IT tools in order to support digital preservation over time. These development speeds of the developments of the equipments, hardware, software and records. Lack of standard concepts, standard procedures, IT standards, and Standards for infrastructure are a major bottleneck of the digital preservation problem (Lorist; 2001). So standards for the tools and techniques are as important as strategy of preservation.

For preservation of digital document/information over a time, the following types of standards are mentioned.

Standards for Architecture	To serve as a reference model to describe the functionality of digital preservatory infrastructure.
Standards for Document format	In order to preserve the digital document object format plus presentation.
Standards for preservation access	In order to preserve the content describing the technical context, provenance and semantics, enable future interpretation of the document.
Standards for interoperability	In order to exchange data in different platform with minimum loss of content and functionality.

Standards for Preservation Content

Standards for preservation content should be depending upon ageing process of the semantic and physical recoverability of the document that is being preserved. A standard can only provide such longevity when the standard itself does not change and backward compatibility is provided. Therefore for future preservation standard should be selected depending upon the technical obsolesces. More often XML and PDF are put forward as two rivals to preserve a document for long-term preservation.

PDF (Portable Document Format)

Portable Document Format is the de facto document standard and is the proprietary of Adobe. It uses the image model of the Postscript language in order to depict text and image as exact copies of the original. The PDF have two types of formats.

1. Text based PDF outline font technology of Postscript PDL (Page Description Language) for describe format of a page; and

2. Raster scanned image PDF without text outline font OCR (Optical Character Reorganization).

XML (Extensible Markup Language)

Extensible Markup Language is a de facto standard rather than an official one. XML is subset of the Standard SGML (Standard Generalized Markup Language) and is related to the web language HTML Hyper Text Markup Language). With the help of the XML the structure of a document can be saved in a specific type document so called Document Type Description (DTD). For the specification of the form of document style sheet can be used. Cascading Style Sheet (CSS), Extensible Style Sheet Language (XSL) or XSL Transformation (XSLT) can be used. Finally the content of the document can be stored in ASCII format with XML tags.

Standards for Preservation Access

Preservation of the bit - stream of the document in some standard format is not enough to preserve a digital document over an indefinite period of time. So, it is necessary for the description of the digital, object or various parts into one object means file formats stored in different physical places

in the information system, and by linked by cross reference. Such types of the description are called metadata, which includes the contextual information to manage, retrieve and interpret the electronic information over time. Metadata for preservation and access carried out in different projects such as CEDEARS or PANDORA or NEDLIB by RLG. The information involved in long term preservation metadata gives information about both preserved document and information about the data processes of the digital objectives that are to be preserved by informing about format name, structure, application etc. There are several existing metadata schemes that have been standardized, each having some specific goal.

Considerations in Digital Preservation

In the task of digital preservation the following aspects are to be considered:

- Integrity of object
- Physical preservation
- Content preservation
- Presentation format
- Functionality
- Authenticity
- Location and references
- Provenance

Difficulties in Digital Preservation

A number of other technical, social and legal issues added to the difficulty of the task. These include:

- Increasing complexity of digital objects (incorporating text, images, audio, video in various formats) and their increasing software dependence (e.g., storage in databases);
- Rapidly increasing number of digital objects and proliferation of document standards and formats;
- Lack of planning to incorporate preservation needs in systems and lack of availability of off-the-shelf products supporting preservation needs;

- Lack of consideration of long-term access requirements when creating digital products;
- Lack of long term thinking about management of the digital information
- Absence of widely-accepted standards which will assure access over time;
- Copyright/intellectual property rights that may interfere with the ability to preserve digital objects through systematic copying;
- Unstable storage media (e.g., diskettes) whose life span is limited;
- Lack of technical expertise in collections managers and preservation experts;
- Technology obsolescence;
- Insufficient resources;
- Insufficient planning.

Research on Digital Preservation

Research issues in digital preservation include: systems design; need to foster learning through critical case studies; standards development; Organisational and economic issues. These issues can be further grouped into two major areas: **Technical and Organisational.** The range of potential research questions on digital preservation is divided into two sections: **Born digital documents** and **digitally recreated or 'born- again' digital documents.**

Born-Digital Documents

They are referred to as 'electronic records'. Cook divided (1992) these into two generations such as:

1. First generation of Electronic Records Research; and
2. Second generation of Electronic Records Research.

The first era concerned the preservation of machine-readable records such as large-scale social science data sets and business applications. In terms file format these were flat or comma-delimited ASCII files. Research indicates that refreshing or re-recording alone is not sufficient to ensure long-term

preservation and they are in danger of destruction. These were proved by the studies conducted by the National Research Council (1995 and 1996) in the US and Green, et al. Their findings revealed that the flat-file or the column binary format was robust and lend it to many migration options.

Relational and object oriented databases and multimedia files referred to as the *second generation of electronic records.* These software dependent documents require a different approach to digital preservation from the flat-file data sets and pose more complex issues. Major thrust of the research is the maintaining the reliability and authenticity of records over a period of time. E.g. Migration from an older version to a newer version. Specific mechanisms for maintaining authenticity and reliability include authentication, version control, date stamping, digital signatures and encryption.

Preservation of born-digital documents and record-keeping systems is easier if systems are designed with long-term value and maintenance. Much research is going on system design and implementation requirements to ensure authenticity and reliability. Examples are: The Pittsburgh project, New York State's Building Partnerships project and the project at the University of British Columbia.

Preservation of E-mail

Email is similar to other types of born-digital documents embedded in any electronic record-keeping system. Preservation of E-mail is significant in the context of social history and the history of scholarly communication. Preservation of E-mail presents problems due to its functionalities over system dependent and the sheer volume of messages. Several research efforts in the preservation of E-mail are :

- Expert system to identify messages enduring value.
- Guidelines for email management that advocate early intervention and assessment of enduring value of the messages through system design and implementation and as well through the creation of metadata.

Preservation of Web-based documents

The recent development of WWW and searching information through it, has generated interest in preserving documents over the Web. Several research efforts in the direction of preserving the web resources are:

- To Create the Internet Archive by taking snapshots of the web (Kahle, 1997).
- To develop and to implement procedures for the identification, capture and long-term digital preservation of online Australian publications (Smith, 1997).
- To create a common architectural framework and basic tools to build a deposit system for electronic publications and to address long-term preservation issues. (Van Der Werf-Da Velaar, 1999).

Digitally Recreated Documents

Digitally born-again surrogates or documents are images of the original. Search and retrieval depend on indexing and descriptive metadata associated with an image. It is observed that there is little consistency in the standards used for digitisation and a lack of coordination and information sharing among institutions carrying out digitisation projects. Therefore in the process of considering the digitisation of documents certain criteria has to be adopted with regard to the selection of documents, decision making and research on different genres and media, the long-term ability to administer digital collections, the evolution of software, operating systems and hardware.

Impact on LIS Training and Education

Recent developments in the field of digitisation and digital preservation have indeed created challenges in the LIS education. In order to cope with the changes in this field, there is an urgent need to train the professionals as well students to enable them to face the challenges in the light of digitalization activities in the libraries. It needs to redesign the course contents and add a new course to the existing course. Course that can be considered for the education and training of prospective information managers in the context of digital preservation is the introduction of

"Preservation and Conservation of Information Materials in the Digital Era". The contents of the proposed course would include the following:

- Introduction to Preservation and Conservation
- Evolution of Information materials from clay tablets to digital forms
- Nature and types of Information materials
- Hazards to Information materials
- Physical and Chemical methods of treatment
- Preservation of Digital and Non-Book Materials
- Role of Micrography and Reprography
- Digitisation: means and methods
- Digital Preservation: Issues and Trends

The above stated course can be considered as a core or an elective course in the LIS School as the case may be. In addition to the formal training on the subject, the LIS schools can also consider to organise Continuing Education Programmes or In-service training programmes such as short-term courses, refresher courses and workshops on this area. This would benefit the in-service personnel both teachers and practicing LIS professionals.

Suggestions

Keeping in view of the above factors, the author venture to suggest the following:

1. Draft a set of guidelines, standards and practices for digital preservation.
2. Develop means to coordinate digital preservation activities among institutions.
3. Develop institutional policies for acquisition, conversion, storage and maintenance of digital materials.
4. Redesigning of Library and Information Science curriculum with reference to digital preservation.
5. Plan and programme for education and training of digital preservationists.

6. Prepare a model for infrastructure required for digital preservation.
7. Sharing of technical know how of digital preservation from and among the fellow professionals.

Conclusion

Digital preservation encompasses a broad range of activities designed to extend the usable life of machine-readable computer files and protect them from media failure, physical loss and obsolescence. Digital preservation will add little values to the research process if it serves only as an alternative form of storage. Preserving digital materials in formats that area reliable and usable will require long term maintenance of structural characteristics, descriptive metadata, display and computational and analytical capabilities which demand mass storage and software for retrieval and interpretation. The digital preservation is a process that requires the use of the best available technology, careful thought, administrative policy and procedure.

Digital preservation policies and practices are not currently well developed in Indian libraries, and few have assumed responsibility for preserving materials in digital form. Preservation in the area of digital technology is a shared responsibility. The wide community of information professionals in libraries, archives and museums has collaborated in developing strategies to build technically sustainable solutions. There is an ongoing need to work together as a community to drive the development of needed products, to grow a demand for commercial imaging services and support for international standards to meet digital preservation needs. Growing from the initiative of a national co-operative digital imaging project, a further need for coordination among the various parties involved in digital preservation to take concrete measures to build capacity and increase staff expertise with issues of digital technology.

The Archives, Libraries, Museums and other Repositories that have been instrumental in preserving and providing access to scholarly communications, documentary heritage and other cultural resources in

traditional formats. It is clear that many of these institutions are beginning to adapt digital preservation to their array of preservation responsibilities. There are no digital preservation policies or established methods to preserve digital information. Digital preservation is a new challenge and they are just beginning to confront the policy, technological, and human resource implications. In digital preservation all that looks new is old again. Keeping in view of the recent developments in the information handling and management, the benefits of digital preservation and digitization could not be overlooked and augmented effectively in order to preserve and disseminate for the future generations to come. Therefore, the information professionals are to be trained in the area of Digital Preservation and digitization techniques. Preserving our digital heritage is more than just a technical process of perpetuating digital signals over long periods of time. It is also a social and cultural process, in the sense of selecting what materials should be preserved, and in what form; it is an economic process, in the sense of matching limited means with ambitious objectives; it is a legal process, in the sense of defining what rights and privileges are needed to support maintenance of a permanent scholarly and cultural record.

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PREVENTIVE CONSERVATION OF MANUSCRIPTS: SOME VITAL ASPECTS

*C. P. Uniyal**

Introduction

Conservation is a continuous process. It includes diagnosis, curative treatment of the diseased artifacts and prevention form further decay. Much depends upon the future preventive measures to be faced by a artifact an for that matters a manuscript. Thus prevention from decay becomes very vital & important. This gave birth to a term *"Preventive Conservation"*, which is synomoneous to the term, prevention. This is particularly relevant to the collections with in four walls of a museum. This is more relevant to manuscripts as a whole. And it goes with the ancient saying *"Prevention is better than the cure "*.

Parameters of Preventive Conservation

It is necessary to have discussion on the parameters of preventive conservation. It is imperative that these conditions are fulfilled to have a successful preventive conservation programme. These are,

1. *To have a stable environment, that is to say the conditions of radiative humidity (RH) & Temperature are to be stable for 24 hrs a day, through the year. For manuscripts the temp 22 ± 2°C RH 50% ± 5% is OK.*
2. *To have checking of the building periodically for any leakage or seepage of water.*
3. *To have local control where air-conditioning is not possible or feasible monitoring of local control measures is a must.*
4. *To have a well ventilated space for display or storage of manuscripts.*
5. *To avoid any condensation of moisture either on display showcases or storage cup-boards.*
6. *To have proper handling, transportation and storage of manuscripts.*
7. *To save the corners of the manuscripts by properly wrapping them.*

8. *To use, periodically, repellents in the display area or the storage of manuscripts.*

9. *To avoid using dark corners either in the display or storage of manuscripts.*

10. *To use seasoned wood, avoid using unknown compositions in the display or storage of manuscripts.*

Monitoring of Preventive Conservation of Manuscripts

Monitoring of the measures undertaken either air conditioning or local measures is essential for the effective use of preventive conservation. For this one needs to constantly monitor.

1. *Temperature and RH either by using a maximum & minimum thermometer and a whirling hygrometer or a weekly recording type hygrometer.*

2. *We need to have data on air pollution, particulate matter etc.*

3. *We need to monitor and checking periodically building, the display & storage area for any leakage etc.*

4. *We need to monitor and checking periodically, the manuscripts on display as well as on reserve so as to avoid any stagnant air pocket, dark corner, conditions of the moisture condensation etc.*

Future Prospects of Preventive Conservation

Preventive Conservation is going to be more and more effective particularly in India. As far as manuscripts are concerned it is of paramount importance, because in most of the cases the process of decay is irreversible you can preserve an manuscript as it had been received but it is very difficult to restore an manuscript to its original position. Moreover the manuscripts are in large number, is different media, covering a wide range of subjects in number of Institutions,wnich all cannot afford to have costly curative restoration. Hence Preventive Conservation or the prevention form decay is the aim of future.

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"PHOTOLAM SYSTEM" FEASIBLE PRESERVATION METHOD TO PAPER DOCUMENTS

Paper documents becomes fragile in ageing subject to climatic condition like moisture light, air, dust, water and handling while go for reference of age old documents and books it is uneasy to handle and it divert researchers concentration. If we keep it preserve with suitable preservation method it will be much aided to researcher and reader. There are so many preservation methods they are chiffon cloth mending, tissue paper mending, encapsulation and PHOTOLAM SYSTEM. Before adapting a preservative method, we must clean and deacidify the document.

Photolam System is a unique innovative system. In Photolam System, a specially processed thin, strong and inert polyester film forms one part and a specially prepared glue forms another part of the raw materials.

Photolam System is a feasible system of preservation of paper documents. The Photolam System overcomes difficulties and defects of other existing systems of lamination. This system's feasibility is justified by the followings:

1. The system is tested and certified OK by Indian Conservation Institute, Lucknow.
2. The products are tested for its quality, strength etc., at Both National Test House and State Testing Centre, Chennai.
3. Photolam System is tear proof.
4. Photolam System is moisture proof.
5. Photolam System is fire retardant.
6. Photolam System's preserved documents even buried nothing will happen. Documents preserved by Photolam System will not be affected even on burial.
7. To save the wear and tear on the original records while undertaking microfilming, photography, digital imaging and photocopying, a conservation staff has to decide whether a document is fit for the process. In this case, Photolam System makes the documents fit for such processes.
8. The Photolam System laminated documents are reversible.
9. Documents have high optical resolution even after this lamination. Direct scanning of Photolam laminated documents will give crisp and clear images than other methods of preservation.
10. The special coating on the film will protect from sticking of pages.
11. Photolam lamination makes the documents rigid and it is possible to reverse as and when required.

12. Whenever adhesives are used for lamination, they should not affect the document or printed matter on ageing. Tests have been carried out as per specifications of the Indian Standards on Photolam System.

13. Photolam laminations have been done for many organisations like :

    a) M/s. Malayala Manorama Co. Ltd., Kottayam, Kerala.

    b) M/s. Mathrubhumi Printing and Publishing Co. Ltd., Kozhikode, Kerala.

    c) M/s. Viduthalai Printers, Chennai.

    d) M/s. The Hindu, Chennai & Etc.

14. Carried out lamination works for Institutions like :

    i) Government Museum, Chennai.

    ii) Government Oriental Manuscript Library, Chennai.

    iii) M/s. Thanjavur Maharaja Serfoji's Sarasvathi Mahal Library, Thanjavur.

    iv) Indian Institute of Technology, Chennai.

    v) Central Leather Research Institute (CSIR), Chennai.

    vi) All India Radio, Chennai.

    vii) CVRDE (Ministry of Defense) Govt. of India, Avadi, Chennai.

    viii) Madras Literary Society, College Road, Chennai.

    ix) M/s. Kalakchetra Foundation, Chennai.

    x) Madurai Kamaraj University (Geography Dept.), Madurai.

    xi) Loyola College, Chennai.

    xii) Ramakrishna Vivekananda College, Chennai.

    xiii) New College, Royapettah, Chennai.

    xiv) M/s. Adyar Library, Chennai (Trial Order only).

Thus Photolam System is justified.

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SAVE MANUSCRIPTS HERITAGE IN AN INNOVATIVE WAY FOR POSTERITY