Photographic Documents and Films

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Typology and history

Photography can be defined as any method producing a visible image by the inter-action of light with a layer of chemicals. Since the birth of still photography in 1839, photographs have been manufactured employing many different methods. About 40 of these methods have been used commercially and examples of the resulting images can now be found in great numbers and varieties in archives and library collections.

The development of a commercially successful system for recording and viewing moving images was the result of work by many people in the latter part of the 19th century. The first successful public demonstrations were given by Lumière in Paris in 1895. Since then many advances have been made including the introduction of sound and of colour. Many different frame rates and sizes of film were devised before the industry stabilised on to a few "standard" formats. A film collection still has to be able to handle films on many formats.

Microfilm

Microfilm was developed to secure original print and image material with special historical, commercial or scientific value. The use of microfilms can also improve the access to the information carried by the original documents. The use of microfilm for access will, as with other forms of access copy, help preserve the original by protecting it from wear and tear and from theft.

New printing techniques

The most recent developments are as a result of the computer revolution. New techniques have been developed using equipment such as ink-jet and thermal sublimation printers to produce copies of digitised images. These should be considered as printing techniques and not as photographic materials although they can provide a good representation of the original photographic image. Because of the short life expectancy and the sensitivity to light and heat, these printing techniques cannot be considered a substitute for photographic materials.

Original and substitutes

The best practice for photographic materials is to have several sets of images. The Original Image kept in ideal conditions and disturbed as infrequently as possible.

– A Safety Master used as a reserve copy. It should be stored in a separate place to the original in case of the loss of the original in a fire or some other disaster and also kept in good storage conditions.

– A User Copy Master made from the original or the safety master and used to make User Copies. User Copies for routine access to the images.

Though photographic images have been made in a great number of different sizes - from microfilms to large posters - the deterioration and preservation principles are dependent upon the chemical process used to make the image and not the size or purpose of the image.

Synopsis : typology

Carrier	Date of manufacturing	Procedure	Composition
daguerreotype	1839-1860	positive (direct)	cooper plate covered with a fine silver layer
salted paper	1839-1860	positive (direct)	print on a paper containing silver chloride
calotype	1841-1860	negative	paper containing silver nitrate treated with potassium iodide
ambrotype	1851-1880	positive (direct)	collodium plate *cliché* seems to be a positive when placed on a dark paper
albumin print	1850-1900	positive (direct)	print on a paper with an albumine coating treated with silver nitrate
collodium plate	1851-1885	negative	solution of coton and pouder in a mixture of alcohol and ether extended on a glass plate
ferrotype	1856-1930	positive (direct)	solution of coton and pouder in a mixture of alcohol and ether extended on a black varnished metallic plate
silver gelatin procedure	1880-	negative	suspension of silver bromide in gelatin
aristotype	1885-1930	positive (direct)	paper containing gelatin with silver citrate or collodium
autochrome	1907-1945	positive (direct)	glass plate with a coloured potato starch coating covered by an emulsion containing silver chloride
negative and positive for colour development	1939-	negative/positive	different procedures

Deterioration of photographic material

As the production of photographs has included many different chemical processes in the capture of the image, photographs also have a wide variety of ageing properties. Some materials were made of extremely self-destructive components, others were very sensitive to physical contact and almost every photographic material is sensitive to the environment, not only temperature, relative humidity and air pollution but also oxidising substances found in emissions from some building materials, wall paints and wooden furnishing. The card-board and paper in boxes and envelopes used for protecting the items from physical damage may also contain harmful substances.

Causes of deterioration

Deterioration factors can be categorised in two ways - internal and external.

Internal Deterioration

Internal deterioration factors are dependent on the components of a photographic item and the residual chemicals from developing- and post treatment processes. The speed of the decay processes is related to relative humidity, temperature and oxidising substances.

Cellulose nitrate films

The most commonly known example of a photographic material deteriorating from internal processes is cellulose nitrate film, which during deterioration emits substances that both accelerate the deterioration process as well as attacking materials in the vicinity. The main ingredient of nitrate film is cellulose nitrate which emits nitrous gases. The gases are not only oxidative but also toxic and explosive. In a self-accelerating deterioration process, the support - the film base - and the emulsion are eventually completely destroyed. What is left is a sticky substance. Cellulose nitrate film is

flammable at fairly low temperatures and rolls of film, like motion picture films, might even self ignite at a room temperature as low as 41° C when kept for an extended period of time in a badly ventilated environment, for example in the traditional metal film can.

Cellulose nitrate film sheets do not self ignite in the same way because the mass per volume is much less and normally the emitted gases slowly evaporate away from the negatives when they are kept in envelopes and open boxes.

Cellulose acetate films

Another materials group exposed to self destruction is that of acetate film - the first safety film. Until recently, acetate film was considered as very stable but today the problem of the Vinegar Syndrome - the popular name for the deterioration of acetate film with the emission of acetic acid (vinegar) vapour as a by-product that acts to accelerate the rate of decay - is widely known. Still another example, although involving an old process, is the yellowing of albumen prints, where the egg white in the emulsion bleaches the silver image.

Acetate film was introduced in the 1920s as a substitute for the flammable cellulose nitrate film. It was labelled "safety film" as it was less flammable than its predecessor. The early acetate film lacked dimensional stability which made it shrink and loosen the emulsion from the support. The acetate base was improved and was considered more or less stable until the vinegar syndrome was discovered during last decade.

Colour photographs

Colour photographs - negatives, prints and transparencies - generally have bad ageing properties as the colour-components are unstable unless kept below 0°C. Photographic colour materials are not only subject to light fading - fading of the colours and image in the presence of light - but also to dark fading - fading in the absence of light. Transparencies are commonly considered to have better colour stability than colour negatives and prints but ageing properties may differ greatly due to different chemical properties.

Collodion

Collodion, one of the earliest photographic emulsion materials, was used in several similar photographic techniques during the mid-18th century, e.g. ambrotypes, collodion wet plates, pannotypes, ferrotypes and celloidin paper. The collodion emulsion contains cellulose nitrate (also used for the first "plastic-type" film base) and emits nitrous gases, though far less than cellulose nitrate film. These gases may attack other objects in the vicinity and, due to the loss of gas which leads to shrinkage of the emulsion, the emulsion may eventually crack.

PE or Resin coated papers

PE or Resin Coated papers are made from paper fibres covered with polyethylene with the gelatine emulsion outside the polyethylene layer. Until about the mid 1980s this photographic print paper had bad ageing characteristics. The paper base contained optical whiteners which absorbed light energy. An oxidising substance was formed which attacked the resin coating resulting in cracking. The oxidant also attacked the silver image and bleached it. During the last decade an anti-oxidant has been introduced and thus the resin coated papers now have improved longevity.

Microfilms

Microfilms have been and are produced using a variety of processes but the silver-gelatine developing-out film is considered to have the best long-term stability. Diazo- and vesicular processes are commonly used for making access copies but they do not have long-term stability and are not recommended for preservation copies.

External Deterioration

Envelopes

External deterioration factors are harmful substances in the preservation environment. Among the many contaminants, a few should be particularly mentioned. Lignin, alum rosin sizing and oxidative residual chemicals in paper and cardboard used for envelopes, boxes and mounting boards as well as plasticisers in PVC-folders and similar storage media are the most common together with air pollutants.

Furbishing

Furbishing in repositories should not consist of materials emitting oxidising gases. Oxidising gases react with photographic materials in a similar way as common air pollutants.

High temperature and relative humidity accelerates these processes.

The external deterioration factors may co-operate with the internal factors to increase the reaction speed of the internal deterioration factors.

Materials with good initial ageing properties - i.e. with few internal deterioration factors - may last longer in a bad environment than an object with bad ageing properties - i.e. with many internal deterioration factors - kept in a good preservation environment.

Good storage conditions will counteract deterioration of materials with bad ageing properties to a certain point, while bad storage conditions will always accelerate deterioration processes.

Preventive Measures

The best way to preserve photographic materials is to emphasise measures on preventive care. The necessity of proper storage materials - envelopes, boxes, archive and library furbishing, etc. - and storage climate cannot be over estimated.

Climatic conditions

If possible a photographic collection should be divided and stored as two sets ; an active and a passive. The active set is for frequently used material - mainly copies of originals - and the passive set is for long term keeping of the originals. The passive set should have a stable climate with low temperature and relative humidity

A number of recommendations exist but they do not differ significantly from the requirements listed in the following table. These are weighted for a good cost/effectiveness ratio. The requirements can be difficult to achieve but must always remain the target. The target temperature and humidity readings can be relaxed provided that the conditions are kept stable and with the proviso that the humidity level is kept above 25 % and below about 60 % - the level above which moulds are encouraged to grow. The penalty in most cases is, however, a shorter life expectancy for the carriers.

Preservation Climate Requirements for Photographic Materials						
	temperature	±/24h	±/year	RH	±/24h	±/year
	°C	°C	°C	%	°C	°C
Still Images						
Negatives	< 18	1	2	30-40	5	5
b/w Prints	<18	1	2	30-40	5	5
Cellulose Nitrate Film	<11	1	2	30-40	5	5
Colour Negatives	<2	1	2	30-40	5	5
Colour Slides	<2	1	2	30-40	5	5
Colour Prints	<2	1	2	30-40	5	5
Moving Images						
Colour Films	-5	1	2	30	2	5
b/w Safety Films	<16	1	2	35	2	5
b/w Nitrate Films	4	1	2	50	2	5
b/w Microfilm						
Silver-Gelatine	<18	1	2	30-40	5	5

A range of humidity levels are quoted for still images and microfilm. The humidity must not move outside this range. Any variation must not exceed the change of RH figure for 24 hours. For moving images, a target humidity level and figures for the maximum movement from this figure over periods of 24 hours and one year are quoted.

Basements and attics are usually not suitable for storing photographic materials. Basements are usually very humid and often accommodate plumbing which, if it starts to leak, may cause irreversible damages. Attics, if not properly insulated, will have an uncontrolled climate affected by the out-door conditions.

High temperature and high relative humidity (RH) accelerates most deterioration processes. The cooler the temperature, the slower the deterioration rate. The control of relative humidity is even more important in an archive or library with photographic materials. These types of damage may occur when the RH is **too high** :

- mould and fungi start to grow when RH rises above 60 %,
- the emulsion swells and get sticky,
- residual chemicals will accelerate deterioration processes,
- glass plates might start to deteriorate and the glass may turn foggy,
- deterioration processes caused by air pollutants, paints, etc, may accelerate,
- photographs on metal support, ferrotypes, may start to corrode.

The following damages may occur when RH is **too low** :

- the emulsion dries out and might flake,
- dry emulsion may fall off the support,
- film support may lose its flexibility.

Pollution

It may be difficult to keep the air in an archive or library clean since most major collections are usually situated in the centre of major cities. But it is nevertheless of the utmost importance to keep the areas free from air pollutants as possible. They are very reactive with substances in both b/ w and colour photographs. Listed in the following table are the requirements for clean air in photographic collections.

Other harmful substances exist in the air but good chemical filters customised for the substances listed in the table will control these as well.

Air Quality Requirements in Archives and Libraries for Photographic Materials		
Gas	**Active Set**	**Passive Set**
	g/m^3	g/m^3
SO_2	1	1
NO_x	5	1
O_3	25	2
CO_2	45	45
fine particles	75	75

If the collection includes any nitrate moving films, seek advice from the local fire authorities about the storage requirements, the maximum quantity of film that can be kept in one storage area and any other restrictions that they may require. This action is not merely good advice - it is essential. Nitrate movie film is considered to be an explosive by the fire authorities in many countries.

Conclusion

Photographic objects belong to a very delicate category of our cultural heritage which need special attention by trained personnel. Materials are susceptible to air pollutants, both fuel generated and emitted from furbishing and protective materials in repositories, as well as high humidity and temperature. It is important, therefore, to be in control of the preservation environment. It is also important to be able to identify the photographic methods represented in a collection and thus be aware of specific preservation problems.

Specifications, methods and measures for improving the preservation environment for photographic materials can be found in special literature and standards. Some of these are listed below.

Standards

ISO 417	Photography - Determination of residual thiosulfate and other related chemicals in processed photographic materials - Methods using iodine-amylose, methylene blue and silver sulfide.
ISO 543	Cinematography- Motion picture safety film - Definition, testing and marking
ISO 3897	Photography - Processed photographic plates - Storage practices.
ISO 4331	Photography - Processed photographic black-and-white film for archival records - Silver-gelatin type on cellulose ester base - Specifications
ISO 4332	Photography - Processed photographic black-and-white film for archival records - Silver-gelatin type on poly(ethylene terephthalate) base - Specifications
ISO 5466	Photography - Processed safety photographic films - Storage practices
ISO 6051	Photography - Processed reflection prints - Storage practices.
ISO 6200	Micrographics - First generation silver-gelatine microforms of source documents - Density specifications
ISO 8126	Micrographics - Diazo and vesicular films - Visual density - Specifications
ISO 9718	Photography - Processed versicular photographic film - Specifications for density
ISO 10214	Photography - Processed photo graphic materials - Filing enclosure for storage.
ISO 10602	Photography - Processed silver-gelatine type black-and-white film - Specifications for stability.
ISO 5-1	Photography - Density measurements - Part 1 : Terms, symbols and notations
ISO 5-2	Photography - Density measurements - Part 2 : Geometric conditions for transmission density
ISO 5-3	Photography - Density measurements - Part 3 : Special conditions
ISO 5-4	Photography - Density measurements - Part 4 : Geometric conditions for reflection density

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Website Directory

Organisations

International Federation of Film Archives (FIAF)
The International Federation of Film Archives brings together over 100 institutions devoted to the preservation of films.
http://orson4.filmtv.ucla.edu/FIAF/

National Film Preservation Foundation
Non-profit organisation which aims at preservation of the American film heritage.
http://www.filmpreservation.org/

American Film Institute (AFI)
AFI ensures the coordination of the organisations concerned with the motion-picture image as art. It has a National Centre for Film and Video Preservation, a database with information on film archives, and a collection of films. The website has pages on deterioration mechanisms, the craft of restoration, and restoration laboratories in the United States.
http://www.afionline.org/preservation/preservation.frame.html

Association of Moving Image Archivists
This non-profit professional association coordinates organisations concernded with collections, preservation, exhibitions and use of film archives.
http://www.amianet.org/

Image Permanence Institute
A laboratory working on photograph and film preservation.
http://www.rit.edu/~661www1/FRAMESET.html

Centre de recherches sur la conservation des documents graphiques (CRCDG)
This French research centre on preservation of graphic and photographic documents (run by the French Ministery of Culture and Communication, the CNRS (Centre national de la recherche scientifique) and the French National Museum of Natural History), carries out research programmes on photographic materials (e.g. the study of organic materials, of deterioration processes...)
http://www.culture.fr/culture/conservation/fr/laborato/crcdg.htm

Documents

Film/Digital/film
Latest information on different preservation methods and film preservation techniques, notably electronic imaging, by Michael Friend.
http://www.oscars.org/cmps/friend/friend.html

Discussion List

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