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EXHIBITION OF PHOTOGRAPHIC MATERIALS IN LIBRARY AND ARCHIVE COLLECTIONS

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Abstract
Photographic materials differ physically and chemically from collections of graphic media on paper. The chemistry and the composition of photographs vary by process. The diversity of image forming materials, binders, and emulsions, and the varying supports linked to each process create variations in the chemical and physical stability of photographs and therefore a greater sensitivity to the exhibition environment.

As a consequence of the absence of an international standard for the exhibition of photographic materials, and due to the fact that many archives and libraries do not have a trained photograph conservator on staff, it may be difficult for institutions to determine the most recent guidelines concerning the exhibition of photographic materials. This impediment can lead to the use of standards created for collections of works on paper, which can have severe consequences for most photographic images.

This paper attempts to summarize the conservation field's contemporary knowledge on the exhibition of photographic materials. Attention is focused on the viewing of photographs, their chemical and physical deterioration, and the effects of the exhibition environment, in particular the effects of light, temperature, relative humidity, and air quality.

Keywords
Photograph collections, exhibition, deterioration, guidelines, monitoring and materials

Introduction

Photographic materials often form a part of archive and library collections. They are usually dispersed between paper dossiers in archives, and sometimes they make up a distinct collection within the institution. Photographs from different processes are composed of various layers that interact differently with each other under various climactic conditions.

Salted paper prints and cyanotypes are examples of one-layer processes in which the image forming material is in direct contact with the paper. Albumen prints have two distinct layers. The albumen serves as a binder for the image-forming silver. It is composed of denatured egg white that is far less hygroscopic than the paper support on which it is coated. Collodion and gelatine printing-out papers (POP) have three layers, and some 20th century papers can have as many as 4 layers due to a resin coat of polyethylene that is applied on either side of the paper core.

Although most photographs have a paper support, processes such as daguerreotypes and ferrotypes have a metal support. There are large reserves of negatives on glass plates, cellulose nitrate, cellulose acetate and polyester film supports, the last three being plastic materials. Ambrotypes and pannotypes are examples of processes on glass and leather respectively, and still other types of supports exist.

In most monochrome images, the image forming substance consists of metals or pigments, including, among other substances, silver and platinum. The majority of photographs today, however, are colour images. The colour may be intrinsic to the process such as in chromogenic prints or silver dye bleach prints (Cibachrome and Ilfochrome), or pigments and dyes may be hand applied to monochrome images. It is the paper support that often links photographs to graphic media collections where they are given a place and treated as though they were also paper objects. Beyond the paper support, however, the similarities between works on paper and photographs end.

Photographs are extremely sensitive to their environment and have individual preservation requirements that in some cases can be compared to graphic media, but are commonly more stringent with respect to housing materials and environmental conditions. One aspect of preservation, the focus of this paper, is exhibition.

The exhibition of photographs requires a well-balanced relationship between the goals of curatorship and preservation. This entails that the viewer be able to examine the photograph under conditions that permit optimal observation and simultaneously not compromise the physical and chemical integrity of the object. This balance is difficult to achieve given that these two goals stand in conflict with each other.

Viewing

While it is complicated to define the boundaries of ideal viewing, previous publications indicate that we can already see most of what there is to see at 50 lux, and that we perceive objects not only better but differently, such as in terms of colour and brightness, with more light (Michalski, 1990, p. 584). McElhone states that a person under 55 years of age can distinguish between colours in a low reflectance object at 50 lux, but that older people may not be able to do so (1992, p. 183). Investigation into optimal visibility also shows that little improvement is seen in a viewer’s judgement in the range of 50 to 400 lux. It is not until illumination increases to 1000 lux and beyond, that visual acuity and colour discrimination clearly improve (McElhone, 1992, p. 183).

These findings play an important role and provide a conflict in the decision-making surrounding the exhibition of colour photographs in particular. These images require on the one hand higher illumination levels for optimal colour perception, but on the other hand they are extremely light sensitive. The exhibition of colour processes poses the challenge of exploring illumination levels greater than 50 lux that are low enough to protect the photograph from deterioration, but also allow for optimal viewing of the photographs. It must, however, be taken into consideration that illumination levels as low as 50 lux for short periods of time will cause noticeable light induced damage in some photographic processes. Levels of 100 lux, applied for the same period, may induce no noticeable damage in other processes. Yet further processes have a light stability that falls somewhere in the middle of this range.

Effects of light, temperature and moisture

<u>Image</u>

Interactions between light, temperature, relative humidity, and moisture content in the photograph, and especially the cycling of these, will lead to various forms of deterioration in the image layer. Although the silver particle is not directly affected by light, research results from Eastman Kodak Co. in 1985 and from James Reilly of the Image Permanence Institute show that some by-products of photo-oxidation of organic components can oxidize metallic silver, which can result in density loss, visually perceived as fading (Kodak, 1985, p. 108; Reilly 1986, p. 103). Practical experience of the effects of exhibition on photographs, as published by Severson in 1986, supports the research undertaken by Eastman Kodak Co. and Reilly. Densitometry measurements were taken from 38 albumen prints before and immediately after a nine-week touring exhibition with light levels below 30 foot-candles (approximately 300 lux), and again after a subsequent period of dark storage. Twenty-one prints showed changes in density after exhibition (1986, p. 40).

The Prussian Blue pigment that makes up the image-forming substance in cyanotypes has also been shown to fade by photochemical reduction mechanisms. Ware demonstrates that light fading of cyanotypes is not ultraviolet (UV) wavelength dependant since Prussian Blue has absorption bands in the red and blue regions of the visible spectrum and "presumably either one is effective in promoting fading". He also shows that fading due to visible and ultraviolet light is reversible by air re-oxidation in dark storage following exposure to light (Ware, 1999, p. 45 & 130).

Silver ions that are present in the image layer of a silver gelatine print can be chemically reduced by light exposure as a result of oxidation reactions and moisture, causing a darkening of the image in highlights and mid-tones or an overall reduction in contrast (Eastman Kodak Co., 1985, p. 84). Light-sensitive silver salts that are present in chemically stabilized photogenic drawings and poorly fixed photographs can "print-out" when exposed to light, causing a density change in mid-tones and highlights that is also visually perceived as a darkening or loss of contrast. A photogenic drawing of a piece of linen fabric made by William Henry Fox Talbot around 1835 "printed-out" and darkened within five weeks of exhibition at 5 foot-candles or approximately 50 lux (Reinhold, 1993, p. 91-92; Ware, 1994, p. 47).

Although sensitivity to light differs in the various colour processes, it is generally understood that light exposure can induce changes in density of the dyes, resulting in a colour shift or fading of the image (Schwalberg, 1990). The stability of the colour image depends on the nature of the dyes. Ink jet (dye-based ink) processes and chromogenic prints are generally among the most light-sensitive colour processes. The magenta dye used in ink jet prints has been shown to migrate at humidity levels above 60% (Robb, 2000), and chromogenic prints have been shown to fade in the dark (Wilhelm, 1993, p. 23). The dye-transfer process, although less stable than silver dye bleach prints, is generally more light-stable than most chromogenic prints (Lavédrine, 2000, p. 184). Pigment prints, on the other hand, can be very light stable due to their use of earth pigments such as sienna and umber. Pigments and dyes used for hand colouring of cased objects such as daguerreotypes and ambrotypes, but also of albumen and gelatine prints, may be very sensitive to light. Hand colouring and retouching is regarded as an intrinsic element of a photograph and may constitute the most fugitive component of the photograph (Watkins, 2003, p. 6).

Image binder

Light not only causes fading or darkening of the image forming substance, it can also react with the binder or emulsion of the photograph. In the presence of light and moisture, for instance, albumen is subject to photochemical damage that results in yellowing. Sugars that are naturally present in the albumen layer can cause yellowing by means of the Maillard or "protein sugar" reaction (Reilly, 1986, p. 35). Pink, blue and purple tinting dyes added to the albumen prior to coating were used between 1870 and 1900 to mask the inevitable yellowing in the highlight areas of albumen prints. These dyes are also extremely sensitive and will fade as a result of light exposure (Reilly, 1986, p. 38).

Collodion can also deteriorate due to light. Lavédrine and Gann suggest that prolonged light exposure can deteriorate the collodion binder causing cracking. Gelatine, which is less sensitive to light exposure than albumen, can yellow or become brittle by long-term light exposure; this is unlikely to happen at museum light levels, however (Reilly, 1986, p. 103). Gelatine can yellow as a result of contact with poor quality exhibition mounts and other mounting materials. Coatings and finishing techniques were used for various purposes on 19th and 20th Century photographs. Organic varnishes can yellow through prolonged light exposure and waxes can deteriorate especially with cycling of the relative humidity and temperature.

Primary and secondary supports

Photochemical reactions can also produce deterioration in the primary support. Ultraviolet radiation, for example, reacts with the titanium dioxide in resin coated (RC) prints causing deterioration of the polyethylene layer in the form of cracking and fading of colour image dyes. Products of this deterioration can also react with the image silver to create orange or red redox (reduction oxidation) blemishes. Around 1977, Kodak incorporated stabilizers into the paper core that diffuse into the polyethylene layer over time, thereby increasing its stability. These prints still exhibit light and ultraviolet sensitivity, however (Wilhelm, 1993, p. 128). Optical brighteners, introduced into paper supports in the 1950's, are also fugitive and can discolour upon exhaustion creating a dull (darker) overall appearance (Messier 2000; Mustalish 2000). The ultraviolet region of the visual spectrum can predominantly cause fading in primary and secondary paper supports, especially if the paper contains lignin (Reilly, 1986, p. 103). Cases for daguerreotypes and ambrotypes contain light sensitive dyed textiles, leathers and papers. Cases with inlaid mother-of-pearl have a lacquer finish which can be heat and light sensitive (Watkins, 2003, p. 7).

Effects of air quality

Deterioration during exhibition is also influenced by air quality. Hydrogen sulphide, an industrial pollutant, and sulphur and nitrogen oxides formed from the combustion of fossil fuels will form acids upon reacting with water. These can cause image fading and yellowing of silver image materials and cause supports to become brittle. Other organic and inorganic acids include acetic, formic, nitric, hydrochloric and phosphoric acids that can cause darkening of cellulose substrates and oxidation of some image forming metals.

Ozone, either a product of smog in outdoor air, of Heating Ventilation Air Conditioning Systems (HVAC) that are equipped with an ozone purifier, or of electrostatic copy machines, contributes to the formation of peroxides and free radicals. These compounds are able to oxidise all photograph components contributing to, for example, fading and discolouration of image materials. Other gases that can cause fading and other deterioration in photographs are ammonia, found in cleaning products, and gases from oil-based, alkyd or latex paints used to paint exhibition galleries. (Watkins, 2003, p. 9). Student research shows that gases from acrylic paints appear to be the least damaging to the image forming substance. The research also emphasizes the need for good ventilation of freshly painted areas. (Beutter, 2000).

Particulate matter such as dust, tobacco smoke, mould spores (in particular conidia) and combustion products such as soot and smoke can scratch sensitive surfaces or become embedded in soft emulsions. They can discolour silver-based photographic images and supports. Tar and nicotine in tobacco smoke stain coatings, binders and supports. Mould can deteriorate protein binders (such as gelatine and albumen), paper supports, and has also been identified on the image of daguerreotype plates (Chen, 2003).

Effects of framing and packaging materials

Sources of oxidizing gases and other harmful substances inside frames include mounts and backing boards, adhesives, and plastic substitutes for glass and frames. All materials should be inert or pass the Photographic Activity Test (P.A.T.), which has been adopted by the International Standards Organization as ISO 14523:1999. The P.A.T. uses artificial aging and Agfa-Gevaert colloidal silver strips to detect volatile compounds evolving from materials such as boards and papers in contact with the photographic emulsion that could cause fading of the silver image of black and white photographs. It also uses fixed and washed fibre-base photographic paper to indicate materials that could cause staining of the gelatine (Wilhelm, 1993, p. 456). Materials that do not meet the standards of the P.A.T are not recommended for exhibition or storage.

Wilhelm recommends non-corrosive metals such as anodised aluminium, aluminium finished with oven-baked enamel, and stainless steel for frames. Wood, especially when made from softwoods such as pine, should not be used to frame black and white photographs, because it releases peroxides, formaldehyde, acetic acid, and other harmful substances that, over time, can cause discolouration and fading of silver images. According to Kodak, varnished, stained or oiled frames should be avoided. Wilhelm specifies that RC prints should never be placed in wooden frames because of the release of peroxides and volatile oxidants not only from the wood but also from the degrading polyethylene layer of the print. Fibre based photographs may deteriorate from the harmful substances that are released from the frame, but they do not have the added problem of the deteriorating RC layer. Framing prevents the diffusion of these gases into the atmosphere away from the image forming material. Wilhelm also notes that there is evidence that under normal display conditions, framing has increased the fading rates of some RC colour prints (1993, p. 513-514).

Effects of physical handling

Human error during handling, packaging, transport and installation can prove detrimental to the physical stability of an object. Only trained and well-instructed staff should participate in the organization and installation of an exhibition. An example of physical damage due to insufficient knowledge of the exhibition staff is exemplified in the installation of a work called “Virtues and

Vices" by John Baldessari. This series of 14 photographs mounted on foam core was on loan and was installed in a gallery in the late 1980's. The technical staff hung the photographs on the wall using two nails at each edge of the photographs. Due to insufficient knowledge and installation techniques, a number of nails were struck through the images themselves and most edges of the photographs were badly damaged.

Standards for exhibition

There exists to date no national or international standard established solely for the exhibition of photographs. The one existing standard that gives mention to the exhibitions of photographs has been established by the American National Information Standards Organisation (NISO): Standard Z39.79-2001, Environmental Conditions for Exhibiting Library and Archives Materials. Its main focus is on paper and book collections in libraries and archives.

Although photographs are mentioned in the scope and purpose, the standard makes no reference to the influence of light, temperature or relative humidity levels in regard to the various categories of the sensitivities of photographs. No mention of the P.A.T. is made, and some photographic processes are listed only in terms of their vulnerability to pollutants: salted paper prints, albumen prints, gelatine printing-out papers, gelatine silver prints on RC paper, and daguerreotypes. The standard recommends environmental values of 21°C and 35% to 50% RH, and, for levels of ultraviolet radiation, the accepted limit of 75 microwatts per lumen at 10 to 100 lux. Illumination for all library and archival objects is recommended at 50 to 100 lux, depending on the object's light sensitivity, which is not further specified in the standard. Illumination with reduced ultraviolet radiation is limited to a 12-month exhibition period but should be based upon an individual item basis, which is also not further clarified.

Guidelines for exhibition

In terms of exhibition, assessment of photographic materials can be made on an individual item bases or according to the class of sensitivity of the photographic process. The National Archives and Records Administration (NARA) has proposed developing a value list to rank individual photographic materials according to their sensitivity. The value list approach would allow for a better understanding of the sensitivity of material for curators, historians and exhibition staff. A drawback to this approach is that this type of assessment is subjective. Also, it is difficult to make complex and varied materials fit into one category, making assessment of the list difficult (Watkins, 2003, p. 12).

As can be seen in Table 1., the illumination guidelines used in institutions vary between 50 and 100 lux. Most institutions listed in the table have made an attempt to specify exhibition terms, and some also specify light source and varying periods of dark storage between exhibitions. The Museum of Fine Arts in Boston, USA, for example, recommends a three-month exhibition period (for every two to three years) and a one-year period of dark storage after each exhibition. The Cincinnati Art Museum in Ohio, USA, recommends a five-year dark storage period after a four to seven-month exhibition for 19th Century processes. According to their guidelines, developing-out gelatine silver prints can be exhibited for up to twelve months, after which the photographs are required to be kept in dark storage for three years. Colour processes are to be exhibited at 50 lux for a maximum of twelve months with a subsequent three year dark storage period.

Institution	Temp.	RH	Light level	Duration
National Gallery of Canada	18-22° C	43-50%	50 – 150 lux	< 11 months
Int. Museum of Photography George Eastman House, Rochester NY	20.5-23° C	37-50%	< 100 lux	As specified
National Gallery, Washington DC	19-25° C	50%	< 50 lux	
Chicago Art Institute	20-21° C	40%	< 100 lux	< 12 months
Harry Ransom Humanities Research Center, Austin TX	21° C	45%	50 – 100 lux	3 – 4 months
Cincinnati Art Museum	21° C	50%	50 – 100 lux	4-12 months process dependant
Victoria and Albert Museum, UK	20° C	50%	50 lux	
British Library, UK	20° C	30-40%	< 100 lux	
J. Paul Getty Museum	20.5° C	30-40%	< 75 lux	

Table 1. Institutional guidelines for temperature and relative humidity, light exposure and duration (Watkins, 2003, p.11)

The Library of Congress drafted guidelines for light exposure levels in 1996. The compilation was updated and published in 2000 and appeared in *Topics in Photographic Preservation*, volume 9 (Table 2.). The guidelines categorize photographic materials into four classes of light-sensitivity under the assumption that all other environmental conditions meet conservation standards, e.g., UV and infrared (IR) radiation has been filtered out, relative humidity is at or below 45-50%, air contaminants are filtered out, and exhibition materials pass the Photographic Activity Test. If a particular process is in one light level category but does not meet all of the qualifications, it should be moved to the next, more sensitive, category. The guidelines express exhibition recommendations in lux hours but also suggest maximum illumination levels for each category (Wagner, 2001, p. 127-128).

Guidelines for Exhibition Light Level for Photographs
<u>Extraordinarily Light-Sensitive Photographs</u> (Only facsimiles should be displayed) Autochromes and other early dye processes Experimental processes such as unfixed salted paper prints Stabilized silver gelatine prints
<u>Very Light-Sensitive Photographs</u> (50,000 lux hours per year; dark storage for 3 years minimum) Poorly processed or deteriorated prints such as faded or yellowed prints Architectural plans or photo reproductions such as cyanotypes, photostats, van Dyke prints Non-earth coloured pigment prints such as carbon, gum bichromate, and Woodburytype prints Colour photographic processes such as pre-1990 transparencies, instant prints, dye transfer, Ciba/Ilfochrome Computer generated prints such as ink jet prints Photographs on resin coated supports Cased objects if case is exposed, such as daguerreotypes and ambrotypes Coloured paper and mounts Hand-coloured photographs Photographs with tinted base or binder, such as can be found in albumen and collodion POP
<u>Moderately Light-Sensitive</u> (100,000 lux hours per year; dark storage for 2 year minimum) Albumen prints Collodion and gelatine POP Platinum or palladium prints Salted paper prints All manuscript inks
<u>Less Light-Sensitive</u> (300,000 lux hours per year; dark storage for 1 year minimum) Black and white fibre-based silver gelatine developed-out paper prints Carbon, gum bichromate, Woodburytype prints if pigments are known to be carbon or earth pigment Cased photographs without hand colouring, only metal image exposed Photomechanical prints such as photogravures, half-tones, collotypes. Only if black earth pigment used, otherwise place in “very light-sensitive” category

Table 2. Guidelines for exhibition, specified by Sarah Wagner, Connie McCabe, and Barbara Lemmen

Another guideline, established by Bertrand Lavédrine in 2000, discusses a similar categorization of processes. Lavédrine established three categories: particularly sensitive, very sensitive, and sensitive, and he designates a number of processes that are not recommended for exhibition. His classification according to photographic process is less detailed. Lavédrine’s recommendations of illumination levels (Table 3.) are expressed in lux hours, or total annual light dosage, and are more conservative than those of the Library of Congress. Lavédrine’s guidelines are based on Karen (Colby, 1993, 3-11) adaptation of the blue wool standard. Lavédrine commented that a characterization of light sensitivity by process is possible because there are broad families of processes that generally behave in a similar fashion. As there are so many other factors causing stability or instability in a photograph, it is impossible to establish the light sensitivity of an image purely by process identification alone. Since exposure to exhibition environment is cumulative and each print ages with time, it is important that each print be evaluated individually and exposed to minimal light levels to reduce long-term damage. (Lavédrine, 2003).

Category	Process	Max. Light level	Annual dosage
Particularly sensitive	19^{th} Century processes	50 lux	12,000 lux hours
	Instant photographs	50 lux	12,000 lux hours
	Chromogenic	50 lux	12,000 lux hours
Very sensitive	Dye transfer	75 lux	42,000 lux hours
	Silver dye bleach	75 lux	42,000 lux hours
	Silver gelatine on RC paper	75 lux	42,000 lux hours
Sensitive	Silver gelatine fibre base	150 lux	84,000 lux hours
	Pigment processes	150 lux	84,000 lux hours

Table 3. Exhibition recommendations from Lavédrine (2000, p. 184)

Guidelines for air quality

Although recommendations for air quality for the exhibition and storage of photographs have not been standardized, guidelines on air quality for the storage of general museum collections have been made by Thomson in 1986. General standards for air quality in storage areas of archives have also been suggested (Mathey, et. al. 1983). Mathey recommends that limits for the level of carbon dioxide (CO_2) in storage areas should not exceed 4.5 micrograms per cubic meter. Ozone (O_3) levels should not surpass 2 micrograms per cubic meter. Levels of sulphur dioxide (SO_2) should not exceed 1 microgram per cubic meter, and nitrogen oxides (NO_x) limits are recommended at 5 micrograms per cubic meter (Mathey, et. al. 1983).

Preservation measures

Monitoring

The implementation of monitoring methods supports responsible exhibition procedures. The monitoring methods should be reliable and well calibrated, and monitoring should take place prior to exhibition, after exhibition, and ideally, when possible, during exhibition. Monitoring should be performed using the same device for each examination and using templates to relocate the exact location in the image that was initially measured. Responsible monitoring will allow for the development of exhibition history files in which changes in the colour or density are carefully recorded for each object. McElhone states that material recorded as having undergone substantial colour change during display should be regarded as light sensitive, and that recommendations for subsequent display (or restriction thereof) should explicitly state the predicted losses for a given exposure. Exposure of sensitive materials can drastically be reduced by installation of simple viewer-operated curtains or automatic light controls (McElhone, 1992, p. 189).

Monitoring equipment

Though often used to detect changes in photographs, visual inspection is unreliable, because colour perception varies with lighting conditions. On the other hand, visual detection usually means that a substantial change in colour has occurred. Other methods can detect a change that is much more subtle allowing immediate removal or discontinuation of display and adoption (or restriction) of future exhibition. There is yet no monitoring standard in the exhibition community, and various methods to measure change of colour or density in photographs are in use.

Densitometry is the least expensive of existing choices. It uses standardized equipment which is easy to calibrate and use. However, it cannot detect changes in chromaticity and requires regular maintenance and replacement of filters and light sources. A colourimeter is an instrument that measures reflected light using red, green, and blue electronic photoreceptors. It is often used by paper and paintings conservators. A single reading incorporates values of hue, brightness and chromaticity. A colourimeter can be confusing to learn to use and is more expensive than a densitometer. A spectrophotometer measures the ratio of reflected to incident light for one wavelength at a time, scanning through the desired wavelength range. The resulting spectrum represents the reflectivity of the measured sample at each wavelength. Its advantage is that it has the highest sensitivity of the three, and calibration is not necessary with "double beam instruments". Spectrophotometers are expensive and are difficult to transport to various locations. Also, assessment is time consuming (Watkins, 2003).

The blue wool standard can be used in conjunction with monitoring with the devices mentioned above. This standard (British Standard 1006) makes use of a fading colour indicator card that was adapted for the exhibition of paper materials by Karen Colby. The standard was adapted by creating three categories of sensitivity of museum objects. The card is usually cut into two halves. One half of the card serves as the control and is sealed in an envelope and attached to the back of the frame on exhibition. The second half of the card is attached to the wall next to the frame during exhibition. If the fading of the exposed dye patches correlate to a standard fade during exhibition, then the illumination or duration of exposure is too high for the artefact that is being monitored. Because the sensitivity of the blue dyes of the scale on the indicator card of the blue wool standard is not great enough to address changes in very light-sensitive photographs, Lavédrine is developing another type of indicator monitoring device. Although not yet commercially available, this type of light dosimeter makes use of an even more light sensitive blue dye that will fade to pink after 50,000-lux hours, and to white after 100,000-lux hours (LiDO, 2003).

Paul Whitmore and his colleagues of the Carnegie Mellon Research Institute, Research Center on the Materials of the Artist and the Conservator, designed a "micro-fading tester" that samples a small area (0.4 mm) in the image area of a photograph with intense light. Reflectance spectra are gathered and computer programme provides real time charts and graphs as fading occurs, and can extrapolate the data to predict long term rates of fading. The sensitivity of the photograph to light is established in a mere five minutes. The test area and the fading that occurs are generally imperceptible to the unaided eye. The main factor limiting the commercial success of this device and its software is the projected cost of approximately US $ 10,000 to 20,000 (Watkins, 2003, p. 17). Currently, the only available method of truly accessing the true light-sensitivity of a photograph is by using a micro-fadeometer such as the one developed by Whitmore (Lavédrine, 2003).

Use of reproductions

Photographs that are physically or chemically too fragile for exhibition should be singled out and replaced by other, more stable, originals or by facsimiles that can be made in various reproduction qualities. A reproduction of a photogenic drawing was exhibited for the first time in the history of the Rijksmuseum in Amsterdam, The Netherlands, in 1999, in an exhibition of photographs by Isaac Asser, one of Holland's first photographers. A sign was used to explain the production and use of the reproduction for the exhibition. This compromise proved successful for the curator, the advising photograph conservator, and the public (Gann, 1999).

Conclusion

When defining an illumination level it is important to consider the optimal viewing conditions for exhibition visitors. Establishing the exhibition illumination level according to light doses in lux hours may be beneficial when trying to reach a compromise. The sensitivity of the photograph, illumination level, temperature, relative humidity (and cycling of these), air quality, quality of materials in the vicinity of the object, careful handling, and responsible monitoring should all be included in an exhibition policy. Irresponsible exhibition can result in damage to all components of the photograph including fading, darkening, or yellowing of the image and binder, and deterioration of the image support.

Establishing the stability of the photograph can be a difficult process, because evaluations must be based upon an understanding of the various processes and the chemical interactions that can take place within the image layer and with the surrounding environment. Assessment of the stability of a photograph should take place on a per item basis. A trained photograph conservator working when necessary in collaboration with a specialized conservation scientist can best make these assessments.

There is a genuine need for the development of exhibition standards that focus solely on the sensitivity of the various photographic processes. The guidelines that libraries and archives adhere to are largely taken from or modelled after the standards established for collections of graphic media on paper. The recommendations and guidelines developed by the Library of Congress and revised by Wagner, McCabe, and Lemmen, and those published by Lavédrine are important initiatives in the development of a standard for the exhibition of photographs.

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