

The Light Matters Caring for Ancient Paintings

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Free Room 3

Open late Fridays

Britishmuseum.org



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Room3

ZHANG Huan 1

00 Preface

Beginning from a mysterious painting from the Caves of the Thousand Buddhas in northwestern China, explore how light matters to collections and how to care for ancient paintings.



The Caves, also known as the Mogao Caves, are famous for their statues and wall paintings spanning 1,000 years. In 1987 they became a UNESCO World Heritage site.



01 Raking light around the painting



Raking light round the painting

Can you see a join down the centre under the raking light? The detail of the painting has been considerably reduced on either side.

Try to switch the raking light on and off from different angles. What else do you see?

What is raking light

Raking light, the illumination of objects from a light source at an oblique angle or almost parallel to the surface, provides information on the surface topography and relief of the artefact thus lit. It is widely used in the examination of works of art. Video: Raking Light -- Lifting Paint

Video: Raking Light -- Raised Panel

Background of the painting

- This painting is made of paper with ink and colour. It is from the Caves of the Thousand Buddhas, Dunhuang, Gansu Province. It dates from the Tang dynasty, 9th century.
- Of all the paintings found at Dunhuang, this one remains perhaps the most mysterious. When found, two woodcut prints of Avalokitesvara had been pasted onto it, covering everything except the string of money.
- A dragon is shown among flames confronting a Chinese official writing with a brush. At the bottom, a string of Chinese coins is represented. The dragon has horse's hooves; the official too has a hoof instead of a foot, though only a small part of it is now visible.
- This drawing may represent the mythical Emperor Fu Xi receiving the trigrams from the dragon-horse, who emerged from the Yellow River. Alternatively, the official's hoof-shaped foot may refer to the lameness of the great Yu who quelled the waters of a legendary flood. He received writings from a river deity (a tortoise, not a dragon). This picture may well be the visual equivalent of such popular stories, the painter having fused the most distinctive elements of two parallel events for greater visual effect.

02 What is light

What is light

• Light is an electromagnetic (EM) radiation, part of which stimulates the sense of vision is called visible light or visible spectrum.



Electromagnetic spectrum



RED Orange Yellow Green Blue Indigo Violet

A triangular prism dispersing a beam of white light into component colors

Light (electromagnetic radiation) that cannot be seen with human eye

- Infrared (IR) is an invisible electromagnetic radiation with a wavelength from 700 nm to 1mm, longer than that of visible light of the visible spectrum at 700 nm to 1 mm.
- Ultraviolet (UV) is an invisible electromagnetic radiation with a wavelength from 400 nm to 10 nm, shorter than that of visible light but longer than X-rays.
- X-radiation (composed of X-rays)) is an invisible electromagnetic radiation with a wavelength from 0.01 to 10 nm, shorter than that of UV.

A video - What is light

Common application of the light



03 Light using for conservation

Technical Imaging of Paintings

- Conservators employ a number of examination and imaging techniques to explore the multiple layers of a painting, layers that are both visible and invisible to the naked eye. Some of these approaches require the simple use of unusual lighting angles, while others involve very specialized equipment capable of producing or capturing electromagnetic wavelengths above or below the narrow band of the visible spectrum. While one technique may assess the nature and condition of the varnish and restoration layers lying on the surface, others are capable of recording hidden layers lying below the visible image.
- A question might be answered with one technique, or several in combination.

What do you see under different Light?



About this drawing

Head of a woman to front, her eyes lowered, with hair tied back. 1505-7 Metalpoint, heightened with white, on pink prepared paper



Technical light: Visible reflected image



Technical light: Infrared reflected image (800-1000 nm)



Technical light: False colour infrared



Technical light: UV reflected image (365 nm)



Technical light: UV reflected-false colour image (365 nm)



Technical light: UV-induced luminescence image (365 nm)

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UV reflected image reveals a blot in the paper



IR suser ve disinus ut exemple quis fist idoneus fist sermoni alegan te eformando. In igit que San libro & inculcat (nec

The handwriting blurred is clearly visible in a Infrared reflected image.



X-radiograph of a embroidered bird

X-radiograph showing a pin and complex wire support for needlepoint stitching of the bird. Concealed from view behind the head is a second glass eye. The embroidery is glued to a wooden board. Growth rings from the wood can be seen as fine lines on the radiograph.

It is just an example. My exhibition intends to find paper based items to show X-radiograph when companted to normal photos.



Jezebel, by John Liston Bymam Shaw (1872-1919), Russell-Cotes Art Gallery & Museum

An X-Ray showing the original nude Jezebel.



X-radiograph of the cat in the Chinese painting

We see the cat's (1) whiskers? (2) eyelashes?

(3) face and neck?

All of this information can not be distinguished with the naked eye.

04 Light induced damage

Why does light damage paintings?

- Light damage is both cumulative and irreversible.
 Light can cause fading, yellowing, and weakening of some materials.
- Museums must be concerned with three different types of radiation from light sources. These three types are ultraviolet, infrared, and visible.
 - Ultraviolet light that damages chemical bonds
 - Infrared light causes heating and subsequent
 - cracking of paint
 - ≻Influence of light on humidity
 - ➤Multiple mechanisms

How does the light damage paper?



Cellulose is the main component of paper.

Oxidation of the cellulose

Ultraviolet oxidation causes paper to turn yellow and weakening.



OX refers to light induced oxidation

Pigment changing color

- One reason is cementing material aging changes the particle density of pigment.
- Another reason is chemical bonds changing. For example, Red color lead tetroxide may turn to black color lead dioxide under some humidity and light. Red color mercuric sulfide may change to black under light.



05 How to reduce light damage

Do you know

Why is the lighting in some galleries dark

Why does the gallery lighting always switch between on and off ?

Select proper lighting

- Luminescence: The term luminescence is used to describe a process by which light is produced other than by heating.
- •No UV
- •No mercury
- Reasonable illuminance, that is that is at a visible light level
- Here are some lighting approaches commonly used in museum, such as LED, Halogen tungsten lamp, fiber lighting.

Avoid unnecessary exposure

- Keep collections away from light.
- Turn lights off after work in the store.





Preventive conservation

 There are many environmental conditions that should be monitored and controlled in museum settings. Maintaining proper environmental conditions in a museum setting is extremely important. These are light, temperature, relative humidity, acidic gases, oxidizing gases, pollutants and dust. When combined they produce a negative effect on objects.



Wireless environmental monitoring system

Light settings for ancient paintings

- Paper items or paintings are sensitive to light.
 Generally, the recommended maximum visible light level is illuminance 50 Lux. It seems a little dark.
- The recommended maximum annual Lux hours exposure is 150,000, which is the product of Lux multiplied by hours. In some galleries, lighting is turned off if there is no audience, that is to limit the light exposure time.

Interventive conservation

 Necessary treatment, for instance, using physical method to strengthen unstable structures, using chemical approach to partly reverse light induced oxidation reaction (photooxidation), which is reduction reaction.



Restoration of hydrogen bonding in paper fibre

06 Flash on



Flash on

What is your light level?

Is it suitable for paintings?



Capture a photo without flash

What is the difference

Capture a photo with flash



Appendix leaflets and handouts

Conservation issues

•As to paintings, the maximum visible light level is 50 Lux. No UV light.

Recommended Light settings in museum (leaflets for visitors)

- The light sensitivity varies for different types of objects. Accordingly, the lighting settings vary.
- Light levels should be between 50 lux (for light sensitive materials) and 300 lux (for light–durable materials)
- UV power of illumination should be reduced to less than 75 μ W/lm and preferably less than 10 μ W/lm using a filter passing the Museum's criteria.
- Light exposure should be limited. Recommended Annual Lux Hours Exposure should be between 150,000 lux (for light sensitive materials) and 900,000 lux (for light–durable materials).

Recommended Light settings in museum (leaflets for visitors)

Sensitivity Materials	Visible light	UV
None		
metal; stone; glass; ceramics; enamel	Illuminance: 300 lux	75 μW/lm
	Exposure: 900,000	
	lux/hours per year	
Moderate		
oil and tempera paintings; undyed leather;	Illuminance: 150 Lux	75 μW/lm
wood; plastics; painted metal surfaces;	Exposure: 450,000	
painted enamel	lux/hours per year	
High		
textiles; costume; dyed leather; fabric	Illuminance: 50 Lux	75 μW/lm
aircraft surfaces; organic igments/dyes;	Exposure: 150,000	
archival material; manuscripts; newspaper;	lux/hours per year	
photographs; watercolours; gouache; prints;		
drawings; natural history exhibits; fur		