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Scientific Approaches to Preventive Conservation

History of Preventive Conservation **Jo Kirby Atkinson**

Lecture notes

Slide 2: Outline

Introduction

Slide 3: Preventive conservation as we understand it today has its origins in our long-standing concern for the care of objects as a part of everyday life. This slide shows medieval European examples of cleaning and storage.

Slide 4: More examples. 1) 16th-century laundry; note the wooden washing bats for beating the dirt out of the linen, rinsing laundry in the river; spreading linen out in the fields to dry and bleach in the sun. 2) 19th- and early 20th-century equipment for beating and sweeping carpets.

Early history – treasuries, libraries and archives

Slide 5: In most communities, and particularly in those where collections of objects – archives, libraries, treasuries, museums – have been formed over time, attention has been given to maintenance and safe storage – conservation of artefacts. The treasury at Delphi is a very early European example. The building is said to have been financed by booty obtained after the battle of Marathon in 490 BCE and recent archaeological evidence suggests the date of construction is after 490 BCE. Historically the treasuries, libraries and archives of medieval cathedrals, monasteries and universities have played an important role in terms of storage and safe keeping. This slide shows an example of a cathedral treasury, Halberstadt, Germany. Most cathedrals had (and many still have) treasuries, although not necessarily where they were originally situated. Climate control was installed in the exhibition cases here in Halberstadt in 2008 by Museumtechnics, Berlin, with an adjustable rate of airflow and controlled RH. The lighting is calibrated to the light sensitivity of the exhibits (http://www.museumstechnik.de/en/portfolio-item/halberstadt-cathedral-treasury/).

Slide 6: The Shōsōin at Tōdai-ji in Nara was built between 756 and 759 AD and many of the artefacts housed date back to the time of its construction. The traditional building material in Japan is wood, vulnerable to fire damage. The Shōsōin is a wooden building, but it was constructed using logs triangular in cross section, thicker and more durable than those usually used. It has a raised floor, in this case of timber, a feature quite often found in *kura* as the passage of air under the building keeps the interior cool and insects, rodents and other pests are prevented from entering.

Slide 7: Archival material such as government documents, financial records, wills, inventories, commercial records required careful storage. This example shows the storage cupboards containing the original wooden archival storage boxes in the Muniment Room of

Magdalen College, Oxford University. The cupboards were built in the late 15th century (the college was founded in 1458). The storage boxes contain title deeds from the properties owned by the College, many of which date from before the foundation of the College. For further information on this project see http://www.magd.ox.ac.uk/libraries-and-archives/conservation/medieval-deeds-project/ (accessed September 2015) and related links.

Early history – control of damage

Slide 8: Religious paintings in northern Europe might be protected from light and dust by curtains or shutters – wings – that covered the main panel, although it is very important to understand that there could also be an important ritualistic element in these cases: the shutters might be opened or closed at certain times in the church calendar and often were kept closed except for particular religious festivals. This, of course, would have given additional protection against dirt, damp and light.
The quotation is from Filippo Baldinucci, *Vocabolario toscano dell'arte del disegno* (Florence, 1681) , p. 121.
Translation from A. Nova, 'Hangings, curtains and shutters of sixteenth-century Lombard altarpieces', in E. Borsook and F. Superbi Gioffredi, *Italian Altarpieces 1250 – 1550: Function and Design* (Oxford, O.U.P. 1994), pp. 177–189: p. 186.

Slide 9: In this altarpiece, the central scene shows The Virgin and Child with Saints Florian and John the Baptist; left wing: The Annunciation (above); The Presentation in the Temple (below); right wing: The Nativity (above); The Adoration of the Magi (below). The predella at the base of the altarpiece is in the form of a chest. The two central panels of the four we can see, bearing images of female saints, are in fact closed wings covering a niche which has lost the decorative elements and sculpted figures it originally contained. The sculpted reliefs formerly on the inner surfaces of these wings are also now missing, as is the carved superstructure which was originally attached at the top of the altarpiece. Carved figures of Saints Peter and Paul, originally attached, are now kept separately.

Slide 10: –

Slide 11: This slide gives two 17th-century English descriptions of curtains used to protect paintings, particularly valuable works of art, as these clearly were. This would include protection from damage by dirt, dust and light. Salisbury House belonged to the Cecil family. Members of this very powerful English family served the English court during the 16th and early 17th centuries.
The quotations are from 1) C.M. Clode (ed.), *Memorials of the Guild of Merchant Taylors of the Fraternity of St. John the Baptist in the City of London* (London, 1875), pp. 92–6;
2) G Dyfnallt Owen (ed.) *Calendar of the Cecil Papers in Hatfield House, Volume 22, 1612–1668* (London, 1971), pp. 249–255.

Slide 12: In the background of this 16th-century Italian wallpainting is an altarpiece with a curtain to cover it. Again, it is important to recognise that in this case too there could be a religious significance to the presence of the curtain, but, as with shutters or wings, curtains would also protect the painting against light, dirt and dust.

Slide 13: Another example of a painting protected by a curtain, by the 17th-century Dutch artist Gabriel Metsu.

Slide 14: Description of an 18th-century temporary exhibition, described as well lit, with curtains to protect the exhibits and heating for the comfort of the visitors.
The quotation is from G.H. Gater and F.R. Hiorns (eds), *Survey of London: Volume 20, St Martin-in-The-Fields, Pt III: Trafalgar Square and Neighbourhood* (London, 1940), pp. 66–68: 10, 12 and 14 Spring Gardens.

Slide 15: Plants (such as wormwood, lavender), poisonous minerals (such as orpiment) and other substances (such as camphor) were used to control moths and other insect pests, rats and mice. The following examples are European, but similar attempts at control could be found in any country.

Slide 16: In *Historical Perspectives on Preventive Conservation* (Los Angeles, Getty Conservation Institute, 2013), edited by Sarah Staniforth, readings are included from some of the housekeeping and other literature used as advice by people to help them deal with pests. As an example, to show that books like this were produced widely, this is a page from a German book of useful household information from the early 18th century, *Neueröffneter curioser Schatz-Kasten, welcher mit allerhand fürtrefflich- und bewährten, der Natur und Kunst, auch Medicinisch- und Chirurginischen Secreten …*(Nuremberg, 1706), suggesting methods to deal with mice and rats (p. 712, translations by Jo Kirby Atkinson).

Slide 17: Details of illustrations. Left: Workshop of Robert Campin, *Annunciation Triptych* (*The Merode Altarpiece*), c. 1427 – 32. Oil on oak, 64.5 x 117.8 cm total: Right-hand wing, showing Joseph in his carpenter’s shop, 64.5 x 27.3 cm. New York, Metropolitan Museum of Art, the Cloisters Collection 1956, accession no. 56.70 a – c. Painted in Tournai, South Netherlands (i.e. present day Belgium);
Top row: Left, Cat with mice – detail from illuminated initial Q at the beginning of Book 16 of Gregory the Great, *Moralia in Job*, Arnheim, Germany, second half 12th century. London, British Library, BL Harley 3053 f. 56v (http://www.bl.uk/catalogues/illuminatedmanuscripts/record.asp?MSID=4076&CollID=8&NStart=3053);
Mousetrap, 1800–1850, pine, London, Victoria and Albert Museum, no. W.10-1934;
Bottom row: Detail of mousetrap from Joseph in his carpenter’s shop, shown left;
Rat-catcher, woodcut, English, 17th century, source unknown.

Slide 18: Insects from left to right: common webbing clothes moth, *Tineola bisselliella*; carpet beetle larva, *Anthrenus verbasci*; woodworm (adult), *Anobium punctatum*; book louse, *Liposcelis* sp.
The quotations are from: 1) J. Gairdner (ed.), *Letters and Papers, Foreign and Domestic, Henry VIII, vol. 10, January – June 1536* (London, 1887), pp. 161–181;
2) W.A. Shaw and F.H.Slingsby (eds) *Calendar of Treasury Books, Vol. 29, 1714–1715* (London, 1957), pp. 814–833: Warrant Books: November 1715, 1–15: Reference Book IX, p. 256.

Slide 19: The powerful scents of essential oils in lavender, wormwood and the related species mugwort were very unpleasant to moths, although not necessarily to people: lavender gives a pleasant scent to clothes and linen. These plants (which might be dried) were placed with clothes for storage. The rhizome of the false helleborine or white hellebore is extremely poisonous. These are all European species. Their taxonomic names are: wormwood, *Artemisia absinthium* L.; mugwort, *Artemisia vulgaris* L.; white hellebore, *Veratrum album* L.; common lavender, *Lavandula angustifolia* Mill.; spike lavender, *Lavandula latifolia* Mill.

Slide 20: Compounds of arsenic and mercury were widely used as poisons, in medicine and for many other uses, including as pigments. They were traded in large quantity in Europe from quite early medieval times. Paper coloured yellow with orpiment (used in India) is not attacked by insects. It is not clear that the mercury mixture described in the recipe given on the slide would be attractive to moths such that it poisoned them, but repelling them would do just as well, of course. Another suggestion for killing lice was the root or rhizome of white hellebore (see slide 19, very poisonous) mixed with black soap and sulphur.
Quotation from *Neueröffneter curioser Schatz-Kasten* …(Nuremberg, 1706), p. 722.

Slide 21: Camphor, a product of the trees *Cinnamomum camphora* (L.) J. Presl. (camphor tree) or *Dryobalanops aromatica* Gaertn. (Sumatra or Borneo camphor), and white sandalwood (*Santalum album* L.) were used against moths in India and other regions, sandalwood having a particularly pleasant smell. (Some other unrelated trees also have scented woods. Note that red sandal- or sanderswood, *Pterocarpus santalinus*, is a dyewood and not scented.) All were imported into Europe from the East in substantial quantities from medieval times and all – and also orpiment and vermilion, the synthetic form of red cinnabar – are described by the Florentine merchant, Francesco Balducci Pegolotti in his handbook written around 1340. Part of his description of camphor, in English, is given on the slide.
The quotation is from Francesco Balducci Pegolotti, *La pratica della mercatura*, ed. A. Evans (Cambridge, Mass. The Medieval Society of America, 1936). For camphor see p. 375; translation by Jo Kirby Atkinson.

Technological change: the Industrial Revolution

Slide 22: The other factors contributing to the development of preventive conservation have been, firstly, the growing recognition of the different agents causing damage and, secondly, a gradual understanding of how these agents affect different materials. The Industrial Revolution in Europe and the USA, the effects of which spread gradually across the rest of the world, brought about considerable technological developments – artificial lighting, more efficient heating, efficient manufacturing methods, ...

Slide 23: … rapid methods of transport, but an increased possibility of damage to both buildings and their contents.

Technological change: Scientific developments

Slide 24: At the same time, however, progress in the scientific understanding both of materials and of the agents that might cause damage, taking place throughout the nineteenth and twentieth centuries and continuing today, has contributed to a greater understanding of both the properties of the materials from which cultural heritage objects were made and those of the agents that could cause damage: light, temperature, relative humidity, pollutants. This has enabled the care of cultural heritage to be carried out more effectively and with a greater understanding. The illustrations show two of the scientists who made great contributions in physics and chemistry during the 19th century, James Clark Maxwell (1831–1879) and Michael Faraday (1791–1867).

The growth of collections

Slide 25: The growth of large museums, galleries, libraries and other collections over the last 150 years or so has provided an impetus for many recent developments in preventive

conservation, in particular the control of lighting, relative humidity and temperature, and pollution.
Libraries existed in early times; early examples are the famous Royal Library in Alexandria (founded in the 3rd century BCE and destroyed by fire sometime after the Roman conquest of Egypt in 30 BCE) and the library in the Roman city of Herculaneum, buried during the eruption of Vesuvius in 79 CE. Monasteries, cathedrals, places of learning had (and still have) libraries. One of the most famous is in the Abbey of St Gall, St Gallen, Switzerland, founded in the 8th century CE. The library interior, shown in the slide, was reconstructed in the mid-18th century. The library of Hereford Cathedral, England (another medieval foundation) is one of the best extant examples of a chained library, a commonly used method to safeguard valuable books (https://medievalfragments.wordpress.com/2012/02/01/meet-the-project/).

Slide 26: Collections of paintings and objects – the Cabinet of Curiosities or *Schatzkammer* – were developed in Europe at the end of the sixteenth century and grew into the museums and galleries of today.

Slide 27: Flemish School, *Cognoscenti in a Room hung with Pictures*, about 1620 (NG1287). Oil on oak, 95.9 x 123.5 cm. London, The National Gallery. © The National Gallery, London. This is an example of a collection focused on paintings. Note the large windows, apparently without curtains (or not that we can see, but these may have been a winter furnishing for warmth). No artificial lighting (candles) has been depicted; this gallery seems to be lit principally by daylight.

Slide 28: Many museums and galleries have their origins in a personal collection or cabinet of curiosities of this type. The collection made by Sir Hans Sloane, which formed the nucleus of the British Museum collection, is mentioned on the slide. Another example is the Ashmolean Museum, Oxford, which was formed from the collection donated by Elias Ashmole (1617–1692). Ashmole had himself acquired the collection of his neighbour, John Tradescant and his son, also called John, which was opened to the public in the 1630s. This collection, Tradescant's Ark, was the earliest significant cabinet of curiosities in England.

Pollution

Slide 29: Pollution from manufacturing trades was a recognised problem in urban areas in Europe (and elsewhere) long before the late eighteenth and nineteenth centuries. Certain trades such as leather tanning and woad or indigo dyeing were often confined to areas outside the town partly because of the smells or unpleasant products generated. Vermilion manufacture in 17th-century Amsterdam is an example of an industry where particular care was necessary because of the poisonous mercury-containing product that was produced by sublimation and thus the poisonous fumes. Although the smells and by-products caused by these industries were not necessarily damaging to artefacts they did cause public nuisance. The quotation is from A.F.E. van Schendel, 'Manufacture of vermilion in 17th-century Amsterdam: the Pekstok Papers', *Studies in Conservation*, 17, 1972, pp. 70–82: p. 71.

Slide 30: The quotation describing the unpleasantness of sea coal is from A.H. Thomas (ed.) *Calendar of Early Mayor's Court Rolls: 1298–1307* (London, 1924), pp. 21–45: Calendar: Roll B, 16 December 1298 – 29 September 1299.

Slide 31: The polluted air in London was so bad by the 17th century that the author John Evelyn wrote his pamphlet *Fumifugium, or The Inconveniencie of the Aer and Smoak of London dissipated* (London, 1661)addressed to King Charles II, indicating that the burning of sea coal was a more important factor in the production of poor air quality than other industries such as lime burning and soap boiling and suggesting remedies. The same year, a Sergeant-Major Franck petitioned the King for a patent for 14 years for his invention of furnaces for 'saving fuel by brewers, dyers, melters of metals, &c. ... the annoyance of smoke in London and other towns would thus be lessened'. Wood for burning was apparently becoming rather scarce. However, nothing of any consequence seems to have been done. The quotation on the patent is from M.A. Everett Green, *Calendar of State Papers Domestic: Charles II, 1660–1, Volume 34: April 1661* (London, 1860), pp. 561–579.

Slide 32: As well as his achievements in the field of chemistry and physics, notably electricity and magnetism, Michael Faraday showed a concern for environmental science, including the noxious smells from the seriously polluted River Thames (to be much improved by the renewal of London's sewage system by Joseph Bazalgette) and advising the British Royal Mint on pollution. By the mid-19th century, with the growth of heavy industry burning more coal and producing more dirt, sulphur-containing gases and other waste, the effects on public collections situated in urban centres were a matter of great concern. This is shown, for example, by the Select Committee reporting in 1850 to the British Parliament on the National Gallery, London, and the condition of the paintings. Faraday distinguished between chimney fumes and general organic pollutants generated by the population, also between sulphurous gases like hydrogen sulphide and sulphurous acid from burning coal (derived from sulphur dioxide and water) as part of his evidence to the committee. The report on the protection of the pictures was written by the gallery's director, Charles Lock Eastlake, Michael Faraday and the painter William S. Russell. The visitors included a large number sheltering from the rain, eating refreshments, children playing and using the gallery as a public space. As a result of the foul air and need for ventilation the windows had to be opened. The illustration is Honoré Daumier, *Free day at the Salon*, from the series *Le Public du Salon*, published in the journal Le Charivari (17 May, 1852) p. 10; the comment is '25 degrees of heat'. The annual Salon exhibitions took place at the Louvre Museum in Paris: clearly unpleasant conditions in crowded galleries was not simply a London problem.

Slide 33: The recommendations of the 1850 report included the suggestion that pictures of moderate size should be glazed and the backs of the pictures covered as protection against dirt and impurities. The 1853 Report observed that the situation was not much improved and recommended a move west to the less polluted area of Kensington Gardens. This did not take place. Over the following years dusting was carried out more meticulously, protecting the pictures while this was being done. Filtration of air was recommended by some authorities by the 1890s, although this was not even studied at the National Gallery until work done by F.I.G. Rawlins in 1936.

Slide 34: This slide shows the pollution from household chimney smoke still present around the National Gallery, Trafalgar Square, London in 1895, a state of affairs that was commonplace in built-up areas.

Light

Slide 35: Gas for lighting (and later cooking etc) was generated from coal, purified and stored for use. The rapidly growing number of power stations producing gas added to the pollution

in cities from the burning coal. The gas for Grosvenor House was supplied by the Gas Light and Coke Company from their main nearby in Park Street. Efficient artificial lighting was immediately successful and its installation in public and domestic buildings spread rapidly, first gas light, later electric light.
The quotation and illustration are from F.H.W. Sheppard (ed.), *Survey of London: Volume 40, the Grosvenor Estate in Mayfair, Part 2 (The Buildings)*, London, 1980, pp. 239–250, Old Grosvenor House. For the illustration see p. 246, fig. 64b.

Slide 36: Pollution had links to lighting: burning generates smoke, and so dirt; candles and oil lamps generate greasy smoke, burning gas, even when purified, contains impurities even before it is burnt.
The quotation is from A.H. Church, *The Chemistry of Paints and Painting* (London, 1890), p. 274; or 3rd edition, 1901, p. 317.

Slide 37: As well as radiation in the visible region, the illumination produced by a light source, such as the sun, contains ultraviolet radiation (which we cannot see, but some animals, such as bees, can) and infrared radiation, heat. Light causes vulnerable colouring matters – dyes, pigments – to fade; the ultraviolet component is particularly damaging and, as well as fading, causes deterioration and loss of strength: fibres become brittle; paper crumbles; textiles fall apart. The heat may also be damaging – one of the reasons for caution over glazing pictures. In this cushion cover, the reverse of the embroidered panel has been protected from light and shows the strength and vibrancy of the colours originally.

Slide 38: This is a detail of the woman as seen from the front (left) and the back (right). The dyes were extracted from natural sources, but have not been identified.

Slide 39: Already during the eighteenth century in Europe, some scientific investigations into the properties of pigments, including their response to the effects of light, were carried out, although these early researches were more concerned with the properties of the pigments than with those of light. Probably one of the earliest relatively systematic studies was that of the English colour maker George Field, dating from the first decades of the nineteenth century. He exposed samples of pigments, made by himself and obtained from other people, to sunlight and the sulphurous fumes from a lavatory (methods of testing also used by others) and noted the results. These were developed into useful tables, first published in 1835, showing the permanence of pigments to light, and also the influence of other factors (damp, sulphur-containing gases). The page of 'specimens' are duplicates of the experimental specimens; he recorded the results as the fading work progressed. Tables listing pigments by their permanence to light (although with less detail than Field's) appeared frequently in published work in the second half of the 19th century.
The table (one of several) is from George Field, *Chromatography* (London, 1835), p. 184. Several editions of this book appeared during the 19th century.

Slide 40: W.J. Russell and W. de W. Abney, *Report to the Science and Art Department of the Committee of Council on Education on the Action of Light on Watercolours* (London, 1888). A useful summary of the report was made by N.S. Brommelle, 'Russell and Abney Report on the action of light on water colours', *Studies in Conservation*, 9, 4, 1964, pp. 140–152, also published in Sarah Staniforth's book, cited above.

Slide 41: –

Slide 42: Later work is summarised in the sections on light in G. Thomson, *The Museum Environment*, London, Butterworths, 1st edition 1978, 2nd edition 1986.

Relative humidity and temperature

Slide 43: Methods of heating or cooling in houses had always been required for human comfort, but they were also important for certain trades to be carried out efficiently and the needs of manufacturing and commerce played a significant role in the development of efficient heating and ventilation systems. To give an example from the English textile industry, a relatively warm temperature was needed for efficient spinning of cotton and silk to avoid breaking the fibres, which meant stopping the machinery, and during the eighteenth century, warm air heating systems were devised for textile mills. These predate the steam heating systems developed and used early in the nineteenth century, notably by the architect Sir John Soane in some of his public buildings, including the Bank of England and Dulwich Picture Gallery, and his own house, now the Soane Museum in Lincoln's Inn Fields, London. William Strutt's design for a stove is taken from G. Sylvester, *The Philosophy of Domestic Economy ... as exemplified in the Derbyshire General Infirmary*, (Nottingham, 1819), plate 2 (detail).

Slide 44: In hotter regions of the world, systems for cooling buildings were required. The ground floor of the main building of the former Marine Police Headquarters in Hong Kong, built in the 1880s, was constructed approximately a metre above the ground and small openings all round the building acted as ventilation portals, permitting a flow of air, cooling the interior and also preventing decay of the wooden floor joists. High ceilings and large windows also helped cool the building in hot, humid weather. (This was originally a two-storey structure; the third floor was added in the 1920s.)

Slide 45: The need for ventilation as well as heating in public buildings was also recognised and the system for moistening, drying and cooling the air in the British Houses of Parliament described by David Boswell Reid in 1844 is one of the earliest examples of air conditioning. D. Boswell Reid, *Illustrations of the Theory and Practice of Ventilation* (London, 1844); an excerpt also appears in Sarah Staniforth (ed.) *Historical Perspectives on Preventive Conservation* (Los Angeles, Getty Conservation Institute, 2013).

Slide 46: 1) M. Eibl and A. Burmester, 'Learning from history: historic indoor climate conditions and climate control strategies', in J. Ashley-Smith, A. Burmester and M. Eibl (eds), *Climate for Collections: Standards and Uncertainties* (London, Archetype in association with Doerner Institut, Munich, 2013), pp. 217–232: p. 223.
2) J.W. McCabe, 'Humidification and ventilation in art museums', *Museum News*, (1 September 1931), pp. 7–8; see also Staniforth 2013, cited above.

Slide 47: For the wartime storage of the National Gallery collection see Martin Davies and Ian Rawlins, 'The war-time storage in Wales of pictures from the National Gallery, London', *Transactions of the Honourable Society of Cymmrodorion*, 1945, pp. 179–93; see also Staniforth 2013, cited above. The National Gallery was not the only museum or gallery to store its collection in caves or mines in this way, but it is one of the best documented examples.

Slide 48: A survey of museums in Europe and North America, carried out by Harold Plenderleith and Paul Philippot and published in 1960, showed that most preferred a range of

values for relative humidity around 40–70%, generally within or overlapping the 50–60% range, 50% being recommended to avoid desiccation of materials such as parchment, 60 % at the upper end to avoid mould growth. This useful survey also described the equipment available for measurement or recording relative humidity, as well as that available for dehumidification, humidification and air conditioning.
H. Plenderleith and P. Philippot, 'Climatologie et conservation dans les Musées / Climatology and Conservation in Museums', *Museum*, 13(4), 1960, pp. 202–41 (French), 242–89 (English).

Slide 49: For further information on work carried out on temperature and relative humidity see G. Thomson, *The Museum Environment*, London, Butterworths, 1st edition 1978, 2nd edition 1986. For further reading see Jo Kirby Atkinson, 'Environmental Conditions for the Safeguarding of Collections: A Background to the Current Debate on the Control of Relative Humidity and Temperature'. *Studies in Conservation*, 59, 2014, pp. 205–12.