

## Glossary

**Alizarin crimson:** alizarin dyestuff, the synthetic equivalent of one of the constituents of madder dye was first prepared in 1868. The lake pigment prepared from it was available by the end of the 19th century.

**Anhydrite:** anhydrous calcium sulfate,  $\text{CaSO}_4$ . See also *Gypsum*.

**Azurite:** a blue pigment; basic copper carbonate,  $2\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$ . See also *Malachite*.

**Black:** these pigments were mostly made by burning plant material such as twigs (charcoal) or peach stones. Soot was also used.

**Blister-laying:** sticking down paint by injecting adhesive.

**Bole:** a smooth clay: containing iron(III) oxide - which is usually a strong reddish-brown colour. Mixed with an animal glue or egg white it was used as the underlayer for gold leaf.

**Bone black:** a black pigment made from carbonised bone, which gives a warmer black than does wood charcoal.

**Brazilwood:** a tropical wood. The source of a cheap and very fugitive red dyestuff.

**Brown earth:** see *Earth pigments*.

**Burnishing:** polishing by rubbing. Gold leaf was burnished (usually with a smooth agate or a dog's tooth) before being punched or otherwise decorated. It was a delicate and time-consuming occupation.

**Cadmium yellow:** a stable dense, deep yellow pigment consisting of cadmium sulfide. Invented in 1817, available from the mid - 1840s.

**Canvas:** the use of canvas as a support began to dominate over wood panel in the early-to-mid 16th century. Canvas is lighter in weight than wood, it is easier to transport and cheaper to buy.

**Cassel earth:** a dark brown earth pigment prepared from lignite (brown coal) and containing a good deal of organic material (from peat) as well as iron (III) oxide; later known as 'Van Dyck brown'.

**Cennino Cennini:** an artist who wrote the earliest Italian treatise on easel painting, *Il Libro dell'Arte*, around 1390. This described traditional painting methods as practised in Italy throughout the 14th century.

**Cerulean blue:** a greenish blue pigment composed of cobalt stannate. Introduced in 1860.

**Chloroform:** trichloromethane,  $\text{CHCl}_3$  - widely used as a solvent. It can also be used for killing insects, and it was a widely-used anaesthetic for operations in hospitals until about 1950.

**Chrome orange:** basic lead(II) chromate(VI),  $\text{PbCrO}_4 \cdot \text{Pb}(\text{OH})_2$ .

**Chromium oxide:** (opaque) dull green anhydrous chromium (III) oxide originally used as a ceramic glaze colourant and later as an artists' pigment.

**Chrome yellow:** lead(II) chromate(VI),  $\text{PbCrO}_4$ . This pigment is rather unstable and, in an atmosphere polluted with sulfur compounds, tends to turn black. Louis Nicolas Vauquelin discovered the element chromium in 1797 (named from the Greek word for colour), and later chrome yellow. Chrome yellow is made by precipitating the pigment by mixing two solutions of ionic compounds - eg lead(II) nitrate and potassium chromate (VI).

**Cinnabar:** the mineral form of red mercuric sulfide used to make the pigment vermilion (although vermilion was also synthesised from early times).

**Cleaning solvent:** a great many organic solvents and solvent mixtures can be used to clean paintings and there are numerous different ones on the market.

**Cloth of honour:** a length of a fabric (usually cloth of gold or brocade) placed behind an important person to single them out.

**Cobalt blue:** a mixed cobalt-aluminium oxide,  $\text{CoO} \cdot \text{Al}_2\text{O}_3$ . The French government sponsored research on the compounds of cobalt, with the intention of producing a better range of blues. The work of L.J. Thénard on the ores of cobalt led directly to cobalt blue.

**Cobalt violet:** a pure mauve pigment consisting of cobalt phosphate or cobalt arsenate, sometimes a mixture of both. Invented in 1859.

**Cochineal:** a red dyestuff derived from a type of scale insect. There are two biologically distinct types, one from the Old World and one from the New World. However, the principal component of the dyestuff is the same in each: carminic acid.

**'Copper resinate':** the name often given to a green glaze, usually containing verdigris. It was widely used during the Italian Renaissance due to the lack of other good greens. Often the resin was simply a constituent of the glaze paint medium, with the oil; but sometimes the verdigris was warmed with the resin (pine resin) before mixing with the oil, and the product then is 'copper resinate'. This product discolours easily to give opaque brown, or even black, with exposure to light.

**Craquelure:** a network of cracks over the surface of a painting which appear as a result of ageing. The cracks are caused by shrinkage, the movement of the ground, paint and varnish. These are not the same as the cracks or defects caused by the inappropriate use of oil.

**Crimson:** the word comes from kermes: a type of scale insect. See also *Lake*.

**Dolomite:** a mixed calcium and magnesium carbonate; a hard limestone, found especially in the Dolomite mountains of the Tyrol.

**Earth pigments:** (brown, red, yellow, orange and black) - natural silica/clay mixes, with the colour due to iron(III) oxide in various proportions. (See *Green earth* and *Ochres*)

**Egg tempera:** pigment mixed with egg yolk and water to make paint. The egg is the medium. (Cennini recommends that the paler yolks of town eggs should be used as the medium for painting young flesh, whereas the deeper-coloured country yolks should be used for older, rougher faces).

**Emerald green:** a brilliant green pigment - 'copper acetoarsenite' invented in 1814 and manufactured on a large scale from then on.

**Energy dispersive X-ray microanalysis (EDX).** For an outline of this process see page 14.

**Fourier transform infrared spectrometry (FTIR).** For an outline of this process see page 15.

**Fugitive pigment:** a pigment which is likely to fade in light.

**Gas chromatography (GC):** eg to find the ratio of carboxylic acids in an oil medium to identify the oil. (For an outline of this process see page 16.) Before sensitive and reliable techniques like gas chromatography, there had been much argument about the medium used in certain paintings. Some artists had made plausible copies of famous works by using egg-oil and oil-resin mixes; and, because they could copy the surface appearance of a painting, they assumed that the original artist had used the same materials and techniques as they had.

**Gesso:** Italian for gypsum: hydrated calcium sulfate,  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ . This is the familiar white material used for ceiling coving and other plasterwork in homes and elsewhere. Gypsum, anhydrite or chalk (calcium carbonate,  $\text{CaCO}_3$ ), mixed with glue, was used to coat panels or canvas to make a suitable surface - or *ground* - before painting began. (A partially hydrated form of calcium sulfate,  $2\text{CaSO}_4 \cdot \text{H}_2\text{O}$ , is Plaster of Paris, used in making plaster casts and for broken bones).

**Glaze:** a layer of translucent paint applied over other paint to modify its colour or to give depth and richness of colour.

**Gold leaf:** pure gold, beaten to a very thin sheet. It was often made from gold coins and required great skill and delicacy of handling, both in its manufacture and application.

**Green earth:** a marine, volcanic or igneous sediment containing silicates and iron(II) minerals, used alone or mixed with lead white. This colour was commonly used in early Italian painting for the underlayers of flesh.

**Ground:** this is the preparatory layer put over the support before the paint is applied.

**Gypsum:** a white mineral composed of calcium sulfate dihydrate; used in the preparation of *gesso*.

**Haematite:** a very hard red pigment, similar to red ochre: iron(III) oxide ore,  $\text{Fe}_2\text{O}_3$ .

**Impasto:** thickly applied paint which stands out from the surface of a picture - in relief.

**Imprimatura:** a thin layer applied to a basic ground to modify its colour preparatory to painting.

**Indigo:** a blue dye, obtained from the plant *Indigofera tinctoria* and other species, including woad.

**Infrared reflectography.** For an outline of this process see page 17.

**Isinglass:** a whitish semi-transparent glue-like substance, a form of gelatin made from the viscera of some fish, especially sturgeon. See *Sturgeon glue*.

**Kermes:** a type of scale insect yielding a red dyestuff used to make lake.

**Knights of Malta:** This was originally a monastic community, dedicated to Saint John. Originally known as the Knights of St John of Jerusalem (the Knights Hospitaller). The Hospital was located in Jerusalem close to the church of St John the Baptist from where they took their name. They administered a hospice-infirmery for pilgrims to the Holy Land, and later became an order of Knights when they were also required to provide military protection for crusaders.

**Lac:** a scale insect, the source of a red dyestuff (and also shellac – a type of varnish).

**Lake:** a pigment made by precipitation on to a substrate from a dye solution — *ie* causing solid particles to form which are coloured by a dye. Lakes may be red, yellow, reddish-brown or yellowish-brown. They give a translucent paint when mixed with the medium, particularly oil. They are often used as glazes and have a tendency to be fugitive. Red or crimson lakes were made originally by precipitating hydrated alumina with the dyestuffs from madder, kermes, lac, cochineal or brazilwood. Now, more usually, lakes are made with synthetic dyes.

**Lapis lazuli:** a complex sulfur - containing naturally occurring sodium aluminium silicate used to make the bright blue pigment ultramarine.

**Laser microspectral analysis (LMA)** also sometimes called **Laser microspectrography (LMR)**. For an outline of this process see page 18. A method used for elemental analysis of the inorganic materials present in paintings. This process is no longer used at the National Gallery.

**Lead-tin yellow (type I):** a mixed oxide of tin and lead,  $Pb_2SnO_4$ .

**Lead-tin yellow (type II):**  $Pb(Sn,Si)O_3$  (approximately), containing some free  $SnO_2$  and some silicon.

**Lead white:** basic lead(II) carbonate,  $(2PbCO_3 \cdot Pb(OH)_2)$ . Made synthetically from an early date. Now banned because of its toxicity.

**Lemon yellow:** strontium chromate(VI),  $(SrCrO_4)$ . Not known before the 19th century.

**Linseed oil:** a drying oil, made by pressing the seeds of the flax plant, which was, and is, also grown for making linen.

**Madder:** a red dye obtained from the roots of a trailing herbaceous plant *Rubia tinctorum*; the pigment made from the dye can fluoresce orange-pink in ultraviolet light.

**Malachite:** a green pigment; a basic copper carbonate,  $CuCO_3 \cdot Cu(OH)_2$  (see also *Azurite*). Both azurite and malachite occur as natural copper ores. They can also be synthesised – *eg* artificial malachite.

**Mass spectrometry (MS).** For an outline of this process see page 19.

**Mastic:** a gum or resin exuded from *Pistacia* tree species, dissolved in turpentine to make a varnish.

**Medium:** the glue which, when mixed with a pigment, makes paint. The two most widely used in old paintings were egg yolk (with water) – see *egg tempera* – and drying oils such as linseed or walnut oil.

**Metamerism:** this occurs when two colours which appear to be the same in, say, daylight no longer do so when lit by, say, tungsten lamp bulbs, or when printed in a colour photograph. It is particularly glaring with blues, and most likely to be seen because of the large areas of sky in pictures.

**Naples yellow:** a manufactured lead and antimony compound. It has been found in 16th and 17th century paintings but was more common in the 18th century. It varies in formula.

**Ochres:** yellow, brown and red – natural clay/silica mixes with varying amounts of iron(III) oxide,  $Fe_2O_3$ , as the main colouring. One type of brownish-yellow ochre is

sienna; this, when heated strongly, gives burnt sienna, which is a warm red-brown. Raw and burnt umbers are similar.

**Orpiment:** a bright yellow mineral pigment; an arsenic sulfide,  $As_2S_3$ . Commonly found in conjunction with *realgar*.

**Patination:** a pleasing appearance of age normally acquired through the passage of time, but sometimes simulated by forgers.

**Pendants:** paintings often of identical size and complementary subject matter, painted to hang together.

**Pentimento** (plural – *pentimenti*): a visible alteration – where an artist changed his/her mind, as the work on a painting progressed. The word comes from Italian ‘*pentire*’ – to repent.

**Pouncing:** transferring a design by dusting coloured powder (usually crushed charcoal), through holes pricked along the outlines of a drawing on paper or parchment.

**Priming:** a preparatory coat put onto the support or ground to prevent subsequent layers from being absorbed.

**Prussian blue:** a complex iron cyanide of approximate composition  $Fe_4[Fe(CN)_6]_3 \cdot H_2O_{14-16}$ . First discovered accidentally in Berlin, between 1704 and 1710.

**Punching:** a process of gently hammering decorative indentations into gold leaf.

**Raking light:** light at a very shallow oblique angle to the surface of a painting, which shows up the texture and irregularity of the paint.

**Realgar:** an orange-red mineral pigment; an arsenic sulfide,  $\text{As}_2\text{S}_2$ . (Mineral realgar is  $\text{As}_4\text{S}_4$ ). Commonly found in conjunction with *orpiment*.

**Red earth:** (see *Earth Pigments*)

**Red lead:**  $\text{Pb}_3\text{O}_4$  is quite rarely used in paintings, except as underpaint for the much more expensive vermilion or red lake. But examples where it has been used on its own for its bright orange do occur – eg in 14th century Florentine painting.

**Resin:** a sticky substance which oozes out of certain trees. It is insoluble in water.

**Rose madder:** prepared from madder root under carefully controlled conditions by a method first developed in the 19th century.

**Scheele's green:** a dull green copper arsenite pigment invented in 1775 but not commonly used until the late 19th century.

**Scumble:** a thin opaque or semi-opaque coat of paint applied to the surface of a picture to modify it. The verb 'to scumble' refers to the process of applying this layer.

**Size:** a gelatinous solution used to stiffen fabric or paper.

**Sgraffito:** Italian for scratched. A technique in which paint is applied over gold or silver leaf and then partially scraped away to reveal the shiny metal. Most often used to represent cloth-of-gold textiles.

**Smalt:** a blue glass, ground to powder and used as a pigment. To make smalt, cobalt ore was roasted to make blue cobalt oxide. This was heated with quartz and potash; the blue melt was then poured into cold water to form glassy particles. These were coarsely ground to make the smalt. The deepest blue smalt contains more cobalt and has the largest particle size.

**Soap.** For cleaning paintings. A salt of a long chain organic acid (such as those found in animal fat or vegetable oil, or a more complex aromatic acid). The soap can be designed for use under very carefully controlled conditions of pH. It must not be too alkaline, to prevent damage to the paint surface. It can then be removed from the paint surface without leaving a residue. Ordinary toilet soap contains a high proportion of sodium stearate,  $\text{C}_{17}\text{H}_{35}\text{COO Na}$ .

**Sturgeon glue:** a glue made from the viscera of sturgeon; superior for some uses to animal-skin glue. See also *Isinglass*.

**Turpentine:** an oily sticky substance which oozes out of certain coniferous trees, and is then

distilled to make a volatile and pungent oil used in mixing paints and varnishes. It is a mixture of quite complicated hydrocarbons called terpenes.

**Ultramarine:** a bright blue pigment: a complex sodium aluminosilicate containing some sulfur. Until it was manufactured chemically in the 19th century it was obtained only from the blue mineral *lapis lazuli* mined in Afghanistan. It was more expensive than gold. *Lapis lazuli* is still mined from the same mountain in Afghanistan. 'Ultramarine' means 'from across the sea'.

**Varnish:** a transparent layer used for coating and preserving the surface of paintings. One common old varnish was made of mastic dissolved in turpentine. The discolouration of varnishes is the main reason why paintings are cleaned.

**Verdigris:** a bright green pigment; basic copper(II) ethanoate,  $\text{Cu}(\text{CH}_3\text{COO})_2 \cdot 2\text{Cu}(\text{OH})_2$ . It was prepared by exposing sheets of metallic copper to vinegar vapours.

**Vermilion:** a bright red pigment – mercury(II) sulfide,  $\text{HgS}$ . Vermilion was made artificially from an early date, although it could also be obtained by pulverising the mineral cinnabar. It has a tendency to convert to metacinnabar,  $\text{Hg}_2\text{S}$ , which is black.

**Viridian:** a green pigment – hydrated chromium(III) oxide,  $\text{Cr}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ . In 1797 Louis Nicolas Vauquelin

discovered the element chromium (named from the Greek word for colour), and the chromium pigments viridian and chrome yellow followed later. See *Chrome yellow*.

**X-ray diffraction (XRD).** For an outline of this process see page 20.

**X-ray radiography:** lead white absorbs X-rays strongly, but so do vermilion (containing mercury), lead-tin yellow, and lead chromates. But it is the fact that lead white absorbs X-rays strongly, and is also widely used in painting, that gives an X-ray image in which the dark-light contrasts are more or less the same as those seen in the painting. Gesso does not absorb X-rays to any great extent. The total X-ray absorption in any area is the sum of the absorption in each of the paint layers in that area, so that it is possible to see whether the painting is directly on to gesso, or on top of blue sky or sea – both of which contain lead white in the paint mix. Flesh colours often contain lead white, so faces, hands *etc.* usually show up well in X-radiographs. Titanium white is less opaque to X-rays than lead white (**NB** Lead is used to protect hospital radiographers from X-rays).

**Yellow lake:** prepared the same way as red lake. The dyestuffs come from plant species such as dyers broom, weld and buckthorn.