

The medieval palette: medieval pigments and their modern equivalents

Introduction

While it is often more convenient to use pre-mixed gouache, watercolour and oil paints, all of which are period materials, it is worthwhile learning the characteristics of individual pigments and being able to mix your own paints. In this way you will be able to use paints not available in pre-mixed form such as egg tempera and encaustic; plus it is considerably cheaper to have one set of pigments and several different binders than to have many different types of paint. You will also gain a better appreciation of traditional medieval techniques, bearing in mind that the first job of a medieval apprentice painter was to grind and prepare pigments and mix paints, so that by the time he actually got to paint he would have been quite familiar with the qualities of each one.

Paint essentially consists of a pigment plus a binder (also known as the carrier or vehicle). It sits on the surface of the painting ground, unlike a dye or stain, which penetrates the surface and hence can only be used on absorbent surfaces. The common binders used in the middle ages were oils (linseed, walnut, poppyseed); egg (purified yolk; and beaten egg white, called *glair*); beeswax (for encaustic); gum Arabic; and lime-wash, milk or hide glue for decorative painting. Pigments were obtained from coloured minerals or vegetable or insect dyes, specially prepared to extract the colour.

Pigments are not all alike: they each have their individual characteristics in terms of the optimal particle size necessary to achieve a good colour, opacity, durability and light-fastness, ease of mixing with different binders and how well they stay suspended in the binder. These characteristics are further modified by the optical properties of the binder. Modern pigments are no different from medieval pigments in this respect, and only practice will enable the artist to grasp the subtleties of each pigment and get the best out of them.

In these notes I will discuss the pigments in groups of each colour, describing the pigments used during the middle ages (written in *italic*) and the currently available pigments (written in ***italic bold***) which may be used in their place. Making the different paints from these pigments will be covered in a later article.

Blacks

Other than the black of *iron-gall* ink, which achieves its colour by a chemical reaction of the iron in the ink with atmospheric oxygen, black pigments were all basically varieties of carbon: charcoal or soot. *Lampblack* is the soot collected from burning oil, tallow or a resinous wood under a metal plate. It is initially a little oily, but if baked inside a ball of dough the oil is absorbed out to leave pure carbon. Finely ground charcoal made from vine pruning or from peach stones also make good blacks. ***Lampblack, vine black, bone black*** and ***ivory black*** are the modern blacks, essentially unchanged from the middle ages. A colour which is almost black can be obtained by mixing ultramarine blue with burnt umber.

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Whites

The pre-eminent white of the medieval palette was *ceruse* or *lead white* (white lead carbonate). It is a dense, opaque pigment which handles well. It is still available to purchase as **lead white** or **flake white**, but has the disadvantages that it is poisonous, reacts with a number of other pigments and discolours in air under some conditions. Where lead white was unsuitable, *lime white* and *chalk* or *eggshell white* (calcined bone or shell) were used. **Lime white** is still used today, mainly for fresco and lime-wash, but the more common whites currently in use are **titanium white** and **zinc white**. Titanium white is a brilliant, opaque white, whereas zinc white is slightly more translucent and a little grey. Zinc white is useful for mixing the flesh tones of sick or dead people, and as a thin wash for veils and mists.

Reds

Many reds were available to the medieval artist. The cheapest and most readily available were the many shades of red earths (ochres) such as *sinoper*. These reds are still in use today, often named after the region where they were obtained. Earth reds include **red ochre**, **red oxide**, **venetian red**, and **burnt sienna**.

Richer reds were available from *minium* (red lead tetra-oxide) and *cinnabar/vermillion* (sulphide of mercury). Minium was commonly used to make red ink for manuscripts and is the origin of the term miniature, originally applied to manuscript illustrations, then to any small picture, and finally coming to mean any small scale thing. Cinnabar, naturally occurring mercuric sulphide, and vermillion, the manufactured compound, were the most esteemed reds. They are bright and lustrous, becoming more so the more they are ground and mixed. **Vermillion** is still available today, but is highly poisonous, quite expensive and potentially damaging to gilding if it contains any free mercury. (For a demonstration of making vermillion in the medieval manner from elemental mercury and sulphur, there is a short segment on the DVD *Cracking the Colour Code* featuring British icon painter Aidan Hart). The modern substitute is **cadmium red**, which has a similar intensity of colour but is slightly less orange than vermillion.

A number of reds were obtained from insects or insect secretions: *lar*, *grain*, *kermes*, and (in the 16th century) *cochineal*. Cadmium red is also a satisfactory substitute for these.

Several reds were derived from vegetable pigments used for dyeing. These are known as lake pigments. As dyes, they have no 'body' to them, and to be used for painting are precipitated out of solution onto alum or chalk and then dried. Red lakes included *brazil-wood* (obtained from Ceylon; the country Brazil is named after the wood), *dragons-blood*, *turnsole* and *madder*. Although madder was a common red dye, it was not much used as a paint pigment until the 17th century because brazil-wood was so much easier to prepare. Lake pigments have the disadvantage that they are not very durable or lightfast. The modern pigment **alizarin crimson** is a synthetic version of madder. It is quite transparent and only good for washes and glazes.

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Blues

The most esteemed blue of the middle ages was *ultramarine*. This intense blue was rare and expensive - the only known source was Afghanistan and it required a complex process to extract the pigment from the stone. It was used to paint the Virgin's robes, both as an allusion to the blue of the vault of Heaven, and because the use of expensive materials such as gold and ultramarine was considered a way of honouring the Virgin. Synthetic **ultramarine blue** is much cheaper and is chemically identical.

For other blues, *azurite* (a copper carbonate ore) was widely used. This was simply crushed to make the pigment, but had an optimal particle size to get the best blue. If it was too finely ground it appeared grey. **Cobalt blue** is a modern approximation.

Other period blues included *blue bice*, a manufactured copper salt; *smalt*, obtained by grinding up cobalt blue glass; and the lake pigments *indigo/woad* and *turnsole*. Turnsole (also known as *folium*) could be red, purple or blue depending on the pH and method of extraction. **Prussian blue** is one of the earliest synthetic pigments (1706) still used today and can be used as a substitute for blue lake pigments. It is rather transparent and best for use in glazes and washes.

Purples

Durable natural purples were difficult to find. The iron oxide pigment **caput mortuum**, still in use today, is purplish brown. Various berries such as elderberry (*menisci*) were used to obtain pink to purple shades but were not durable. *Murex purple* from whelks and other crustaceans was very expensive and smelly to produce. This and *turnsole purple* were mainly used for dyeing parchment and paper rather than as paint pigments. Purples were usually made from a mixture of red and blue, and this is the option I would recommend with modern pigments.

Greens

Green was also a problematic colour. There were green earth pigments available (*terre verte*), but the mineral greens obtained from *malachite* (copper carbonate) and *salt green* and *Spanish green* (verdigris; copper acetate) were unstable and often corrosive to paper and parchment. Some plant greens were available from sap and berries, but greens were predominantly mixed from blues and yellows.

Terre verte is still available, and **chrome oxide green** is a useful general purpose green which mixes well with other colours.

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Yellows

A number of yellows were available. *Earth yellows* widely used in the middle ages. The corresponding earth yellows today are **yellow ochre, yellow oxide and raw sienna**. The lake pigments included *saffron, weld* and *buck-thorn* all of which mixed well with indigo to make green. *Indian yellow*, which was used by the Persians, is obtained from the urine of cattle exclusively fed mango leaves.

The available mineral yellows were *giallorino* or *mascot* (yellow oxide of lead), *orpiment*, and *realgar* (yellow and orange sulphides of arsenic respectively). Orpiment and realgar are highly toxic and were recognised as such even in the middle ages. They also have the major problem of being incompatible with lead and copper-based pigments, as well as being difficult to grind. The modern substitute, **cadmium yellow**, has none of these problems.

Browns

Apart from some unsatisfactory experiments with bitumen-based browns by later period oil painters, browns were almost exclusively earth pigments, and are the same pigments used today - **raw sienna, burnt sienna, raw umber, burnt umber** and **caput mortuum**. They can be darkened by adding a little black, but attempts to lighten them with white is much less satisfactory and results in dull, muddy colours.

Metallics

Metal leaf, particularly *gold leaf*, was widely used. A cheaper imitation was made by using *tin leaf*, and painting it with saffron-tinted varnish. *Silver leaf* was used, but tended to blacken even if varnished.

Powdered metals such as gold, mica and bronze were used, mixed with binders such as gum Arabic. In the case of gold this was known as *shell gold* after the small seashells in which it was mixed and stored.

The materials and techniques of applying metals have not really changed. Various types of **metal leaf** are available, as is **shell gold**. Cheaper alternatives include **calligraphers gold ink** and **"gold" powder** (actually bronze) mixed with a binder, however these can never achieve the brilliance of genuine gold.

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Suggested pigments for pre-17th century painting

For a starter set of pigments suitable for making egg tempera, oil paints, pastels/chalks, encaustic and manuscript paints (watercolour or gouache) I would recommend the following:

1. lampblack, ivory black or carbon black
2. titanium white
3. zinc white
4. cadmium red
5. cadmium yellow
6. chrome oxide green
7. ultramarine blue
8. terre verte
9. yellow ochre or yellow oxide
10. venetian red, red oxide or red ochre
11. burnt sienna
12. burnt umber

The following pigments will extend your colour range but are not essential:

13. cobalt blue
14. raw umber
15. raw sienna
16. caput mortuum
17. alizarin crimson (madder lake)
18. prussian blue

There are a number of historic pigments available, of which lead white (flake white) and vermilion are the most widely stocked by art supply shops. Some pigments may only be obtained by mail order from overseas e.g. orpiment. It is important to note that a number of these pigments are very toxic, orpiment in particular. In addition to taking precautions when storing, using and disposing of them, there may be restrictions on their import due to Australian laws (poisons legislation).

Avoid phthalo-, naphtha-, acrylide- and other synthetic pigments and acrylic binders.

Some of the more well-known brands are **Langridge Artist Colours**, an Australian company; **Natural Pigments (Rublev Colours)**, based in California with affiliated companies in Russia and Lithuania; and **Lukas Artists' Colours**, a German company. These companies also stock a large range of traditional art materials and tools and provide information on their web-sites about how to make and use historic paints. Golden Artist Colours produces only acrylic paint, however their on-line newsletter has a lot of useful articles about pigment technology. The Science Daily website features the latest articles on scientific art history research, some of which challenges existing knowledge about historic art materials and techniques.

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References

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Lukas Artists' Colours website http://www.lukas.eu/WEB_GB/index.html

Natural Pigments website <http://naturalpigments.com/default.asp>

Golden Artist Colours *Just Paint Newsletter* <http://www.goldenpaints.com/justpaint/index.php>

Science Daily *Fossils and Ruins News* http://www.sciencedaily.com/news/fossils_ruins/