Shield Paints

Compiled by Hazel Uzzell

Contains colour illustrations of pigment samples on wood

© Hazel Uzzell 2012
CONTENTS

Introduction

Sources

References to paint...stones & boards

Glossary

Binding mediums

Historical notes on pigments

Pigments used in other countries

Pigments

Dyes

Preparation of wood

Mediums & Carriers

Recipes

Varnish

Colour printed examples of pigments

Suggestions for modern paint equivalents

Useful notes
SOURCES

Personal Communications

Gill Woolrich  Assist Curator of Archaeology, Sheffield City Museum
Tim Padley  Keeper of Human History, Tullie House Museum, Carlisle
Fraser Hunter  Dept of Archaeology National Museum of Scotland
Elizabeth Hartley  Keeper of Archaeology, York Museum, and Museum of Yorkshire Life
Steven Plunkett  Keeper of Archaeology, Ipswich
David Symons  Antiquities Curator, Human History Dept, Birmingham Museum
John Clark  Curator, Mediaeval Dept, Museum of London
Pamela Hayworth  Chairman of Management Committee, Woodbridge Museum
Prof Rosemary Cramp
Cornelissen & Son Ltd, London

Written Sources - Books and Articles

Clamavi  Summer 1989  ‘A Case of the Blues’
May/June 1994  ‘The Grimstrup Painted Shield’

Theophano of Galweg  ‘Spice’

The Materials & Techniques of Mediaeval Painting  J Stevenson
Artists Pigments  A History of their History and Characteristics  Ed. R Feller
The Painter’s Methods and Materials  A P Laurie
Materials of the Painters Craft  A P Laurie
Artists Pigments 1600 - 1835  R D Harley
Divers Arts  Theophilus
The Artists Handbook of Materials and Techniques  R Mayer
Art & Society in Roman Britain  J Laing

© Hazel Uzzell 2012
Materials for the History of Oil Painting
(reprinted as Methods and Materials of the Great Schools and Masters)

Eastlake

Viking Age Sculpture
Richard N Bailey

The Materials of Mediaeval Painting
D V Thompson

Formulas for Painters
R Massey

Early Anglo-Saxon Shields
Tania Dickenson & Heinrich Harke

Archaeology by experiment
J Coles

Mappa Claviculae
T Phillips - Archaeologia No 32, 1847

Armies and Enemies of Imperial Rome
P Barker

Eirik's Saga (from The Vinland Sagas)
Tr M Magnusson & H Palsson

Romano British Wall Painting
Roger Ling

Although not used as a source for this present research, ‘Lost Civilisations of the Stone Age’ by Richard Rudgeley, has an excellent chapter on the use of Ochre.
REFERENCES TO PAINT

References to Painted Shields

Norse-Icelandic literature mentions shield paintings which inspired Bragi, a ninth century Norwegian Poet.

The Story of Thor's fishing expedition is reputed to have been painted on shields and carved in the Halls of Iceland. - All in Richard Bailey

Leather and wood decoration may not be unusual on shields. Painting on the front of the board may well have served the dual function of decoration and identification. However, painting is extremely difficult to prove in the archaeological record. Sutton Hoo provided no evidence of painting or staining. Polished and yellow shields are mentioned in Beowulf lines 232, 437-8, 1243-4, 2620, though this need not imply painting. Tacitus, (Germania 6) refers to the colours of the 1st century Germanic shields. The Waltherius Poem (lines 781-804) mentions a painted shield, red paint was found on shield timber and leather from Denmark. Red shields are stipulated by later Norwegian Laws, whilst the Viking shields in the Gokstad Ship were painted yellow and black. Post Roman Celtic shields could have been whitewashed - written sources use the term 'Lime white' describing them. Roman shields were coloured to identify the unit, and parade shields were spectacularly painted. - All in Dickenson & Harke.

Eirik's Saga tells of white shields to indicate friendliness, and red shields to indicate aggression.

While looking in back issues of Clamavi I found an article referring to a possible painted shield in the Grimstrup Chieftain Grave - Blue/black background, with greenish interlace outlined in white. Also possible shield from the Isle of Man with black and white stripes and red dots.

References to Painted Stones

We have good evidence that many, if not most Pre Norman sculptures were originally painted. There follow some examples:

Monkwearmouth and Ilkley Red Pigment
Urswick Blue/Black
St Pauls London Brown or Red Gesso under Blue/Black, Brown/Yellow and White
St Mary, Castlegate, York White gesso under Red Pigment
Burnstall, Newgate-York, Bingley, Middleton, Stonegrave, Brompton, (All Yorkshire), Kerklevington, Cleveland - Lancaster, Chester le Street and Winwick (Cheshire) all showed a red pigment put on to the stone as an 'undercoat' for other colours.

**Painted Boards**

In Bede's *Lives of the Holy Abbots of Wearmouth and Jarrow*, he writes that Benedict Biscop brought home with him religious paintings done on 'boards'. When Gregory arrived in this country - he also brought Holy Pictures - presumably done on wood.

The replies that I received from eleven museums seem to indicate that there is no evidence of painted shields from this country. *(If anyone knows otherwise, please let me know details).* On the analysis of paint found on sculpture, Rosemary Cramp indicated to me that analysis had proved 'disappointing' - showing 'earth colours'.

Documentary evidence in the form of reference to colour in Old English literature could also prove hazardous. Old English colour terms present difficulty of translation. Modern vocabulary indicates distinction of hue. Old English is based on difference of brightness and the same word may be used of objects that differ in hue but are alike in brightness - eg *Fæalice* - Glossy - of horses, glossy or glinting objects.
GLOSSARY

Alkaline Substances  Caustic Soda (lye), Sodium Carbonate (Washing Soda), or concentrated as Soda Ash, Sodium Bicarbonate or Sodium Acid Carbonate (Baking Soda), Sodium Tetracarbonate (Borax)

Casein  The curd, or ‘cheesy’ part of milk - a protein.

Distemper  Paint made from hide glue, water and pigment.

Dye  Colouring matter in, or not in solution which naturally penetrates other materials and imparts colour to them.

Emulsion  Liquid mixture in which a fatty or oily substance is suspended in a finely divided state in water.

Gesso  A viscous or liquid material used as a base - made by mixing water, glue or casein with chalk or white pigment.

Glaze  Binding agents which, with pigment give a transparent glossy coating over paint.

Lake  Pigment originally made from the gum called lac. Now a pigment made by the interaction of an aluminous mordant and a dye.

Medium  Includes all combinations of ingredients suitable for adding to or combining with paint. (See Binding Mediums below).

Metallic Salt  Produced by action of an acid on a metal.

Paint  Solid colouring matter suspended in a liquid vehicle so as to impart colour to a surface.

Oxidation  Chemical combination of a substance with oxygen to form an oxide. Burning is oxidation (rapid) and also rusting (slow). Iron oxide is an iron salt, roasted.

Pigment  Colouring matter used as a paint or dye. Lies on the surface of other materials and needs to be attached with a binding medium.

Resin  ‘Juice’ thick exudation of certain plants and trees.

Size  Substance of a gelatinous nature, like weak glue.

Stain  Colour by a process other than painting.

Turpentine  Solvent. Oily liquid obtained by distillation of resin.

Varnish  Resembles glaze but a simpler formula, used over paint to protect it.
BINDING MEDIUMS

Binding mediums can be used in three ways:

1. Binding medium applied to the surface and then the pigment.
2. Binding medium and medium mixed and applied.
3. Pigment applied and then binding medium.

For our purpose I have chosen number 2.

HISTORICAL NOTES ON PIGMENTS ETC

References to use of pigments

Theophrastus’s History of Stones - C Davies 1774.
Manuscript of 4th century BC. One of the earliest Greek sources. Pliny incorporated it into his works. It mentions a few pigments.

Vitruvius on Architecture - F Granger 1931-4
Treatise on architecture, building and general subjects. Topics relating to Roman materials and fresco painting based on Greek practice.

Elder Pliny - Ed K C Bailey 1929
Chapters on chemical subjects.

Elder Pliny - History of Art - Trans K Jex-Blake 1896
Incorporated earlier works.

Greek Herbal of Dioscorides AD512 - OUP 1934
Mentions a few pigments, resins, gums and ‘solvents’

Theophilus - Divers Arts Nelson & Son 1961

Notes

The earliest use of paint that we know is ‘pre-historic’ This term includes the ancient classical Greek culture.
What information that we have comes from relics, archaeological discoveries and the writings of early historians (See above).

These authors were sometimes writing several centuries after the methods which they describe. The best way to decide what is true is to look for methods of using pigments which may have survived unchanged and for the rest, try it and see if it works! Many of the so called ‘innovations’ in painting techniques in 13th and 14th centuries can be shown to have been in use from the earliest times. e.g The making of white lead as described in Pliny’s Natural History. The way that pigments were used developed along separate lines in different countries - governed by the supply of raw materials and also the climate - a point that we would do well to remember. It has been pointed out several times that the Roman soldiers in this country painted their parade shields with ‘bright’ colours, but I would point out that the Romans also made glass, mass produced sophisticated pottery and built in stone - all skills which were temporarily lost to us.

Linseed oil has been known since the earliest times, but it was a crude, mucilaginous product, totally unlike the oils that can be bought today, a fact to be born in mind if you intend to produce your own oils and varnishes.

Distillation was known to writers of the 3rd century AD (see Varnish) but was not practiced in any way widely until the 15th century AD, so alcohol and true solvents were virtually unknown.

A base is obviously recommended for use on the wood, under the paint (see Wood Preparation). It was the Romans who introduced the use of lime plaster to this country, and while a gesso (see note below) base is recommended for painting panels, it would probably be totally unsuitable on a shield! However, for those of us considering the possibility of painting daub walls - lime plaster must be used, as a water colour wash on stone or ordinary plaster will wash off. (see note below on lime)

Oil paint was in use in England in the 13th century, but we have little or no record of its use here before.

‘Stand Oils’ (see Varnish) and drying oils were known to Galen in the 2nd century, but I have no record of their use in this country.

LIME

Quick Lime Quick lime, burnt lime and caustic lime is calcium oxide, made by burning native calcium carbonate with wood in a kiln. The calcium carbonate could be limestone, chalk, marble or oyster shells and the result is in mortar and plaster.

Slaked Lime When mixed with water in the ratio of 64:1 the result is slaked lime. The entire amount of water should be added to the entire amount of lime all at once or the mixture will crystallise. Wooden containers should be avoided as
temperatures can reach 400°C in generated heat. This process produces lime putty. It should be aged for from 3 months to 1 year before use.

**Lime Mortar**  
Lime mortar is a mixture of lime putty, sand and marble dust.

## PIGMENTS USED IN OTHER COUNTRIES

### South Africa

- **Sienna**: Compounds of iron and manganese
- **Whites**: Oxides of metals, white earth
- **Yellow**: Clays stained with iron oxide
- **Red**: Clays stained with iron oxide
- **Black**: Burnt organic matter, charcoal

### Mediums Used

- Wax has to be applied hot. Marrow fat and ochre makes a better paste suitable for area painting. Mutton fat difficult and fades over time - fine lines difficult to draw. Plant juices would not mix with enough density to give a satisfactory colour, and too large quantities are needed. Gall bladder bile is possible but may fade over time. Honey - won’t stick(!) and is removed by water. Tempera is the most successful - from bird droppings or egg shells.

### Roman Pigments

- **Piddington Villa - Northants.** Purple/brown/plum, khaki, pale green.
- **Boxmoor, Herts.** Orange, pink.

The traditional Roman palette was:

- **Black**: Lampblack or bone black
- **Blue**: Egyptian blue or possibly copper ores
- **Brown**: Native earths
- **Green**: Egyptian green (see Egyptian Blue), Green earth
- **White**: Lime
- **Yellow**: Ochres
- **Red**: Native oxides

Pigments used by Roman wall painters in this country were mostly earth colours - red ochre, yellow ochre, green earth, chalk based white and black from soot or charcoal. Blue was an artificially produced glassy pigment called blue frit or Egyptian blue. Pliny divides the pigments into two types - plain and florid. Plain pigments were held in stock by the painter - but the more expensive imported florid pigments had to be supplied by the patron. In Britain, the vast amount of pigments used were plain. Among florid colours were Tyrian Purple (this doesn’t survive) and cinnebar (in only 4 cases in this country). Pliny gives cinnebar at 50 sesterces per pound as opposed to red...
ochre at 8 sesterces. Even good red ochre had to be imported here from the Black Sea, or at 2 sesterces from Africa.
PIGMENTS

Pigments can be divided into two types:-

1. Natural
2. Artificial

**Natural pigments** include:-

**Manufactured salts**

**Lake pigments**, which include vegetable and insect dyes.

**Elements** Carbon black and sulphur yellow

**Compound minerals** Natural deposits of metallic salts e.g. oxides of iron and carbonate of copper. Coloured earths and stones.

None of these can be simply ground up and used - they contain too many impurities. Also, the size of the particles ground will affect the colour. For earth colours, ochres etc, impurities are removed by washing. The ground pigment is mixed with water to a thin paste. Sandy impurities will precipitate quickly - humus, peat etc will float. The surface must be skimmed and the coloured pigment in water filtered off the sandy deposit. This must be allowed to settle again. The purified ochre will sink to the bottom. The water must again be drawn off and the purified ochre dried. Ground stones can be seperated into different sized particles in the same way.

Vegetable extracts e.g. saffron, can be soaked in water or *glaire*. Saffron, however would be prohibitally expensive, is semi-transparent, and fades in sunlight.

Most vegetable extracts e.g. Rhammus berries, Iris flowers, violets and cornflowers are highly unsuitable. (see madder and weld below)

**Artificial Pigments**

1. **Salts** From combining elements e.g. vermillion from sulphide of mercury

2. **The action of acid on metal** Verdigris - copper and vinegar

3. **Double decomposition of salts in solution e.g. Lakes** Solution of potassium carbonate mixed with solution of alum. Aluminium hydroxide is precipitated and carbonic acid escapes as gas. Potassium sulphate is formed in solution. If vegetable or insect dyestuff is present with the alum the aluminium hydroxide takes up the colour. Lakes made like this are transparent. Opaque lakes can be made by using chalk instead of potassium carbonate. As alum as such was very unlikely to have been widely
available in our period, (personal communication Geology Department, Liverpool Museum) I feel that lakes, such as madder, kermes and weld would be unsuitable.

The pigments follow in alphabetical order as to colour names. I have attached my thoughts as to suitability and availability.

**Black**

**Lampblack, charcoal, black bone, ivory black and vine black** are all based on carbon. Carbon is produced by raising various organic substances to a red heat. Any of these could have been used with the exception I think, of ivory black. For bone black the bones should be heated in the absence of air, otherwise you get bone white. Bone black is probably the best, as the others may have greasy impurities which would impede drying. Bone black is fairly good mixed with oil, but can be slow drying and brittle.

**Slate black**  
Ground slate. A poor greysih black.

**Pitch**  
Pitch is got by distilling tar. Tar is got by the dry distillation of wood. As there are Old English and Old Norse words for both of these - it was probably known.

**Blue**

As we all know, blue garments were fairly rare and blue pigment even more rare. In the Middle Ages, dyers of blue cloth had to have a licence. Purply blue was highly valued - yellowish blue or greenish blue, not so much. Blue pigments were susceptible to colour change, and various 'tricks' were used to make poor, greenish blues look better e.g. surrounding them with 'warm' colours.

**Folium**  
Turnsole, Heliotrope [Croton Tinctorum]  
Not known to grow in this country. As litmus, it changes colour according to acidity or alkalinity of its surroundings. Red and violet blue are known. A neutral solution produces violet, and an alkaline blue. (Both tend to return to a pinky red). Lakes were made from this by staining pieces of cloth with the juice of berries and using these clipped up as the vegetable constituent of the 'lake'. It would be transparent. **Totally unsuitable.**

**Orchil**  
This colour can be obtained from Lichens of the Rocella group. It was little used, even in manuscript painting. Like turnsole, it is an indicator dye, changing colour according to its environment. It must be ground fine with unslaked lime and urine. It easily revers to pinky red - is transparent and a water colour. **Unsuitable for shields.**

**Azurite**  
Copper ore. This is found, amongst other places, in Armenia, Spain, Hungary and Germany. It is called Citramarine azure, and is often found with Malachite. It is also called German azure. It looks very like Lapis Lazuli, (Ultramarine) but when heated to red hot Azurite turns black while Lapis remains blue. Azurite would be ground to a powder, the coarser the powder, the darker the blue. A very fine powder
would give a very pale blue. The powder would be washed 6 or 7 times and floated to separate the grain size. This is a very slow process, each wash taking several hours. If the powder is ground with gum and washed with lye it will settle more quickly. Sometimes the separated grains would be washed with vinegar to remove the greenish element - this begs the question - what would you use for vinegar?

Good blues were coarse grained and very hard to use. Size is always needed as a binder as the colour is greenish if mixed with oil. The coats must be thick and several would be needed. This blue cannot be varnished successfully. It was time consuming, an expensive import and, in my opinion, not suitable.

**Lapis Lazuli** Ultra marine or French blue. A very expensive import, mainly found in Afghanistan. It was not processed in this country, but was imported as a pigment product for manuscripts in very small amounts. It cannot just be ground, like Azurite. If this is done, the resulting powder is grey and useless lapis ash. The method of producing the blue pigment was not known in Europe before the 13th Century. The powder had to be made into a *putty* with wax, oil and resin. The putty is then *kneaded* underwater until the blue leeches out into the water. It is affected by acids or acid vapours. **Obviously totally unsuitable for shields.**

**Cobalt blue** Cobalt is a silvery white metal similar to nickel. The blue pigment was not known in this country until the 19th century.

**Egyptian Blue** Cerulean Blue (Roman name). Although the method of making this blue is said to have been known to the Romans, some authorities doubt this. However, the pigment has been discovered in isolated cases in 9th century frescos in continental Europe. The later form of this is *smalt*. It is roasted cobalt blue glass or compound of cobalt and tin oxides. Whereas Egyptian blue used Copper. This is a North European innovation and not likely to have been in use in our period.

**Indigo** Not available here.

**Woad** During the processing of woad for dyeing, a bluey green froth appears on the surface of the vat (see notes on woad dyeing). This froth is collected and dried to make the pigment. There follows a 12th century recipe from Cambridge. Take white marble and put it into hot dung for 1 night then remove it and grind it to a fine powder(!). Take the woad foam and put this on the powder and work for a long time. When dry, add more foam until the powder takes a good colour. When dry, wash with water and allow to settle. Pour off the water and grind again. You can also take the powder when almost dry and make it into pellets. Allow these to dry in the shade, and then they can be ground to a paste with size or oil. It is unreliable and can turn to a dull blackish/blue. Of all the blues, this is the most likely, as at least the woad would have been available! We have tried just the dried woad foam, but it was transparent on wood and faded quickly - a matter of days!
**Verdigris** Copper acetate (see greens), mixed with lime and salts of ammonia turns green verdigris blue. This can revert to green through loss of ammonia. **Not available in amounts needed to paint a shield - but is possible for small areas.**

**Brown**

Several authorities state that wood would not have been painted brown - after all, it is already brown! Brown as such was not a colour used in manuscript painting until the 15th century.

**Ochres** Yellow, red and brown have a long history of use. English ochre was nearly always yellow (see yellows), with a good source near Oxford. Some brown could be produced by burning yellow ochre (Spanish Brown)

**Siennas**
Raw Sienna is Ferric Oxide from ore native to Italy. A pale bright buff to dark brown olive
Burnt Sienna - as above but calcined.
Raw Umber - As Raw Sienna but with manganese. Also found in Cyprus.
Burnt Umber - as above but calcined.

**Probably not used. The safest would be Spanish Brown.**

**Greens**

**Malachite** This is a changed form of Azurite and all the notes and stipulations for that pigment apply to this.

**Green Earths** Terre Verde. Celadonite, Glaucnote, Cronstedite, Chlorite. Celadonite occurs in fractures in volcanic rocks. Glaucnote is found in small greenish pellets known as green sand. Vitruvius mentions green chalk or clay and Pliny, an Appian Green, a cheap substitute for malachite. Sometimes, the juice of parsley, rue, columbine was mixed with green earth to make a pigment.
Isidore of Seville (570 - 636AD) called green earth ðPrasinað but in the Mappa Claviculae the description of ðPrasinusð cannot be green earth as it is described as a metal associated with silver. Theophilus mentions two green pigments - Virdis - a copper based colourant, and prasinus - a green/black colourant that dissolves in water. Cronstedite is/was available from the Mendip Hills and in Cornwall. The texture of the pigment is described as dull, transparent, claylike and soapy. I have no information as to its preparation, but it is said to give a light bluish grey with a greenish cast, varying to dark olive brown.
Celadonite - available in Italy gives a light cold green and glaucnote from Czechoslovakia a yellowish olive, mixed with white gives sage green, and with yellow, light sage.
If you know that you have a deposit of any of these rocks/minerals near you - have a go!

Vegetables Sap green (buckthorn berries), Iris green, Lily and Pansy green are all made by the ḍake ḍprocess and are not suitable.

Verdigris Acetate of copper. Note - if the copper used is not pure, other colours may be present, e.g. lead white. Mixed with water, verdigris gives a transparent light blue/green colour. It is susceptible to the action of moisture, blackened by alkalies, and darkened by natural gases in the atmosphere. It is incompatible with white lead or orpiment (see yellow). Verdigris is made by corroding copper plates with acid vapour - e.g. vinegar (verjuice?). It takes about five weeks for sufficient verdigris to form. The pigment then has be cleaned before use. Pliny suggests dissolving it in pine balsam.

Salt Green Made like verdigris, but the plates of copper are coated with honey and salt.

Viridian Viridian must not be confused with verdigris. This colour was not available.

Purple

The immediate reaction to this is to say mix blue and red - but after reading all the pigment information, this may seem hasty - the most probable result of this would be brown. For fresco painting - a mixture of haematite and dark red ochre served as purple - but was rarely seen. This seems odd as haematite is a red iron oxide. Oh well.........

Lichen Purples See blue. Not suitable as a pigment. That leaves -

Shellfish I don’t think that the Mediterranean shellfish murex trunculis/brandaris would have been used for shields - One fish gives only a drop of dye, but the locally grown Dog Whelk may have been used for an eye or a claw! The shades range from black through to red - all covered by the word purple. May have been used as a glazing colour over a pale red??

Pink

You won’t believe this but pink is a modern concept. The original pink pigment was yellow vegetable pigment combined with a white base, and the word pink comes from the Dutch language.

Red Red ochre (Fe₂O₃) - Reddle - Ruddle. Red Lead (Pb₂O₄) - Minium
**Red Ochre**  Natural red iron oxide, found fairly widely in England. Iron oxides are called ochres. Also called iron minium. These are mined, ground, washed and floated. The hydrated oxide of iron is yellow, and if roasted will turn red.

**Red Lead**  This is one of the earliest pigments to be artificially prepared. The naturally occurring mineral minium was only used - if at all, at a very early date. Red lead is lead tetroxide, which is chemically the same as the mineral minium. Pliny applied the name minium to cinnebar - a naturally occurring form of the pigment vermilion (Mercuric Sulphide) and he called red lead minium secondarium. Dioscorides used the name false sandarach for red lead because of its resemblance in colour to sandarach. This is naturally occurring red arsenic sulphide. Vitruvius also used the name sandarach for red lead. Sandyx however, was a mixture of red lead and red ochre (see above). Just to confuse matters more, the pigment is also called red lead oxide and the mineral crocoite is sometimes referred to as red ore of lead.

Chinese texts of 5th century BC refer to the manufacture of red lead. From the 2nd Century BC to the 2nd century AD the term red cinnebar was used in China to denote an artificially prepared pigment. Vitruvius notes that red lead was first produced by accident when white lead was placed in the fire. Roasted lead white was known all over the Middle East, paintings using it being identified from Egypt to Pompeii. There was an official factory in China producing it, and in India it was called China Flour. In Theophilus and the Mappa Claviculae, the process of roasting white lead is described as treating metallic lead with vinegar and then roasting the resultant white lead. Temperatures of 450-470°C are needed to produce red lead, and the product may also contain litharge. The modern method of removing this is with dilute acetic acid - vinegar. Occurrences of use in wall painting are from Medieval Lübeck in Germany - 14 European illuminated manuscripts dating from 10th to 16th centuries - the Crucifix in Lichtenstein Castle (1050AD) - and paintings from a stave church in Norway (12th century). Red lead can turn black in contact with air. For small quantities white lead could be roasted over a fire, ground and roasted again, stirring all the time - probably not a home product, as it must be roasted for a very long time.

**Orange Lead** can be a synonym for red lead but usually means a pigment prepared from lead white, being roasted. Mediaeval orange lead was altogether a paler colour than what we understand by the word orange.

A lot of natural red earths and stones will not produce a pigment, merely grinding down to grey. To produce a good colour they must contain a lot of coloured salts of iron. Red ochres may vary in colour from light and warm to purply black. Iron filings can be spread out in an earthenware pot and covered with strong vinegar and left in the sun to dry. Repeat this twice a week for a month. Roast the result and it will turn scarlet.

**Yellow**
Yellow Ochre - Limonite. It gives a dull yellow/brown shade. One source states that yellow ochre should only be ground, not washed and when making the paint, should be ground in oil, not water, as it loses its colour, another that it can be mixed with anything; a third that it becomes transparent in oil. Take your choice!! All agree that it is very slow drying.

Massicot Some form of lead and tin oxide. I have no information on how it was made but gives lemon yellow.

Orpiment Realgar. Yellow sulphide of arsenic. This cannot be mixed with any colour made from copper (no green or blue verdigris) or lead (no paler colour with white lead). It has an unpleasant smell and very toxic fumes. Its sources are small deposits in Asia Minor and Europe. It gives a light, vivid yellow which inclines towards orange. Not a candidate for shields I feel!

Roasted Lead Acetate See red lead.

Vegetable yellows Dyers greenweed and weld - see description of Italian recipe, otherwise must be made as a lake. Saffron - not reliable, fades and must be made into a lake.

Antimony A greeny, pinky yellow. Had to be imported. Very poisonous and no evidence from our period, although evidence from 5th century BC Babylon.

Bile Yellow A mixture of fish gall, chalk and vinegar. Gives a pale acid yellow.

Raw Sienna See brown.

White

Lead White Ceruse. A very old pigment made by exposing metallic lead to vinegar fumes. A 12th century recipe has lead hung over strong vinegar in a pot, sealed tightly and buried in hot dung. This gives lead acetate and not white lead as we know it. It was then roasted gently in air. This might produce a carbonate of lead. This is very poisonous and is blackened by sulphur gases.

Bone white Any animal bone roasted in a fire, in the presence of oxygen, and ground up. A good one I think.

Roasted Egg Shells or Oyster Shells Whiting. As above. Native calcium carbonate, must be washed and refined as well as ground. If ground in oil, it becomes a yellowish brown putty. If mixed with water and glue instead of oil it retains its white colour and is used as gesso. Another good one!

Lime White See Lime putty. Whitewash - a solution of quick lime and size.
DYES

Woad  Woad leaves can be crushed into balls and dried. They are then ground to a powder and damped and fermented with water and bran or urine and bran.

Weld and Dyers Greenweed  A 17th century Italian recipe. Cut weld or dyers greenweed in spring. Make a very strong dye solution. Crush eggshells very finely. Put them into a fresh (unglazed) earthenware jar. Pour the dye liquid over them and leave overnight. I have done this using chalk. The liquid is absorbed by the earthenware and leaves behind the chalk, dyed bright yellow.

Madder  This is an allazarin dye. It was made into a lake using fabric clippings dyed with madder. This was the vegetable matter added to the chemical lake process. It was not commonly used as a pigment - if at all in our period.
PREPARATION OF WOOD

Glue Gesso, Casein Gesso and Paint

Plywood is not the best material for painting onto as the glue used to hold the panels together can emit acidic vapours which affect the paint - however, plywood is less likely to warp or split. Oak or poplar both make good grounds. Eraclius (13th century) tells us to carefully prepare the wooden surface by planing it with shave grass - however it is done, there should be no blemishes on the surface. A ground should be applied onto the wood to act as a buffer between the wood and the paint. Glue gesso, containing calcium carbonate could be used or any size or glue. (see appropriate sections). However, any acrylic polymer commercially bought would suit our purposes.

Glue gesso is made by mixing chalk or any other inert white pigment (see pigments) with a solution of glue gelatin or casein (see appropriate sections). When the surface is dry, it can be sandpapered smooth.

Recipe: 2¾oz animal skin glue in a pot, can or enamel saucepan. Keep some pieces to soak separately. 1 quart of cold water. Soak glue in water overnight. It should absorb all the water and increase to 3 times its original volume. The colour may be an opaque green/grey. Any tough rubbery pieces should be re-soaked. Heat the pot until the glue dissolves. Do not boil. A double boiler is best. It should resemble tough jelly when pressed apart with fingers. If too tough - add hot water - if too loose, add more glue from seperately dissolved pieces. Heat as hot as possible without boiling and pour onto the white pigment, stirring all the time. Sieve to produce a smooth paste.

If you are going to apply any fabric such as hessian to the surface of the shield, it should be done before the glue gesso is applied. The fabric should be dipped in glue, smoothed over the surface, tacked down and left to dry. If hide glue has been used to prepare the glue gesso the mixture must be kept hot during application. It must also be stirred continually so that the chalk or other white pigment doesn't settle to the bottom. The texture should be like smooth, thin cream. The first coat should be scrubbed hard into the surface of the wood with a stiff nail brush or rag. Rub over with the fingers to remove any bubbles. When this surface has become dry enough to withstand it, the next coat may be applied. The first coat will be dry in only a few minutes - any subsequent coats will take longer. The next coat should be applied with all the brushstrokes going in the same direction. When dry, the next coat should be applied with brush strokes at right angles to them. When this coat is dry, it should be sandpapered smooth.

Casein may be used as a binder instead of hide glue. Casein is described as poor lean cheese soaked in water, washed and crumbled and ground with lime and a little water making a treacly mixture which dries very hard. It is made from milk protein and used as a glue and as a binder for pigments. Theophilus mentions its use. It can be bought as a powder, and also as a ready prepared paint. If you can't buy the powder, it can be made:- Allow skimmed milk to sour. Separate the curd from the whey. Wash and dry
the curd. All traces of cream and butter fat must be removed as it will impair the resulting product. Casein mixed with water forms a sludge, but when an alkali is added it will go into solution. Soda and lime can be used for this but the best results come from ammonia water or ammonium carbonate.

Casein has the advantage of being applied at room temperature. About 1oz of casein should be used to 1lb of chalk. The casein should be stirred well with water in a metal container. Allow to stand for several hours. Clear ammonia water is then added drop by drop, stirring with a wooden spoon or rod. The material should be just dissolved, thick and honey-like. Warm the solution in a double boiler to cause the ammonia to evaporate. Do not boil. Pure concentrated ammonia can be used, but for small amounts dilute half strength ammonia is better. (also see recipes at the end)

Casein gesso cannot be kept. Ammonium carbonate can be used instead of ammonia water, when no soaking is needed.

**Modern Recipe** Stir 22 fl oz of water into 4 oz of casein in a double boiler. (allow room for fizzing!) Add the water gradually to form a paste. Warm gently in the boiler and then add 1 floz of ammonium carbonate, which has been mixed to a smooth paste with a little water. Effervescence will occur. When this has subsided the solution is complete. Allow to cool. Add 10 fl oz of water to produce a useable solution for binding pigments. Add a white pigment to form gesso.

Casein solution can be mixed with any pigment to form a tough paint. It is resistant to moisture. Commercial casein paints can be bought.

The amount of casein binder to pigment is a matter for trial and error. Paint a trial piece of wood. Allow to dry and rub hard. If the paint comes off as a dusty deposit, there is not enough binder.

Casein makes a better adhesive than hide glue, as it can be applied cold.

Casein paint is tough but inflexible. It dries with a matt or semi-matt finish. The surface can be polished with a piece of fine linen to produce a sheen. It can be varnished.
MEDIUMS AND CARRIERS

Oils wax and size (Glue) could, in theory, all be used as a carrier for pigments. How practical that would have been for the average 'man in the village is another matter.

**Beeswax** Beeswax was used in classical times (Pliny 23-79AD), the pigment being stirred into the melted wax. Egg yolk is also mentioned by Pliny - but not until the 15th century do we have a full description of the method used.

Pliny and Dioscorides mention 'Punic Wax'. This could be beeswax which was boiled then combined with sea water and potassium carbonate. It is then poured into cold water and exposed to sunlight. This bleaches and refines the wax.

Wax emulsions can be made. These are for the most part resistant to external moisture and can be polished to a soft sheen with a cloth.

**Recipe:** Boil 1oz of white beeswax with 5fl oz of distilled water. After it has melted slowly pour in ½ oz of ammonium carbonate which has been mixed to a cream with a little water. Stir all the time. 1 tsp of half strength ammonia can be used instead. Heat until all the ammonia gas is driven off and cool, stirring occasionally. This paste may be diluted with distilled water. This can now be mixed freely with egg. Whether it can be made with unrefined wax - undistilled water and stale urine instead of ammonia I know not!

**Size** Size was used by the Egyptians, Greeks and Romans and throughout the Middle Ages for wall paintings. Much of our written evidence is either incomplete or inaccurate, being written by 'compilers and not by the artists themselves.

Dioscorides describes the preparation of nut and poppy oil, but their use is not mentioned as drying oils in painting or 'varnishing'. The astringent properties linseed oil are mentioned by Greek physicians, but only for medicinal use.

The first mention of the use of a drying oil is made by Aetius (5th century). He describes the preparation of linseed oil for the use of gilders and encaustic artists to preserve their work. The manuscripts of Theophilus and Eraclius (11th and 12th centuries) both describe the use of drying oils as a pigment carrier.

The oil is extracted from the seed by heat, pressure or by boiling in water. It is far from pure and dries VERY slowly. It can be rendered more quick drying by boiling and exposure to sun and air. If mixed with water and repeatedly shaken and then exposed to the sun and air, it can, after some several repeats of the process be cleaned of impurities, and the oil becomes bleached and will dry quicker.

Theophilus recommends the use of pigments ground in such oil only for things which can be dried slowly in the sun. The painting would need at least three coats, and the next coat cannot be applied until the previous one has dried. Ideally, the object being painted
should then be covered with a ‘gluten’ varnish. It should be placed in the sun and when the varnish begins to melt and run, it should be gently rubbed into the surface with the fingers. This also should be repeated three times, and left to dry thoroughly - a VERY long process I think!  

**Egg/Oil Emulsion**  
This could be made by the addition of a little egg yolk to the thickened oil, with a little water added to the egg. The emulsion can then be mixed with the pigment - already mixed to a paste with water. The volume of the mix should be 2 of egg yolk, 1 of oil and 3 of water.

**Egg Emulsion**  
Separate egg yolk from white. Dry on a paper towel. Pick up yolk between thumb and finger without rupturing the skin - suspend it over a cup and puncture the skin at the bottom with a needle or a knife point. The pigment should have been well ground with water. Just before use equal quantities of the pigment paste and egg yolk should be mixed. The mixture should be kept covered while in use.

**Whole Egg and Oil Emulsion**  
This requires the addition of some kind of varnish. Egg yolk mixed with a little water and the pigment paste can also be used. This can be varnished over with size.

‘Glaire’  
De Clarefound in 11th century Berne. This is egg white, beaten stiffly and allowed to stand. The liquid that runs off is ‘glaire’  **Not at all suitable for shields.**

I don’t consider the above methods viable for painting large areas.

**Emulsions of casein and oil**  
Can be made but they discolour quickly.

Laurie considers that egg and wax were the original media, replaced somewhere between 800 and 1200AD with oil. It would thus seem that all are open to us.

**Cheese Glue**  
Theophilus mentions cheese glue, which when mixed with pigment gives an extremely tough and durable paint (see casein).

**Fish Glue**  
Fish glue corresponds to modern Isinglass. It is the washed and dried inner layers of the swim bladder of fish. The best comes from sturgeon. It has the advantage of being able to be used cold.

**Hide Clippings Skin and Sinew**  
- boiled with an equal quantity of water until reduced by half would be allowed to solidify, cut into slices, and air dried. This would be gelatin. This can be used as a substitute for hide or fish glue but it is not as good.

**Parchment Clippings**  
Glue made from parchment clippings can also be used to temper pigment, but would only be available in an ecclesiastical context.

**Flour Paste**  
- This could be Theophilus’ ‘gluten varnish’ - is made by mixing flour to a paste with a little water. Getting a smooth paste could only have been done by finely seiving the flour. More water should be added until a milky consistancy is
reached - then the batch should be heated until it thickens. (see recipes at the end of the section).

Sometimes the binding medium affects the transparency or otherwise of the pigment, e.g. chalk mixed with size becomes white and opaque, but with oil becomes dark and transparent. Terre Verte (see pigments) is transparent in oil and opaque in egg. The appearance of the pigment is also affected by the amount of binding medium used. Colours mixed with size tend to become darker when waxed or varnished. Blue (see pigments) has to be laid on thickly and so needs a strong binding medium.
RECIPIES

Distemper

Hide glue affords a low cost paint recipe.

1 part Hide glue  
10 parts water

Leave glue in water overnight to absorb as much water as it can, then pour off excess water. Warm in double boiler until all material has melted.

Work dry pigments into a heavy paste with water, then grind the pigments into the warm glue solution. Keep this warm while painting with it and use tepid water to dilute if necessary. Apply the paint in thin layers. The paint must be allowed to dry, and has to be varnished.

Glue Oil Emulsion

Make hide glue as above. Use 2 parts glue solution to 1 part thickened linseed oil (see stand oil) or a concentrated resin solution. Stir vigorously.

Grind dry pigment into a water paste then use paste with emulsion.

Starch Solution

Makes a quick drying paint.

1 part starch - (any vegetable flour)  
3 parts cold water  
3 parts hot water

Stir flour into cold water to make a smooth paste. Slowly add this to the boiling water stirring well. When the solution begins to clarify, put aside to cool.

To use. Add enough water to make the solution thin. This can be used to make a solution with oil or resin, or to use as a ground on wood. It must be stored in the fridge or it will spoil.

To use as a paint. Make the pigment into a paste with water and use by dipping brush alternately into pigment and paste. Be aware that this is not a permanent paint so is really not suitable for shields.

Starch Oil Emulsion

4 parts starch solution (see above)  
1 part oil
Use ingredients at room temperature. Add the oil to the starch a little at a time stirring vigorously. Make a paste of pigment with water and grind with emulsion. As above, not permanent and must be varnished.

**Casein Solution**

2 parts powdered casein  
16 parts water  
1 part ammonium carbonate or household ammonia

Sift the casein slowly into half the water, stirring to get rid of lumps. Add the ammonium carbonate and stir. Allow to stand for at least half an hour. Stir in remaining water. Use as a ground on plywood. Allow to dry thoroughly.

**Casein Paint**

Make up size as above.

With a palette knife combine size and pigment, adding water to make a paste. Make sure the dry pigments are well ground. Make sure the brushes are kept in water during use and washed with soap and water afterwards. Casein paint can be varnished when dry.

**Casein Oil Emulsion** (Using casein paint)

2 parts casein solution  
1 part heavy or stand oil  
Dry pigments

Make casein paint as above. Make a thick paste. Drop by drop add stand oil. This emulsion can be diluted with water. This will set in about 10 minutes.

**Fixatives**

**Egg and water**

1 part egg yolk  (see how to separate eggs)  
34 parts water

Combine. This is a fixative, not a varnish

**Milk**

Skim milk. Spray pure skim milk onto paint. This is a fixative not a varnish
**VARNISH**

The first description of the preparation of an oil varnish is found in the Lucca Manuscript (contemporary with the Carolingian Empire). It describes dissolving natural resin in a drying oil. It is similar to a recipe given in the Mappa Claviculae.

The base of most varnishes is resin - requiring a solvent to reduce it to a liquid state. Such solvent may not have been too widely available so resin occurring in a liquid state was probably used e.g. pine or larch (oleo resins). Larch resin, applied at 20°C takes many days to harden.

**Oil Varnish** can be made by putting linseed or hemp oil in a shallow vessel in the sun for several days. A thick skin will form on the surface. When this skin is removed a fatty oil remains. It should have the consistency of runny honey. When boiled with pitch pine or larch resin this becomes an oil varnish. Before 1500AD all varnishes were made - if made at all - in this way. These varnishes would not be termed durable by modern standards. They would have been thick and sticky and probably rubbed into the surface with a warm hand. Pliny mentions the distillation of turpentine by heating pine resin in a vessel covered with fleece. (The resin left behind is called rosin). As the condensed vapours rise they are trapped in the fleece and can be wrung out. The preparation of turpentine is described by Marcus Graccus in the eighth century. The possible use of turpentine in paint must be admitted. Wax dissolved in turpentine may have been used as a medium.

Resins that dissolve in water are called gums. These either dissolve in water or swell to a jelly. Cherry, almond, apricot, peach and plum trees all exude such gums and so may have been available. Old lumps of dry gum can be difficult to dissolve and should be mixed with water and squeezed through a cloth to separate out undissolved pieces. This gum will swell and absorb water. 1oz of gum to ½ pt of water gives a thick solution. This should be strained through cloth to remove any bits of bark. This is mentioned by Dioscorides and Theophilus. It mixes well with tempera ingredients. Tempera means any liquid medium with which pigments can be mixed to make paint.

**Beeswax Turpentine Varnish**

If you accept the availability of turpentine you can make this varnish.

1 part beeswax

3 parts turpentine

Heat both ingredients in a double boiler until the wax melts into the solution. Remove from heat. This will cool to a soft paste. Apply with a soft rag or brush. When dry, polish with a soft cloth.
<table>
<thead>
<tr>
<th>Paint Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lime White</td>
</tr>
<tr>
<td>Red Ochre</td>
</tr>
<tr>
<td>Iron Oxide</td>
</tr>
<tr>
<td>Red Lead</td>
</tr>
<tr>
<td>Yellow Iron Oxide</td>
</tr>
<tr>
<td>Yellow Ochre</td>
</tr>
<tr>
<td>Fish Bile</td>
</tr>
<tr>
<td>Green Earth</td>
</tr>
<tr>
<td>Woad</td>
</tr>
<tr>
<td>Azurite</td>
</tr>
<tr>
<td>Egyptian Blue</td>
</tr>
<tr>
<td>Lapis Lazuli</td>
</tr>
<tr>
<td>Verdigris</td>
</tr>
</tbody>
</table>

Those paints marked with an asterisk would have been prohibitively expensive or difficult to produce.
SOME COMMERCIALLY AVAILABLE PAINTS

These paints are fairly close in colour to the 'authentic' ones.

VERDIGRIS

DULUX COLOUR PALETTE

Dulux 30GG 57/217
Dulux 30GG 40/290
Dulux 30GG 24/407
Dulux 30GG 16/394

DULUX NON-DRIP SATIN
Mystic Jade
Jade Splash
Crystal Mint

DULUX DISCOVERY NON-DRIP SATIN
Chi

CUPRINOL COLOUR WOOD
Country Jade

B&Q COLOURS
True Green

SANDTEX DECKS & CHAIRS
Turquoise

LAPIS (Not suitable for large areas. Confine to an eye or a claw!)

DULUX COLOUR PALETTE

Dulux 70 BB 21/171
Dulux 70BB 14/202
Dulux 70BB 09/241

DULUX NON DRIP SATIN
Cobalt Skies
Simply Indigo
CROWN LATINO

Rhumba

CROWN SOLO

Oxford Blue

B&Q COLOUR FOR WOOD

Spruce Blue

SANTEX EXTERIOR FOR WOOD & METAL

Oxford Blue
Parisian Blue

AZURITE (Expensive. Confine to small areas )

DULUX COLOUR PALETTE

Dulux 79BG 53/259
Dulux 89BG 37/353
Dulux 98BG 26/393
Dulux 04BB 432 E43

DULUX NON-DRIP SATIN

Azure Oasis
Betty Blue

CROWN LATINO

Rhythm

WOAD (Still a complicated and time consuming procedure. See notes)

DULUX VICTORIAN

French Grey

DULUX COLOUR PALETTE
Dulux 70BG 41/076
Dulux 70BG 30/092
Dulux BG 17/116  
Dulux 70BG 08/129

**CUPRINOL COLOURWOOD**

Bluebell  
Summer Lupin

**DULUX NON-DRIP SATIN**

Baroque Blue  
Soft Sky  
Blueberry Satin  
Lavender Pillow

**DULUX ONCE GLOSS**

Dream Boat  
Bluebell Dew  

**SANDTEX DECKS & CHAIRS**

Blue Dusk

**B&Q COLOURS**

Aqua Blue  
Cool Blue  
Slate Blue

**EGYPTIAN BLUE** (You have to be very Royal!)

**DULUX ONCE GLOSS**

Velvet Sky

**GREENEARTH**

**CUPRINOL COLOUR WOOD**

Soft Willow

**B&Q COLOURS**

Fern Green
DULUX COLOUR PALETTE
Dulux 60YY 62/277

SANDTEX DECKS & CHAIRS
Dusky Green

CROWN ONE COAT GLOSS
Portobello

CROWN NON-DRIP GLOSS
Dragonfly

DULUX CALM COLLECTION
Dragonfly

CROWN PERIOD COLLECTION
Vicarage Green

FISH BILE

DULUX COLOUR PALETTE
Dulux 60YY 71/540
Dulux 60YY 67/626
Dulux 60YY 62/755
Dulux 50YY 58/581
Dulux 50YY 53/665

B&Q COLOURS
Soft Lemon

CROWN NON-DRIP GLOSS
Hummingbird

YELLOW OCHRE OR IRON OXIDE
CUPRINOL COLOURWOOD

Wild Corn

DULUX COLOUR PALETTE

Dulux 10YY 21/500
Dulux 00YY 19/464

CROWN ONE COAT GLOSS

Spiced Cider

DULUX WARM COLLECTION

Burnt Ginger
Amber Honey
Saffron Glow

CROWN SOLO SATIN

Ginger Snap

CROWN PERIOD COLLECTION

Emperor Gold

RED LEAD

B&Q COLOURS

Ember Red

DULUX COLOUR PALETTE

Dulux 70YR 33/514
Dulux 70YR 23/650

SANDTEX DECKS & CHAIRS

Indian Sun

CROWN ONE COAT SATIN

Fandango

CROWN NON-DRIP GLOSS

© Hazel Uzzell 2012
Clementine

DULUX NON- DRIP SATIN

Overly Orange

B&Q COLOURCARE FOR WOOD

Cedar Red

**RED OCHRE AND IRON OXIDE**

RONSEAL WOODSTAIN

Deep Mahogany
Redwood

CUPRINOL COLOURWOOD

Copper Spice

DULUX COLOUR PALETTE

Dulux 39YR 11/342
Dulux 39YR 14/482
Dulux 27YR 10/372
Dulux 23YR 10/308

DULUX HERITAGE COLOURS

Vicorrian Red
Victorian 12

DULUX SOLO NON-DRIP GLOSS

Burgundy

SANDTEX EXTERIOR WOOD

Rowan Berry

SANDTEX DECKS & CHAIRS

Firefly
DULUX DISCOVERY

Bazaar

DULUX WARM COLLECTION

Rich Russet

DULUX VIBRANT COLLECTION

Saucy Scarlet

DULUX ONCE GLOSS

Rustic Red

**BURNT GREEN EARTH**

DULUX HERITAGE COLOURS

Victorian 18
Purple Brown

This is not meant to be a complete list, just an idea of how many colours that there are out there that will do. I found many more in other makes, such as the Fired Earth shops collection and the V &A Museum collection. What we did was to take the colour sticks to our local B&Q and had paint mixed to match.
USEFUL NOTES

A list of Lime Proof Pigments

**White**  
Lime Putty - Whitewash etc

**Black**  
Ivory - Vine - Charcoal Black

**Yellow**  
Ochres

**Brown**  
Siennas i.e. Ochres

**Blue**  
Ultramarine

**Red**  
Earth or Oxides

**Green**  
Green Earth

**Melting point of**  
Beeswax 620°C  
Amber 250°C  
Partially soluble in turpentine

**Flashpoint of Gum Spirits**  
340°C

**Boiling Point**  
1550°C

**Drying times of oils**

<table>
<thead>
<tr>
<th></th>
<th>Raw Linseed</th>
<th>Stand Oil</th>
<th>Sun Thickened</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thin</td>
<td>3 days</td>
<td>2 days</td>
<td>2 days</td>
</tr>
<tr>
<td>Thick</td>
<td>10 days</td>
<td>10 days</td>
<td>9 days</td>
</tr>
<tr>
<td>coat</td>
<td>(thin coat)</td>
<td>(thin coat)</td>
<td>(thin coat)</td>
</tr>
<tr>
<td>coat</td>
<td>(thick coat)</td>
<td>(thick coat)</td>
<td>(thick coat)</td>
</tr>
</tbody>
</table>