Paintings in the laboratory: scientific examination for art history and conservation

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Karín Groen

In the Beginning There Was Red

Red: Symbolic Meaning

Red is one of the oldest colours used by man. Already in prehistoric times, some 35,000 years ago, red earth was used in European cave paintings. Also, the 71 pieces of red ochre that were recently discovered in the ca. 100,000 year old Qafzeh cave in Israel were, judging by the anatomically modern humans living there, *Homo sapiens sapiens* – clearly chosen for their red colour. Researchers say that the red ochre found in the cave supports the controversial theory that symbolic thinking, a hallmark of modern-day human thought, arose deep in the Stone Age.¹ The pieces of red ochre pigment were found together with ochre-stained tools, near several of Qafzeh’s oldest graves. The association with burial was a strong indication of symbolic thought: early modern man had made the mental leap of associating the red colour with death. Prior to the find of red ochre in Qafzeh cave, the oldest undisputed indication for symbolic culture was a 72,000-year-old piece of – again – red ochre, with a scratched-in line pattern, found in Blombos cave in South Africa.²

Red had since early times also been symbolic for the divine. Red represented fire and light, the colour of the sun. The colour red was since ancient times the symbol of might and status of dignitaries. There is a long tradition in the preference for red in matters of importance. John Gage lists many special occasions where red was used: in ancient Greece to sanctify weddings and funerals; as a military colour in both Greece and Rome to strike awe into the enemy. Before the fifth century, Greek *stelae* (upright funerary stone slabs or columns) were painted red. So were the interiors of some temples. The list is sheer endless: walls of shrines in India, the walls of the temple of Isis in Pompeii, statues of Roman gods, etc.³ In the Middle Ages, especially in Northern Europe, red also became the colour of justice, signified by the red church door.⁴ In antiquity and early medieval times, red also had a particular affinity with gold. The tradition of assigning a symbolic meaning to red and the affinity of red with gold – an affinity that affected the working methods in painting – continued for a long time, even in unexpected places, as will be shown in this article.
Canvas Painting

Nowadays, painting is usually done on a white surface, either paper or prepared canvas. This was different in the seventeenth century. At that time, the surface to paint on had a colour, often a light flesh colour or grey. These light grey or flesh colours had a function in the painting process. Such a coloured ground was just what was needed for determining the division of light and dark in the composition as a whole in an early stage of the painting process. The coloured ground made it possible to rapidly and efficiently give the light and dark parts their place. The chiaroscuro, so important in baroque painting, was almost instantly achieved.

The fact that grey goes very well with all the other colours is already noticed in written sources containing advice for painters. Theodore Turquet de Mayerne, the court physician to Charles I in London, when recommending what pigments to use for the top layer of the ground, which he calls the ‘priming’, explains: ‘For priming canvases, take lead white, red ochre, a little umber and very little charcoal black: In this way, the priming will be bleuisch, and easily takes all the colours, especially blue and green’. In a 1777 anonymous text this advice is more or less repeated: ‘The grounds mentioned last are made of lead white mixed with brown red and a little coal black, in order to render the right hue, a reddish grey, that in general agrees with all the colours in the art of painting’.

Not only in the written sources, but also in the paintings themselves one can see the grey ground. Especially from examining paintings on canvas we know, that opaque, light coloured paint often covers a red layer; the canvas was obviously first prepared with a red paint (figs.1 and 2). This way of working seems remarkable: why would one first paint red, if then the red is immediately painted on with grey? This manner of preparing canvases was, however, very common in Holland in the seventeenth century, and also with some Flemish, French and Italian painters, and they persisted with this method into the eighteenth century. To give an example, more than half of the canvases used by Rembrandt and his studio to paint on were prepared in this way, as research has shown. In Utrecht, Abraham Bloemaert and Hendrick ter Brugghen used flesh coloured grounds on red. Canaletto started to paint on such grounds in the 1730s.

From the examination of paintings we know that the red coloured ground was more or less covered: the colour did not seem to play a major role. Then, why use such an outspoken colour as red in the first place? Why not use a reddish grey mixture straight away, if a warm grey surface to paint on is preferred to a red one? Why bother with applying red when it will be hidden by grey? As we shall see, there were practical and financial reasons for the use of red. There was also the symbolic aspect of red. The use of red became a tradition in itself, and it often continued, even when practical, financial and symbolic reasons had lost their meaning.

In the following paragraphs I will show that a red ground was used on other objects besides paintings and that its use started long before the seventeenth
fig. 1 – A double ground, first red then grey, is visible at the surface of the unfinished picture by a follower of the Lenain, *Three Men and a Boy*, canvas, 54.1 x 64.5 cm, London, The National Gallery, cat. no. 4857. The first, red ground is the orange-red patch at the lower right.

fig. 2 – Paint cross-section of a sample from the edge of the canvas of Follower of Rembrandt, *Portrait of the Clergyman Eleazar Swalmius*, 1637, Antwerp, Museum voor Schone Kunsten, Inv. Nr. 705. Under the dark surface paint there is the build-up of ground layers: first orange-red, then (light) grey (lead white + a few black pigment particles)
century. With the examples chosen I want to speculate that the use of a red ground stems from early methods of making polychrome stone sculptures, murals and various other decorative coloured and gilded ornaments.

**Statues and Murals**

Red grounds were encountered often in medieval churches in the Netherlands. The red coloured preparatory layers were found on different types of objects. A typical example is the five polychrome calcareous sandstone sculptures that now form part of the central collection of the Centraal Museum in Utrecht. The gothic sculptures, according to old notes deriving from Utrecht’s Dom church, date from 1450/51. The four Saints, Agnes, Mary Magdalene, Paul, and Pontian of Spoleto, are depicted frontally in an upright position. Saint Martin is on horseback, donating part of his mantle to the beggar behind him. It was obvious that the sculptures were meant to be seen only from the front and the sides: the front and sides are carved, the backs are flat. The archives of the Domchapter produced an indication that the five sculptures were made for the sacrament house (sacramentum) of the Dom: ‘beneden an’t sacramentshuys gemaeckt’. The sculptures were provided by the Utrecht sculptor Jan Nude. Not only the name of the sculptor, but also the names of the painters were identified; they are Ulricus Liebaert and Jacobus van Rietvelt. In 1451 Liebaert and the heirs of Van Rietvelt were paid ‘de pictura vulgariter stoffiringe domus sacri eucharistiae’.

The sacrament house - a sort of cupboard for keeping the consecrated wafers - was positioned in the choir of the Dom. Furbishing the sacrament house must have been quite a large project; in 1442/43 already thirteen sculptures had been ordered for the purpose of decorating this ‘cupboard’.

The sculptures are coloured, but under the colours there is a red ground (fig. 3). The orange red colour underlies most of the polychrome. For instance, all of the flesh colours including that of the horse, the sole of the beggar’s foot and his little finger; the green grass under the feet of the saints, the horse and the beggar; parts of the draperies and all of the gilded parts such as the saints headdress and other decorations and Pontianus harness and shield. The red is thus found under all the colours, including cool ones like green. The only exception were blue painted areas, such as the blue lining of draperies; they were underlain with black, as was common practice. Black would enhance the tone of the greenish blue azurite, suggesting the expensive pigment obtained from the deep blue precious stone lapis lazuli.

A red ground is also specific for a surface that is to be gilded. The richly polychrome and gilded sandstone retable — also in the Dom — of canon Anthonis Pott, who died in 1500, is on a red ground as well. Comparable to the Centraal Museum ‘Dom sculptures’, under most of the colours and under the gold, including the gilding on imitation textile relief brocade, red was applied first.
FIG. 3 – The examination, in 1974, of the polychrome surface of one of the Dom sculptures – Saint Mary Magdalene – and the removal of a tiny paint sample in the Centraal Museum in Utrecht
Painting on red grounds can be found in many medieval churches in the Netherlands and not only on stone sculptures. Red underlies many of the mural paintings as well. For instance, the remnants of the tin-relief painted tapestries on the piers in the Dom, dating from the middle of the fourteenth century, that served as backgrounds for the statues of Christ, Mary and the twelve apostles, are on a red ground. Tin-relief textiles are a form of applied application that imitated the surface structures of metallic cloths and embroideries, widely used in fifteenth century European polychromy. During the examination and restoration of tin-relief textiles we noticed that detachment of the fragile relief had nearly always occurred between the red ground and the (usually) wax filling of the tin relief, a strong indication that the red was not part of the manufacture of the relief’s structure but of the preparation of the surface – in Utrecht the piers – to be decorated with cut pieces of tin-relief.

Also on a red ground are the slightly later Jesse’s Tree murals in the St. Janskerk in ’s Hertogenbosch and in the Buurkerk in Utrecht, dating from just before 1422 and ca. 1448 respectively (fig. 4). Also, the early sixteenth century St. Christopher murals in the St. Maartenskerk in Zaltbommel and in the St. Jacobskerk in Utrecht are on a red ground and so is the Crucifixion mural dating from the second part of the sixteenth century in the St Joriskerk in Amersfoort. It was very interesting to find that the red grounds in the early sixteenth century St Christopher murals in Zaltbommel and in Utrecht, and in the Crucifixion mural in Amersfoort have – at least in places – a dark grey application on top of the red. This discovery indicates that in the sixteenth century, for murals, red was considered too outspoken a hue to paint on directly, as it was in the seventeenth century, for canvas paintings. As far as their colour is concerned, the preparatory layers on stone, in the fifteenth and sixteenth century, apparently do not differ much from those of canvases in the seventeenth century.
Chemical identification of the red material would provide insight into the status of the 'red murals'. The analyses of the material of the red grounds used for the murals and the stone sculptures contained – besides red earth, as was expected – some red lead (minimum, lead oxide) and sometimes vermilion (mercury sulphide). Red lead, for instance, was found to be the main constituent of the red preparation layer of the painted tapestries on the piers in the Dom church and on the Centraal Museum’s ‘Dom sculptures’. The find of toxic substances such as lead oxide and a mercury compound suggests that the function of the red is that of a preservative. However, it is not clear if painters were aware of the preservatives qualities of red at that time. Also, since lead or mercury were not present in the grounds of all the paintings, preservation does not seem to be the only reason for applying red to the stone before painting.

A clue as to the use of red paint directly on the wall is already given in Roman times by Pliny: ‘Among the remaining kinds of red ochre the most useful for builders are the Egyptian and the African varieties, as they are most thoroughly absorbed by plaster’ (my italics, KG). In the seventeenth century, De Mayerne continues, saying that stone surfaces, like sculptures, sculpted ornaments and walls, should first be treated with oil to make them smooth and impermeable, so that one can paint on them. Soaking the stone with oil should first close the pores in the different kinds of stone – with differing porosity. De Mayerne is anxious about the drying of the oil; a little red lead – a good dryer – or ochre should be added. Then he remarks that, although the best ground is a grey one, the paint mixture needed for it is expensive, as the main ingredient is the costly lead white. So, in order to save money, one should start with the much cheaper (red) ochre: ‘This (grey) ground would be good as the last layer, because, if one wants to save, then one could make the first one with ochre [...]’. The conclusion we can draw from these recommendations is that, when painting walls, stone sculptures etc., red lead was added to the oil to enhance its drying properties and red earth was used for economical reasons. From the fourteenth century onwards the use of a red preparatory layer had become tradition, typically a rule-of-thumb method.

Moreover, in early days painters like Ulricus Liebaert and Jacobus van Rietvelt, who painted the ‘Dom sculptures’, were most probably not ‘painters’ in our sense of the word. At the time, painters earned their living by painting and gilding a variety of objects, even horse harnesses and saddles, flags and banners, signboards, doors and objects made from leather and wood. An anonymous book of secrets, printed in Antwerp in 1553 (probably copied from an earlier French book), states that when ‘applying gold leaf (or silver) to all sorts of metal – for instance iron –, clocks, stone etc.’, one should take ‘ochre, a third of minimum and a fourth of (the red) Armenian bole’. The book concludes: ‘brush it onto whatever you like.’ Applied in this way, the gilding could stand water. Gilding was done on a large
scale. (Stone) sculptures, painted tapestries and other decorative elements were partly gilded. Making polychrome and gilded stone sculpted and flat ornaments into a unity was easiest done by first giving them a flat ground colour. Therefore the key to the red ground, in the Netherlands, as in other parts of Europe, must lie in the technique of gilding. The application of gold leaf, and therefore the use of red, could stem from the manufacture of objects seemingly remote from easel paintings, namely objects made from metal. The goal was to imitate, or fake, solid metal.

Gold leaf stuck onto Armenian bole could be burnished, red bole being an iron-rich clay that can take a high polish. It would resemble a solid block of gold. The sculpted ornaments would pretend to be hammered from pure gold, the same way the painted tapestries pretended to be expensive gold-threaded textile brocades. A connection between painting and metal working was first proposed by Jilleen Nadolny, who argued that the medieval technique of tin-relief, which later was adapted to the production of tin-relief textiles, would stem from metal working. She in particular investigated the origins of the use of metals – in cast form, in sheets, in applied relief and in gilding – by painters. In a way one could say that also the sculpting and gilding of stone ornaments, old murals and easel paintings, associated with the ornamentation of medieval churches, originates in metal working.

**Conclusion**

In summary one can say that traditionally and according to the written sources quoted here, there were economical reasons for the use of red in preparatory layers as well as reasons related to preservation, drying and gilding. As a happy coincidence the materials possessing the right physical and chemical properties for these functions were of the favoured colour, red – although this was an orange red and not visible through the paint or gold covering it. Painting red has a long tradition, the affinity with the colour red stemming from symbols from ancient times. Although it cannot be proven that in later times red still had a symbolic meaning, in the early Middle Ages and medieval times there was the affinity with gold, the other important ‘colour’. In the guild tradition there was a consolidation of the symbolic meaning of red with the technique of gilding – although orange red instead of deep red. The craft tradition continued through the ages, in the use of red in mural painting and stone sculpture, until well into the seventeenth century, on canvas. The symbolic meaning of red merged with the very strong guild-craft tradition. The use of red continued, even when symbolic meaning of the colour was lost, through rule-of-thumb methods under the strong rules of the Guilds.

The tradition even worked in the seventeenth century – in the priming of canvases. Canvases primed in this way were also used in Rembrandt’s studio. Rembrandt broke with this tradition when he received the commission for painting
the Night Watch. He went to the trouble of finding clay that was light in colour, not red, so that, to obtain the right tone to paint on, he did not have to revert to an additional grey layer. The basic materials for the new priming – sand and clay – were inexpensive. The fact that the Night Watch can still be admired today is due to Rembrandt’s break with tradition and his discrimination in making choices.22

NOTES
5. Theodor Turquet de Mayerne, Pictoria Sculptoria & quae subalternarum artium, 1620, in: E. Berger, Quellen für Maltechnik während der Renaissance und deren Folgezeit, München 1901, p. 250: ‘Pour imprimer les toiles faut prendre Blanc de plomb, ocre rouge, un peu d’Ombre, & tant soit peu de charbon de bois, cherkole: Ainsi l’imprimeurera bleuastre, & receura facilement toutes couleurs, bleues & vertes principalement’.
10. The Middle Dutch word ‘stofferinge’ is not unambiguous. It means 1) to adorn something 2) everything needed for the furnishing of something, especially a house. My suggestion for the translation of this sentence is ‘for the painting – in the vulgar tongue stofferinge – of the house of the holy Eucharist’.

14 Documentation file 80/43 at the Netherlands Institute for Cultural Heritage in Amsterdam.

15 Recently, a similar find was reported for remnants of painted textiles on the piers in the St. Pieter church in Leiden; see Friedrichs, ‘De geperste brokaten’ (see note 12), p. 82.


17 Berger, Quellen für Maltechnik (see note 5), p. 276: ‘quand on peind sur muraille fault premierement sans en coller imhiber ladicte muraille d’huile deux ou trois foys avec une broitisse y mettant un peu de myne & d’ochre pour ayder a secher’.

18 Berger, Quellen für Maltechnik (see note 5), p. 278: ‘ceste imprimeure sera bonne pour derniere, car si on veult espargner on poura faire la premiere d’ochre [...]’.


20 Anoniem, Dat playant boekten van recepten [...], Antwerpen 1553.


22 Groen, ‘Grounds in Rembrandt’s workshop and in paintings by his contemporaries’ (see note 7).