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Historical recipes for preparatory layers for oil paintings in manuals, manuscripts and handbooks in North West Europe, 1550-1900: analysis and reconstructions

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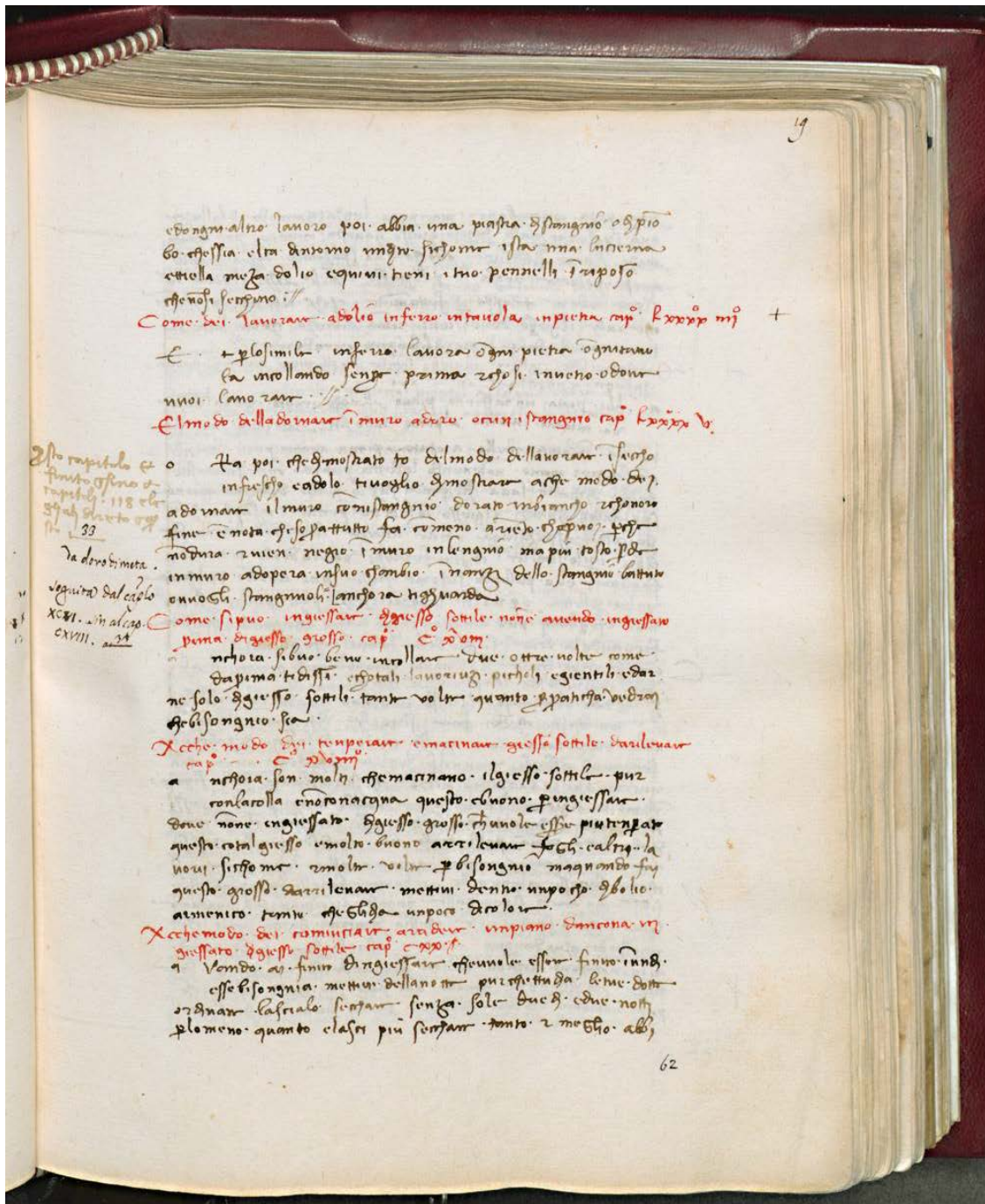


Figure 4.1 Folio 62v of the manuscript of Cennini's 'Libro dell'arte'.

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Chapter 4 Background: main developments in North West Europe c. 1400-1550

Now we come to the business of working on anconas¹ or on panel

Cennini c. 1400, translation Thompson 1960²

This chapter discusses the materials and layer structures of preparatory layers for oil painting before the year 1550 as it has been presented in earlier research. It serves as a background for the main period that is investigated in this dissertation.

As stated in Chapter 2, only a relatively small number of recipes is available from before 1550 (see Appendix 4 for an overview of recipes from this period). The fact that a large number of these recipes has been written in Italy, restricts the data that apply to the main subject of this dissertation even further. Notwithstanding the scarcity of available historical recipes, it is important to provide an overview of current knowledge on the topic, since the developments that take place before 1550 continue and, as will be shown, influence more recent recipes for preparatory layers.

Fortunately, early Northern European oil painting has received considerable attention from both (art) historians and scientists, which has led to a considerable amount of technical data being available for this period. As described in the introduction, nineteenth and early twentieth century research has paid particular attention to developments in oil painting in the circle around the Van Eyck brothers and to the influence of their paintings on Italian artists. Published research on this topic includes transcriptions of a number of historical recipe books, many of these of Italian origin, in efforts driven at least in part by a desire to develop clarity about the ‘introduction’ of oil painting.³

A considerable amount of analytical data have been published on the Flemish Primitives.⁴ The techniques employed in the earliest Italian paintings in oil executed on canvas, have

¹ The Italian term employed is *anchona*. Lara Broecke, who is currently preparing a new English translation of Cennini, explains that: ‘there is no real equivalent in English and the Italian meaning isn’t very well defined either’.. She writes that the term ‘does not appear in the *Voce Crusca* [=dictionary of the Italian language by the Accademia della Crusca. remark Stols-Witlox] in the 5th edition (1863-1923) where it is defined as a painted panel for an altar, usually shaped towards a point at the top’... however that the term ‘has also been used in some part of Italy for a diptych’. Broecke notes that others align *ancona* closely with the word *icon*’. She concludes that all we can say with certainty is that ‘it’s something slightly more complex than simple ‘panel’, although the complexity can be manifested in many different ways in different times and places’. Many thanks to Lara Broecke for this information. (email correspondence, 26-10-2013.)

² Cennini c. 1400, edition Frezzato 2003: 142-3. Translation Thompson 1960: 69.

³ See Nadolny 2003 and Nadolny 2005 on this topic, as well as Brinkman 1993. Roy 2000 and White 2000 discuss the reception of Vasari’s theory and research regarding its veracity, by nineteenth and twentieth scientists.

⁴ From the early 1950s on, when consistent, long-term research into art historical as well as technical aspects of the Flemish primitives was initiated by amongst others Roger Marijnissen, Paul Coremans and Jean Thissen at the Brussels ‘Centre National de Recherches ‘Primitifs Flamands’’, a number of this center’s publications have included descriptions of technical examinations, for instance in the series ‘Contributions à l’étude des Primitifs Flamands’ (first volume published 1952), and in the *corpus of Flemish primitives*.

been described in publications that focused both on documentary research, including recipe research, and on scientific analysis.⁵ Together with the more dispersed information available on other historical recipe books and in combination with other studies on different aspects of preparatory layers for oil painting in North West Europe before 1550, this data provides enough information to allow for a discussion of the main developments during the 150 years directly preceding 1550. As a recent investigation by Spring and Higgitt (2006) has demonstrated that chemical interactions between the oil binder and pigments in the paint or ground films may in earlier investigations have resulted in false positives for proteinaceous binder additions, special care must be taken with early identifications of emulsion binders.⁶

Although this dissertation focus on North West Europe, the present chapter also deals with developments in Italy. This is necessary, since, as will become clear, modern literature discusses the influence both areas have had on each other's development. Prior research generally states that Medieval oil painting on panel in Northern Europe has influenced a transition from tempera to oil painting in Italy. Conversely the introduction of oil painting on canvas, which is described as having taken place in Venice, is considered to have spread through Europe, reaching North West Europe later.⁷

Developments in the colour employed for preparatory layers are described separately at the end of the present chapter.

4.1 Preparatory layers for wooden panels, c. 1400-1550

While earlier research (*see below*) has not found any evidence to indicate that oil paint is employed on canvas prior to the late fifteenth or early sixteenth century, the use of oil binding media on panel has been documented much earlier.⁸ Analysis of the scattered evidence that remains, has led to the conclusion that oil binding media may have played an important role in Northern Europe *throughout* the Middle Ages.⁹ Dunkerton et al. (1991) even suggest that oil was the 'indigenous panel painting medium' in medieval

Important contributions to the present-day knowledge about the painting techniques of the Flemish primitives are the descriptions of paintings that appear regularly in the *National Gallery Technical Bulletin*. Volume 18 of this *Bulletin* is devoted solely to Flemish primitives and includes the results of the analysis of 45 paintings (Campbell, Foister and Roy 1997). In 1998, Mund and Stroo (eds.) published: *Early Netherlandish painting (1400-1500): a bibliography (1984-1998)*, volume 8 of the *Contributions à l'étude des Primitifs Flamands*, Brussels: KIK/IRPA. These are just a few important contributions. References in Chapter 4 will concentrate on the most recent publications relevant to the present context. Focus lies only on those publications that provide evidence for their statements about the characteristics of preparatory layers, leaving aside those publications that do not substantiate claims about materials and techniques with references to specific information sources in the form of recipes or technical examinations.

⁵ For instance Bomford et al. 1989 (1996); Dunkerton et al. 1991; Martin et al. 1992; Dunkerton and Roy 1998; Löhr and Weppelmann 2008.

⁶ *See* Spring and Higgitt 2006

⁷ *See* for more information on the cultural and political boundaries and cross-currents in the period preceding Van Eyck for instance: Kemperdick and Lammertse 2012; *see* Aikema and Brown 1999 for information on trade and cultural crosscurrents between Venice and Northern Europe; *see* Nuttall 2004 about the influence of Flemish artists on connections between artists from Florence and Flanders in the period 1400-1500.

⁸ Examples will be provided below.

⁹ Colman 1960; Plahter and Wiik 1970; Plahter 1984; Tangeberg 1984; Straub 1984; Dunkerton et al. 1991; Brinkman 1993; Billinge et al. 1997; Massing et al. 2003; Plahter 2004; Binski et al. 2011; Hermens and Townsend 2012.

Northern Europe and egg tempera only a temporary fashion during the fourteenth century.¹⁰ In recent years, an increasing number of publications have appeared that document the use of oil binders in Medieval painted altars and polychrome sculpture.¹¹

Whereas recent publications suggest a more important role for oil in Northern Europe, published results of scientific analysis lead to the conclusion that in Italy, egg tempera was the most important binder employed in panel painting until at least 1400.¹² However as Nuttall (2004) writes, oil was used in Italian workshops throughout the middle ages for other purposes (mordent gilding, varnishes, translucent glazes on metal leaf and some glazes in tempera paintings).¹³ Therefore knowledge of the basic properties of oils and of the preparation of oils for painting was present.

Evidence shows that the role of oil binding media in Italy increased during the fifteenth century. Dunkerton (1996), who together with her colleagues from the National Gallery in London has published widely on Italian painting techniques, describes the use of mixed techniques: oil and egg were sometimes combined within a single paint, they were used in alternate layers, or were combined within one painting but used in separate areas. Dunkerton for instance describes the use of opaque aqueous underpainting covered by transparent oil-based glazes. The earliest Italian example she has located that demonstrates such techniques is thought to date from the 1420s.¹⁴

Dunkerton believes that the growing role of oil as a binder is the result of Flemish influence and mentions Flemish paintings that were on show in Italy, Flemish artists working in Italy and Italian painters travelling north as important stimuli for the transition from tempera-based techniques to oil-based painting.¹⁵ Also Nuttall (2004) describes a growing influence of Flemish models in Florence from about 1460 onwards, even though she notes a reluctance of Florentine painters to abandon traditional tempera painting techniques. Nuttall observes that the Florentine artists of the second half of the fifteenth century attempted to create effects similar to those observed in Flemish paintings 'within the existing technical disciplines'.¹⁶ Dunkerton's description of the techniques employed in the paintings investigated at the National Gallery London convincingly supports the theory

¹⁰ Dunkerton et al. 1991: 193.

¹¹ For example: 14th century polychrome sculpture decorated with oil-based polychromy is found in England: Wrapson on the 'Westminster Abbey Sedilia'. (Wrapson 2006: 129). Data on the fourteenth century 'Thornham Parva altarpiece' is published in Massing et al. 2003, and on the use of oil binders the thirteenth century 'Westminster Retable' in Binski et al. 2011. The use of oil binding media in Medieval Scandinavian polychrome sculpture and altarpieces was discussed by Plahter and colleagues. For instance: Plahter and Wiik 1970; Plahter 1984; Tangeberg 1984; Plahter 2004. (White 2000: 102-103) provides an overview of early examples of oil painting.

¹² Dunkerton 1996, Bomford et al. 1996 (first published 1989).

¹³ Nuttall 2004: 162-3.

¹⁴ She remarks that the number of works examined (70) was limited. Dunkerton 1996: 29-34. Elsewhere Dunkerton expresses the fear that due to the low number of works having survived, the question of the transition from mainly tempera painting in Italy to the use of mainly oil as a paint binder for easel paintings may never be fully resolved. Dunkerton et al. 1991: 197

¹⁵ Dunkerton et al. 1991: 197-9. Travelling artists are discussed both by Koller 1984: 222-3, Dunkerton et al. 1991: 198. Nuttall discusses the interest of Italian collectors in paintings by Van Eyck, how motives depicted by Van Eyck found their way into Italian paintings and mentions Italian copies of works by Van Eyck. Nuttall 2000: 169 etc.

¹⁶ Nuttall 2004: 170-174.

that the transition to oil painting in Italy was gradual and that even by the beginning of the sixteenth century it 'was far from complete'.¹⁷

As will be seen, paint analyses and historical recipes demonstrate that in Italy, both the transition from mainly tempera painting to oil painting and the introduction of oil painting on canvas went hand in hand with developments in the layer build-up of preparatory layers and with the introduction of different materials. This suggests that these developments were related to the use of oil as a binder. The next paragraph will discuss these innovations in preparatory layers.

4.1.1 Preparatory systems for panel paintings during the fifteenth century

Historical recipes compiled in the published research¹⁸ in combination with analyses published by Straub, support the assumption that the grounds used in Medieval tempera painting were commonly bound in glue.¹⁹ It is generally accepted that North of the Alps these glue-bound grounds contained mainly chalk (CaCO_3) as filler, whereas in Italy gypsum ($\text{CaSO}_4 \cdot n\text{H}_2\text{O}$) was the predominant filler.²⁰ Scientific analysis has shown that in Portugal and Spain both gypsum and chalk were employed.²¹ It has been concluded that the occurrence of both types of fillers was dictated by local availability, a hypothesis that is supported by several authors who analysed the paintings of a number of Dutch artists working in Italy and showed that in their Italian paintings, these artists make use of gypsum grounds.²² Fernandes Pombo Cardoso (2010) however in her study of grounds on Portuguese baroque altarpieces comes to a different conclusion regarding the occurrence of chalk and glue preparatory layers in Portugal. She questions the conclusions of earlier authors that artists only employed local materials, rather she remarks that some of the panel paintings on which chalk grounds are found have strong ties to Flemish practice, which implies that established tradition with a specific material outweighs local availability.²³

The calcium carbonate most frequently found in North European painting grounds is a marine sedimentation product consisting of the skeletal remains of small prehistoric invertebrate sea creatures. Microscopically small skeletal remains such as coccoliths and foraminifers are an important feature of this type of chalk and may provide the possibility

¹⁷ Quote: Dunkerton 1991: 204. Dunkerton's description of 15th century Italian oil painting appears on pages 197-204.

¹⁸ See below for information on these recipes, see also Appendix 4.

¹⁹ Straub 1984: 155 etc. provides an overview of published analyses of medieval chalk and gypsum grounds; more recent data is available in Christie 1988; Dunkerton et al. 1991; Martin et al. 1992; Billinge et al. 1997; Veliz 1998; Santos Gomez et al. 1998; Hackney et al. 1999; Dunkerton et al. 1999; Kempfski 2003; Noble 2004; Hendriks 2006a, 2006b.

²⁰ Straub 1984, Dunkerton et al. 1991; Gettens, Fitzhugh, Feller 1993: 216 etc.; Nadolny 2008. Early Italian example of calcium carbonate grounds are ca. 1260, *Madonna statue*, Lucca; Cimabue, *Madonna with angels*, Louvre (Straub 1984: 156). Gypsum was analysed in the thirteenth century Westminster Retable, produced in East Anglia, England. According to the authors, late Medieval paintings indeed show a general division between the use of chalk North of the Alps and gypsum South of the Alps, however analyses of early Medieval art shows more examples of the use of gypsum in North Europe (Binski and Massing 2011: 238).

²¹ Alves 1974: 51; Veliz 1998: 142-3, Bruquetas-Galán 2002; Santos Gómez 2005.

²² San Andrés et al. 1997: 92. The same trend has been noted during the sixteenth century (Van de Graaf 1962: 471-472) and the seventeenth century (Plesters 1968: 263).

²³ Fernandes Pombo Cardoso 2010: 96-104, 106-108.

to determine its geographical origin.²⁴ Calcium carbonate also appears in nature as precipitated limestone. However according to Straub (1984) and Dunkerton (1999) its use seems to have been less common than the marine sediment. Examples are known of the use of dolomite (mixture of CaCO_3 and $\text{CaCO}_3 \cdot \text{MgCO}_3$) in Medieval Burgundy, Bohemia and Poland and in the Alpine regions, where it was mined locally.²⁵ Heydenreich (2007) in his research on Lucas Cranach concludes that this artist used mainly local limestone, since only in a few panel paintings the remains of fossils were found.²⁶ Goldberg (1998) writes that in Dürer's paintings, different calcium carbonates were used. Whereas some grounds were prepared with sedimentary chalk, chalks in other paintings show characteristics that point towards the use of rehydrated burnt calcium carbonate-containing rock or eggshells.²⁷ In German chalk and glue grounds, additions of gypsum or even of lead white to the chalk have been found.²⁸ In contrast to gypsum, chalk does not require as much pre-treatment to prepare it for use in a ground. After collection, it was probably just washed and slaked to remove impurities and then mixed straight with animal skin glue.²⁹

Whether wooden boards were generally sized before ground application remains uncertain because of a lack of analytical data. The Bavarian 'Liber Illuministarum', or 'Tegernsee manuscript' (c. 1500) advises to soak the wood in glue three times before ground application.³⁰ In some cases the support was covered with a layer of cloth or parchment, alternatively plant fibres. This preparatory step is not described in contemporary North European recipes,³¹ but Skaug (2008a) identified canvas, parchment and fibrous coverings on North European panel paintings dating from this period. Although Skaug remarks that much more research is required, he tentatively concludes that results so far seem to indicate that before 1500, North European artists most commonly employed strips of canvas or fibre to cover the joints of the boards, whereas in Italy more examples are found of panels covered completely with one or more canvas layers. Skaug furthermore writes that after 1500, such local differences were no longer apparent and notes that in general after that date, only fibres were used to cover the joints.³²

²⁴ Gysau 2005: 22-25.

²⁵ Straub 1984: 155, Dunkerton 1999: 217; Billinge et al. 1997: 22.

²⁶ Heydenreich 2007: 93.

²⁷ Goldberg et al. 1998: 60-1.

²⁸ Straub 1984: 156.

²⁹ Unfortunately hardly any fifteenth century North European recipes seem to have survived. For that reason, the much earlier treatise written by monk Theophilus is often cited in this context. Although probably written in the eleventh century, his descriptions are commonly considered to still apply to fourteenth century panel preparation. In the absence of other sources, his recipe for a ground preparation for panels on altarpieces or on doors is included here. Theophilus advised the use of burnt gypsum or of chalk to prepare panels. His recipe for a calcium carbonate ground specified grinding the calcium carbonate with water and adding animal glue. The mixture was applied up to three times onto the panel which had been covered with untanned, de-haired horse skin. Each layer was applied more thickly than the earlier. After ground application, the surface was scraped with 'Schachtelhalm' (reeds or rushes). Theophilus 11th century and later (edition London; John Murray 1847): 22-3.

³⁰ 'Liber illuministarum' c. 1500, transcribed by Bartl et al. 2005: 182-3. Research by (Witlox and Carlyle 2005: 520) compared 17th-19th century recipes for panel preparation and canvas preparation and showed that although for canvas preparation size layers are mentioned in a large proportion of the recipes, size layers are frequently omitted from panel preparation recipes.

³¹ Coverings were described by Cennini. Cennini c. 1400 (edition Frezzato 2003): 144.

³² Skaug 2008a: 24-9. See below for a discussion on the application of coverings in Italian panel paintings. Skaug describes the use of different types of whole or partial coverings on panel paintings from Italy,

Dunkerton *et al.* (1991) note that the Flemish and German chalk and glue grounds they investigated only rarely matched the greater thickness of Italian contemporary grounds. The authors relate this difference to the quality of the support, Italian panels (often poplar) having more defects and a rougher texture than the woods typically used in Northern Europe (oak, lime).³³ Also the fact that full coverings were more common in Italy than in North European examples is possibly be related to the quality of the wood.³⁴

To prevent both gypsum and chalk and glue grounds from absorbing too much tempera paint binder, un-pigmented isolation layers are suspected to occasionally have been applied to grounds intended for tempera painting. This is supported by the fact that the the Bavarian *Liber Illuministarum* (c. 1500) advises against their application to areas that would be gilded, probably because such layers would increase the hardness or brittleness of the ground and would therefore hinder the burnishing of gold leaf.³⁵

Oil paint application on an unsaturated glue-bound surface is more troublesome than on a more binder rich, saturated surface.³⁶ Therefore isolation layers seem to have played a more important role in paintings executed in oil. Furthermore, uneven absorption of the paint binder can potentially be problematic when using the transparent oil-based glazes so typical of early Flemish and German oil painting, more so than when using opaque tempera paints.

The theory that non-pigmented oil, glue or oleoresinous isolation layers are a common feature of early oil painting is supported by several modern authors describing fifteenth and sixteenth century Middle and North European oil painting practice, who observed such layers in paint cross sections.³⁷ However it must be noted that the thinness of the

Norway, Sweden, Denmark, England, Bohemia, Germany, Austria, Switzerland and Spain (Skaug 2008a: 24-5). Billinge *et al.* 1999: 20-1 mention the presence of full coverings on a number of German fifteenth century panel paintings. Whereas during the fifteenth century full coverings were described and found on paintings, the few available sixteenth century recipes describe only strips of canvas or fibres. (Skaug 2008a reports a general preference for fibres applied across the joints). For instance (Borghini 1584 (edition 1730): 135-6)) advised to apply hemp fibres or strips of old canvas to the wooden support before smoothing the support with an iron scraper and applying a ground.

³³ Dunkerton *et al.* 1991: 164. Indeed, Cennini advised to fill defects with a mixture of strong animal glue and sawdust and then smooth them with a knife (Cennini c. 1400, edition Frezzato 2003: 142-3). Case studies from paintings confirm that some panels were repaired before the ground was applied. Uzielli reports that in Mediterranean countries, large boards sawn from the poplar tree usually contained some faults, even if very high quality wood was used (Uzielli 1998: 116).

³⁴ Skaug notes the exception of the London National Gallery *Wilton diptych* (c. 1395-9), which was painted in Northern Europe but nevertheless has a full covering of parchment fibres. Skaug 2006: 195, note 75.

³⁵ Bartl *et al.* 2005: 185, recipe 258. Billinge *et al.* 1997: 23 describe the Tyrolean School *Death of the Virgin* and *Saints Ambrose, Exuperius and Jerome* (circle of Master of Liesborn) as paintings that only have an isolation layer in non-watergilded areas. Gifford *et al.* 2003 report the absence of the lead white pigmented isolation layer present in painted regions from gilded areas of an anonymous early Netherlandish quadriptych dated ca. 1400.

³⁶ The fact that the absorbency of aqueous layers could be perceived as difficult was evident in a much later recipe. Apparently Bouvier (1827) had noted that some painters needed to be convinced of the benefits of aqueous –in his case starch-based– grounds: ‘If the sketch is a little more difficult to execute, this inconvenience does not exist anymore in the second painting; because here the sketch serves as the oil priming, and one paints on top with the same ease as on any other sketch: therefore the inconvenience is not large, and the advantages are positive’. Bouvier 1827: 573-7.

³⁷ Straub 1984: 166; Goldberg 1998, Heydenreich 2007: 98, Vandivere 2011.

possible isolation layer combined with the absorbency of the ground makes a positive identification difficult, even uncertain.³⁸

Until recently, the capability of analytical techniques to identify the binder of generally very thin isolation layers was limited. Therefore the amount of data on the materials used in isolation layers is small.³⁹ A complicating factor for the determination of the binder, which should also be taken into consideration, is the mobility of binder components. Reconstructions by Carlyle, analysed by Keune (2005), have shown that binder components may become dispersed into other paint layers, even in the presence of intermediary isolation layers.⁴⁰

Pigmented isolation layers have been found on Northern European oil paintings dating from as early as the thirteenth century, produced in Norway and England. These first examples were of a whitish tone and consist of mainly lead white, thought to have been bound in oil.⁴¹ Lead white is considered to have added to the ground's luminosity, which would have been important in the Early Flemish manner of painting that uses transparent glazes and is described as having exploited the light reflecting properties of whitish preparatory layers.⁴²

During the period c. 1400-1550, the colours employed for pigmented isolation layers diversified. Since a number of modern authors relate this development to contemporary developments in canvas painting and describe colour developments in North Europe as following from the introduction of coloured grounds in Italy, the topic of colour will be discussed in more detail later, in Paragraph 4.3 of the present chapter, after an overview of preparatory layers employed in Italian panel and canvas painting has been provided.

4.1.2 Preparatory layers for panel paintings in Italy, c. 1400-1550

As will be seen, fifteenth century Italian recipes for preparatory layers for panel still mention the calcium sulphate fillers that were prescribed in earlier medieval recipes. Recipes also describe the use of animal glue size layers and parchment or canvas coverings.⁴³ Skaug (2006, 2008a) identifies the use of different types of coverings on

³⁸ Which is also commented upon by Billinge et al 1997: 23. Increased fluorescence and a transparent region in a chalk and glue ground may be caused by the application of unpigmented isolation layers, but can also be the result of penetration of paint binder into the ground or the result of a phase separation inside the preparatory layers themselves. Carlyle et al. executed reconstructions based on a number of historical recipes and with these reconstructions demonstrated that a chalk and glue ground was partially impregnated by binder from the subsequent ground layer consisting of lead white in oil, which gave the chalk and glue layer the appearance of a double ground layer. Carlyle et al. 2008a: 117-118. Similar absorption is noted in Stols-Witlox et al. 2008: 85, 88 and in Vandivere 2013.

³⁹ See Chapter 15 on streaky imprimaturas, which uses reconstructions as a means to obtain information on such thin layers.

⁴⁰ Keune 2005: 74.

⁴¹ Kempfski, 2003: 150. The *Westminster retable* is dated late thirteenth century (Binski et al. 2011). The *Thornham Parva retable*, produced in East Anglia, England, is dated c. 1335-40. In the *Thornham Parva retable* the picture planes are covered with a chalk and glue ground, a subsequent underdrawing and underpainting and an isolation layer of lead white in linseed oil (Bucklow 2003: 44).

⁴² See for instance: Straub 1984: 167; Dunkerton et al. 1999: 218; Heydenreich 2007: 99.

⁴³ Cennini provided instructions for local repairs of knots and other irregularities. Both Cennini and the anonymous fifteenth century 'Bolognese manuscript' describe the application of a glue size layer to the scraped support prior to ground application. 'Bolognese manuscript' 15th century (transcribed in Merrifield 1849 (1999): 594-5); Cennini c. 1400 (edition Frezzato 2003): 142-3, 147. Cennini also mentions the

panels dating from this period.⁴⁴ Cennini (c. 1400) describes a preparatory system that consists of multiple coats of *gesso grosso* followed by coats of *gesso sottile* (Fig. 4.1).⁴⁵ Indeed such preparatory layers are identified on a large number of medieval Italian paintings.⁴⁶ Bomford et al. (1989) and Thomas (1995) both agree that 'standard' panels may have been prepared by specialists in this craft, whose existence was mentioned in contemporary sources. However Thomas quotes archival information that seems to indicate that in some cases, especially for larger altarpieces with a non-standard format, gesso application is performed by the workshop itself.⁴⁷

On the basis of their scientific investigations Dunkerton et al. (1991) conclude that a simplification in layer structure takes place during the fifteenth century.⁴⁸ In a number of cases the National Gallery London researchers find only single grounds, consisting either of *gesso grosso* or *sottile*, *gesso sottile* mainly in areas North of the Appenines and *grosso* South of these mountains. They furthermore note that some painters vary between both types of *gesso*. Dunkerton *et al.* provide the example of Neri di Bicci, who leaves a written record that states that he prepared one crucifix with *grosso* and another with a *sottile* gesso.⁴⁹ They report that in some paintings a combination of both types of *gesso* is present within a single layer.⁵⁰ According to Martin (1992), the Tuscan school of painting forms an exception and continues producing grounds consisting of both the *grosso* and *sottile* layers.⁵¹

application of a canvas 'covering' after sizing, before *gesso* application. It consisted of linen cloth soaked in glue. Cennini c. 1400 (transcribed in Frezzato 2003: 144).

⁴⁴ Skaug's investigations identified linen, parchment and fibrous coverings on panels in Medieval Italy. They were either applied below the ground or between ground layers. He concluded that their purpose was either to reinforce and homogenize the whole of the support, or they were applied locally to weak areas like the joints of planks or knots (Skaug 2006: 182-201; Skaug 2008a).

⁴⁵ Two types of gypsum occur in nature: calcium sulphate dihydrate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) and anhydrite (CaSO_4). They are rather gritty and hard, but apparently can be used as fillers without processing. Burning (and slaking) purifies them and makes them more suitable for the smooth grounds required for gilding. By burning calcium sulphate dihydrate, associated water is driven off. This is the process employed to make *gesso grosso*. See for detailed information on this process: Federspiel 1995; Zillich 1998; Santos Gómez 2008; Fernandes Pombo Cardoso 2010. Cennini's instructions describe steeping the gesso in water and state that this soft powder, mixed with animal skin glue, was used for the *gesso sottile*. Cennini c. 1400 (edition Frezzato 2003: 145). Although Cennini prescribes burned gypsum mixed with animal skin glue for the *gesso grosso*, analyses of *gesso grosso* from Italian as well as Spanish paintings have shown that these layers can also contain mixtures of anhydrite with hemi-hydrate and sometimes even dehydrate (Straub 1984: 156-7; Dunkerton 1991: 163; Martin 1992: 82-92; San Andrés et al. 1997: 93-4). San Andrés suggests that these mixtures may result from a partial re-hydration of the gypsum that takes place over time (San Andrés et al. 1997: 98). It cannot be ruled out that mixtures may be the result of fluctuating burning conditions in medieval ovens. Indeed this topic is discussed by Fernandes Pombo Cardoso, who points out that such mixtures have longer setting times, which creates a longer window in which the mixture may be used. Fernandes Pombo Cardoso 2010: 84.

⁴⁶ Examples of early analyses are given in Bones 1954; Gettens and Mrose 1954. More recent descriptions are available for instance from Straub 1984; Bomford 1989; Dunkerton et al. 1991.

⁴⁷ Thomas 1995: 155-7; Bomford et al. 1989: 19.

⁴⁸ Dunkerton et al. 1991: 163. It is interesting to note that also in descriptions of the paint layer build-up of artists from the North Netherlandish Leiden school, Van Duijn et al. and Vandivere note simplifications in a comparison of fifteenth and sixteenth century technique. They interpret them as sign of a transition to more economical painting methods. Van Duijn et al. 2011: 104-110; Vandivere 2011: 7

⁴⁹ Dunkerton et al. 1991: 163.

⁵⁰ Dunkerton et al. 1999: 218. It cannot be ruled out that the mixture resulted from incomplete de- or re-hydration during the preparation of the gypsum by burning and slaking.

⁵¹ Martin 1992.

Air bubbles in the gesso preparation and scratches from scraping the panel after ground application that are noted in a number of paintings, led Dunkerton and colleagues to conclude that during the sixteenth century, grounds may have been applied less carefully than before.⁵² Dunkerton *et al.* (1991) link the apparent simplification in layer build-up to the gradual disappearance of gilding from paintings,⁵³ which eliminates the need for an absolutely smooth support. In a later publication the same authors point out that gilding does not disappear completely and remains in use in some more traditional areas of Italy and in Germany, as well as for specific details in paintings from other artistic centres.⁵⁴

The gesso ground recipes provided by Cennini (c. 1400) and the fifteenth century 'Bolognese manuscript' do not reflect this simplification. Both sources mention a layer build-up consisting of both *gesso grosso* and *sottile*. However it may be significant to note here that both recipes appear to relate to tempera, not to oil painting.⁵⁵ Filarete (Antonio Averlino) (c. 1452-62) describes oil painting on panel. From his recipe it is not clear whether the gesso consists of one or two layers, as the author does not pay much attention at all to gesso preparation and application. He only states that after the panel has received a gesso ('ingessato') and has been polished, a glue isolation layer and then a layer of oil paint are applied before the support is considered ready for oil painting.⁵⁶

4.2 Preparatory layers for canvas paintings, c. 1400-1550

Although canvas was employed for painting during the middle ages,⁵⁷ oil binders were apparently not used to paint on this support. Of the few remaining fifteenth century

⁵² Dunkerton *et al.* 1999: 218, Dietz *et al.* 2011: 91. Heydenreich notes a pattern of scratches in the ground surface of some paintings by Cranach the Elder that appears to have been applied with a toothed plane (Heydenreich 2007: 94). Bruquetas-Galán describes how some Spanish sixteenth century panel paintings show cross-hatched diagonal scratches in the support that appear to have been applied deliberately, possibly to increase adhesion of the ground layers to the wood (Bruquetas-Galán 2002: 222-4).

⁵³ Dunkerton *et al.* 1991: 163-4.

⁵⁴ Dunkerton *et al.* 1999: 220.

⁵⁵ Cennini c. 1400 (edition Frezzato 2003): 142-3, etc. After his description of panel preparation, Cennini describes gilding and tempera painting. It therefore appears that this recipe is connected to tempera painting. According to Merrifield, who transcribed the sections relevant to art, the Bolognese manuscript does not include any prescriptions for oil painting, although it does contain a reference to boiling oil. 'Bolognese manuscript' 15th century (transcribed in Merrifield 1849 (1999): 594-5).

⁵⁶ Filarete (Antonio Averlino) c. 1452-62, in Van de Graaf 1958 (Who takes his quote from Oettingen 1890: 461): 112.

⁵⁷ The extent to which canvas was employed during the Middle Ages is difficult to establish due to the low number of surviving works. If we would base our understanding on the number of paintings preserved in public collections and on the attention medieval panel paintings have received in the modern literature, it would even seem that during the Middle Ages the use of canvas supports was rather exceptional (*See for instance* Billinge *et al.* 1997: 16, who note that the majority of Flemish and German paintings dating from 1400-1550 in the collection of the National Gallery in London is on panel.) However documentary evidence suggests a more regular use of canvas (Dunkerton *et al.* 1991: 161). Both Wolfthal and Dunkerton partially attribute this discrepancy to the lower durability of canvas paintings, a hypothesis that is supported by the often degraded and fragile state of the few surviving examples (Wolfthal 1989, Dunkerton *et al.* 1991). Apart from the supposed influence of the support and aqueous technique on the stability of the painting, also its function may have played a role: According to (Dunkerton *et al.* 1991: 161), canvas was the usual choice for temporary decorations. Wolfthal 1989 describes its use as a lightweight alternative for panel for paintings that had to travel, as temporary decorations and as alternatives to wall tapestries (Wolfthal 1989). *See also* Heydenreich 2007, who discusses early oil painting on canvas in the context of Cranach.

paintings on canvas,⁵⁸ both Flemish and Italian, only a small number has been analyzed to date, and the results suggest the use of aqueous binding media, which places such canvases outside the scope of the present research.⁵⁹

The general understanding is that the first canvas paintings executed in an oil binder were painted in Venice just before 1500.⁶⁰ Dunkerton *et al.* (1991) link their appearance to the damp conditions in Venice, which do not favour the use of panel or fresco, both being moisture sensitive. This is a strange theory, as canvas is also sensitive to moisture. The preparatory systems of the first canvas paintings, described below, often includes aqueous layers. This would result in a moisture sensitive system. As noted by Vasari 1550 (edition 1568), the greater ease of transporting canvas by rolling may have contributed to their popularity over panels. In particular in Venice, where canals inhibit road transport and necessitate light water crafts, this advantage may have been an important one.⁶¹

Apparently many Venetians were quickly won over by the characteristics and possible advantages of canvas paintings. Of the next generation of painters, Titian (1485-1576) and Veronese (1528-1588) both painted almost exclusively on canvas.⁶² Koller (1984) points out that in some Italian cities, like Rome and Florence, panel remained the favoured support until well into the sixteenth century.⁶³ Miedema and Meijer (1979), who investigated the introduction of coloured grounds in the Netherlands, concluded on the basis of their calculations of the number of paintings in several large exhibitions executed on either support, that during the sixteenth century the fashion for canvas spread to Spain and that its use in Northern Europe also increased quickly. A tie with Venice seems legitimate, since their investigations showed that Venice acted as forerunner and influenced artists, such as the Haarlem Mannerists in the Netherlands.⁶⁴

⁵⁸ Executed on linen (in most cases) or silk of a very fine weave. Wolfthal 1989; Dunkerton *et al.* 1991.

⁵⁹ Koller describes how aqueous paintings on fine canvas continue to be executed in sixteenth century Flanders. Koller 1984: 290. Of the nine canvases whose analysis was described by Wolfthal (1989), a ground layer could be detected in only five. These ground layers were thin and were described as bound with animal glue. Some contained chalk, others earth pigments. Wolfthal 1989: 24-25. Wolfthal supposes that in cases where no ground was detected at least a size layer must have been used to prevent bleeding of the paint into the canvas. The fact that coloured preparations were seen is interesting in relation to the introduction of coloured grounds, which in North West Europe took place much later than contemporary watercolour paintings on canvas. *See also* Dunkerton *et al.* 1991: 164. Straub (1984), Wolfthal (1989) and Dunkerton *et al.* (1991) discuss a number of recipes that describe preparatory layers for aqueous paintings on canvas. Those recipes also mention animal glue size layers or animal glue as binder for a thin ground layer. In addition, gum Arabic is mentioned. The sources mentioned by these authors include Heraclius, twelfth century (*see* Straub 1984: 151) and Le Begue (transcription dated c. 1431) (transcribed in Merrifield 1849 (1999): 85 *etc.*). Cennini described a layer of animal glue followed by a thin layer of *gesso sottile* to fill the canvas interstices, applied using a knife. This layer contained a little starch or sugar to raise its flexibility. After drying, it was scraped down with the same knife to ensure its thinness. Cennini c. 1400 (edition Frezzato 2003): 182-3.

⁶⁰ Miedema and Meijer 1979; Koller 1984: 289-91; Dunkerton *et al.* 1991: 160-1; Young and Katlan 2012: 127-9.

⁶¹ Vasari 1550 (edition 1568: 53

⁶² Koller 1984: 292-3 provides numbers. Biographical information on both artists from <http://www.rkd.nl>. Accessed 27-1-2014

⁶³ Koller 1984: 292. Dunkerton and Spring 1998's survey of Italian sixteenth century paintings shows a similar contrast in different Italian regions. Naturally one must keep in mind here that the exact ratio may have been influenced by collecting policy.

⁶⁴ Miedema and Meijer 1979: 87. Abraham (1989) wrote an interesting master thesis on the Haarlem mannerists' use of coloured grounds. She combined microscopic examination and painting examination with

Given these signs of Italian influence, it is not surprising that a number of modern authors discuss North European canvas preparations in relation to the materials and techniques used for canvas preparation in Italy.

4.2.1 Preparatory layers for canvas in Italy

It seems logical to assume that the materials traditionally used for panel grounds would initially be employed for canvas preparation as well. Due to the low number of surviving fifteenth century oil paintings on canvas, analytical data on their grounds is unfortunately rare. Paolo Uccello's *St. George and the dragon* (probably early 1470s) is executed in oil on canvas prepared with a first layer of gesso (calcium sulphate),⁶⁵ which corresponds to preparatory layers employed for contemporary panel painting.

Analyses by Dunkerton & Spring (1998) confirm that thin gesso grounds continued to be used in Venetian canvas paintings during the sixteenth century. In the majority of the cases investigated, gesso layers were applied as single grounds. Analyses of oil paintings on canvas from other Italian regions also indicate the use of single gesso grounds.⁶⁶ Koller (1984) provides examples of the addition of other materials to gesso layers, such as smalt, found in some of Tintoretto's paintings (before 1550/60) and lead white, found in the paintings of Salviati (dated circa 1530-40).⁶⁷

Both Birkmaier (1995) and Dunkerton & Spring (1998) performed analyses of Titian's grounds. They report that in some cases Titian worked straight on a gesso/glue ground but that he also employed gesso grounds covered with a whitish or light coloured oil ground,⁶⁸ a layer build-up very similar to contemporary panel grounds.⁶⁹

Dunkerton & Spring (1998) describe how a number of paintings executed by the generation of painters after Titian were painted on coloured, oil-based grounds applied straight to the (sized) canvas.⁷⁰ In the Venetian examples discussed, the grounds had grey, greenish grey, reddish or brown hues and consisted of pigments and fillers such as lead white, gypsum, earths and blacks, with the addition of siccatives such as minium or litharge.⁷¹ A recipe by Vasari (1550) explains that a canvas that needs to be rolled should

data from historical sources. Also the oeuvre of Lambert Lombard (Liège 1505-6/1566) contains a number of oil paintings on canvas, whose technique and materials are discussed below. Sanyova and Saverwyns 2006.

⁶⁵ On top of this layer, an orange-red layer was applied consisting of ochre and a little lead white, bound in walnut oil. Although this layer was thought to be part of the preparation of the canvas in an earlier publication, more recent research has indicated that the canvas is likely to have been reused. Dunkerton and Roy 1998: 27

⁶⁶ Dunkerton and Spring 1998.

⁶⁷ Koller 1984: 303.

⁶⁸ Birkmaier et al. 1995: 119; Dunkerton et al. 1999: 271. (Dunkerton and Spring 1998: 126, 128) report the use of gesso grounds covered with a white (lead white) priming layer in three of the seven white primings found, next to one example of a light grey priming layer, supposedly in oil, on a first layer consisting of gesso.

⁶⁹ See Paragraph 5.2

⁷⁰ Dunkerton and Spring 1998's tables show that also some paintings produced outside of Venice did not give any evidence of the application of a gesso layer before the white or coloured priming layer was applied. In their paper the authors describe that for each painting they used two, preferably more samples. This decreases the chance that gesso layers may have been missed during sampling.

⁷¹ Dunkerton et al. 1999: 271-3.

not receive a gypsum and glue layer because this layer would flake upon rolling.⁷² Whether this indeed is the reason behind the omission of a gesso layer in the examples mentioned by Dunkerton and colleagues, cannot be proven.

4.2.2 Preparatory layers for canvas in North and Central Europe

Unfortunately very little analysis has been performed on the few sixteenth century North European oil paintings on canvas that have been preserved.⁷³ The low number of surviving cases does not allow for comprehensive conclusions about the technique of such paintings. We do know however that chalk and glue grounds were employed in a number of these cases, covered with a white or coloured second ground. Billinge *et al.* (1997) describe the use of a chalk and glue preparatory layer for a Cologne *Cycle of the life of Saint Lawrence*, dated 1510.⁷⁴ Analyses of a number of paintings from within the oeuvre of Lambert Lombard (Liège, 1505/06-1566) show that for his oil paintings this artist employed canvases that were covered with a thin chalk/glue ground on top of which a thin, greyish imprimatura was applied that consisted of lead white, chalk, black and in some cases a red pigment.⁷⁵ Panel paintings attributed to Lombard's studio are not executed with such tinted imprimaturas. Here, researchers Saverwyns and Sanyova just find thin oil 'isolation layers' that contain a little lead white.⁷⁶

It is interesting to note that Lombard's workshop apparently employed a different preparatory system and colour depending on whether the ground was applied to panel or canvas. Research by Heydenreich (2007) on the painting technique of Lucas Cranach the Elder shows that this artist also uses different preparations for panel and canvas. While Cranach nearly always employed chalk and glue grounds on panel, analysis of some of his canvas paintings show a different size layer and first ground layer binder. Here he used a size layer of glue and flour paste, a first ground that contained glue, flour paste and chalk and subsequently a layer of lead white and calcium carbonate in drying oil.⁷⁷

The Bavarian *Liber illuministarum* (c. 1500) provides differing recipes for the preparation of panel and canvas. Whereas for panel a layer build-up consisting of chalk and glue followed by an oil-based pigmented layer is advised, the preparatory system described for canvas consists of a glue and flour paste size layer, a layer of 'whiting' (probably chalk and glue⁷⁸), and finally -and only if the cloth is intended for oil painting- an isolation layer of oil.⁷⁹

⁷² Vasari 1550 (edition 1568): 53.

⁷³ The fact that the National Gallery in London only owns five Netherlandish school canvas paintings that fall within this period, of which a number are categorized as aqueous paintings without grounds, against a much larger number of panel paintings, demonstrates their scarcity. Billinge *et al.* 1997: 24.

⁷⁴ Billinge *et al.* 1997: 24. The authors remark that such cycles may have had a 'decorative function; they were cheap substitutes for tapestries'.

⁷⁵ Sanyova and Saverwyns 2006: 270.

⁷⁶ Sanyova and Saverwyns 2006: 295.

⁷⁷ Heydenreich 2007: 245.

⁷⁸ Nadolny 2008 provides an overview of terminology related to preparatory layers for panel supports before c. 1550.

⁷⁹ Bartl *et al.* 2005: 184-185. A paste was boiled of flour and glue, which was applied as a size layer. Subsequently, a layer of 'whiting' ['weyßss', chalk] was applied, and for oil painting this layer was impregnated with oil.

The advice to use an oil-based isolation layer, white or tinted, is comparable to contemporary Italian practice. The fact that instead of gypsum, these North European preparatory layers contain chalk is not surprising if we consider the local availability of both materials. So far no evidence of intermediary glue isolation layers has been found in North European paintings and the small number of investigated works from this period and region prevents a final conclusion on this topic. However animal glue isolation layers are described in contemporary Italian recipes.⁸⁰

4.3 Developments in ground colour, c. 1400-1550

Whereas the published research thus far indicates that fourteenth and early fifteenth recipes for preparatory layers describe white grounds⁸¹ and while analyses of contemporary paintings indeed finds whitish ground layers, it is evident that during the late fifteenth century the first examples of coloured grounds appeared. The question whether such coloured layers first appeared on canvas or on panel remains unresolved and will only be answered through the examination of a statistically significant number of paintings. The data assembled so far (*see below*) seems to point at a simultaneous introduction of coloured grounds for both supports.⁸²

In Northern Europe, some early fifteenth century Flemish and German artists are reported to have employed light, slightly toned lead white imprimaturas on panel, instead of purely white preparatory layers.⁸³ For instance Jan van Eyck (ca. 1390-1441) and Hubert van Eyck (c. 1385/90-1426) used an warm white oil based layer (lead white with a minor addition of red) to cover the chalk and glue ground of the *Ghent altarpiece*,⁸⁴ Van der Weyden (1399/1400-1464) employed lead white with a black and a red pigment, with possibly the addition of some calcium carbonate, in an oil-bound second ground layer for his *Descent from the Cross*.⁸⁵ Ferreira, Morrison and Boon (2008) found a pigmented imprimatura layer of the *Sherborne triptych* (c. 1480).⁸⁶ Early examples of more strongly coloured ground layers on panel appeared late in the fifteenth century and during the first part of the sixteenth century.⁸⁷

Miedema and Meijer's research (1979) shows that in the Netherlands, coloured grounds on panel only became more frequent towards the end of the 16th century.⁸⁸ The colour of such panel imprimaturas is described in Koller's overview (1984) as ranging from grey (observed in several panel paintings dating from the later 16th century) to pink or ochre

⁸⁰ Vasari 1550 (edition 1568): 53; Armenini 1587: 124-5

⁸¹ The only fifteenth century source located so far that hints at the use of different colours is Filarete (Antonio Averlino) 1452-62 in Van de Graaf 1958, citing (Oetingen 1890: 641): 112, who states 'If it is white, it's good, and also if it another colour, it does not matter which colour it is'.

⁸² Dunkerton and Spring's overview of grounds on Italian paintings from the National Gallery London collection reveals no patterns that linked the introduction of coloured ground colour to either support. Dunkerton and Spring 1998.

⁸³ *See* Heydenreich 2007: 103 for examples.

⁸⁴ Brinkman 1993: 212-3. Brinkman describes staining tests by Coremans that point to the use of oil.

⁸⁵ Ferreira, Morrison and Boon 2008: 54-56.

⁸⁶ Ferreira, Morrison and Boon 2008: 57.

⁸⁷ *See* for additional examples Noble 2004; Vandivere 2011: 9.

⁸⁸ Miedema and Meijer 1979: 79-98.

(German and Dutch panels from the late 16th century).⁸⁹ The technical differences between Jan Breughel the Elder's painting of the *The numbering at Bethlehem* (1566) and copies of the same painting made by the Brueghel studio around 1600-1618, demonstrate this transition. Whereas the master painting was executed over a white imprimatura based on lead white, many of the copies have a light ochre colour or orange-beige imprimatura, sometimes used in the final composition.⁹⁰

The general view is that coloured ground or imprimatura layers were introduced earlier to Italy than in North Europe. However, the notion that coloured grounds or imprimatura layers in North West Europe appeared under the influence of Italian examples does remain difficult to prove. Although the chronology of their introduction in different regions seems to point in this direction, coloured grounds becoming a general feature of Italian paintings sooner than of North European paintings, one may question whether such a chronology sufficiently proves this theory. Evidence does however exist of contacts between North and South Europe, as was mentioned above in relation to the 'introduction' of oil painting in Italy. Cross-fertilization seems logical and examples have been discussed in the literature.⁹¹

The investigation by Dunkerton and Spring (1998) of the preparatory layers of nearly 140 sixteenth-century Italian paintings in the collection of the National Gallery in London provides the most extensive and convincing published evidence of the use of coloured grounds in Italian paintings,⁹² although the introduction of coloured grounds in Italy was certainly investigated by earlier researchers.⁹³

Dunkerton and Spring's research leads to the conclusion that a modification is required of the reputation of Venice as Italy's most innovative artistic centre in this age. Dunkerton and Spring show that Venetian painters, although early in their adaptation of canvas supports for oil painting, did not play an innovative role when it comes to the development of coloured grounds. In contrast to surrounding artistic centres, where numerous examples were found of the use of coloured grounds, most works by Venetian painters examined continued using white, often gesso-based grounds throughout the sixteenth century. Furthermore, the examples of Venetian coloured grounds that are found, all date from the second half of the century, while in other regions mid to dark toned ground layers or imprimatura layers are found on paintings from the 1520s onwards, with some even earlier examples. Dunkerton and Spring (1998) describe Correggio, Dossi, Parmigianino, and a the Brescian painters as forerunners whose oeuvres contain the earliest examples of markedly tinted imprimaturas, consisting of earth pigments or lead white tinted with earth pigments and with additions of black pigments.

⁸⁹ Koller 1984: 305-306.

⁹⁰ Currie 2001: 86-7.

⁹¹ See for a discussion of this topic and overview of earlier literature on commercial contacts, artists working abroad, etc: Aikema and Brown (1999) and Nuttall (2004), who focuses on contacts between Florence and Flanders. Nuttall describes a Florentine colony in the Flemish city of Bruges in the fifteenth century. Nuttall furthermore discusses some examples of Italian patrons who ordered paintings from Flemish artists to be shipped to Italy. Nuttall 2004: 43-75. Koller suggests that in Spain it may have been the arrival of El Greco in the 1570s that initiated the transition to coloured grounds. Although in Toledo El Greco still used gypsum-glue grounds covered with glue bound coloured imprimaturas (ochre or red-brown), he simultaneously started using single, reddish brown grounds consisting of earth pigments with gypsum. Koller 1984: 305.

⁹² In their paper the authors point out that the National Gallery's acquisition pattern does not necessarily result in a unbiased sample collection. Dunkerton and Spring 1998: 120.

⁹³ For instance Koller 1984: 303.

Light to mid toned grounds (light grey, grey, light brown, warm brownish grey) are found most in paintings executed north of the Appenines, while more strongly or darker coloured grounds appear less frequently in those regions.

Publications by Noble (2004) and by Heydenreich (2007) indicate that the first examples of markedly coloured imprimatura layers that up to now have been found on paintings created in countries situated centrally between Italy and North Europe, also date from the first half of the sixteenth century. Just after 1500, Lucas Cranach the Elder employed light reddish or pinkish imprimaturas on panel, although he simultaneously continued painting on whitish imprimatura layers based on lead white. Heydenreich draws a convincing comparison between Cranach's use of light red imprimaturas as background for underdrawings, and this artist's use of light red toned paper for sketching. In early examples from Cranach's *oeuvre*, the imprimatura covers the underdrawing. However in later paintings Cranach executed his underdrawing on top of the coloured imprimatura.⁹⁴ The imprimatura would thus indeed function as a base colour for the compositional sketch.

Heydenreich's examinations furthermore indicate that Cranach the Elder sometimes diverted from the application of traditional chalk and glue grounds below the pigmented imprimatura in his panel paintings. His *oeuvre* contains some examples of the use of reddish preparatory layers that contain red lead and lead white (with calcium carbonate). Reddish grounds seems to be rather rare around this date, although some examples from other artists have been published.⁹⁵ Whether their use points to a particular purpose for the finished paintings, for instance outdoor placement, as suggested by Heydenreich, remains unresolved.⁹⁶

Also Hans Holbein's paintings are often mentioned as early examples for the use of coloured imprimaturas North of Italy. From the 1530s on, this artist employed both salmon-pink and grey imprimaturas on his panels.⁹⁷ The present state of knowledge does not allow an answer to the question if Cranach and Holbein should indeed be seen as exceptionally early examples or if around this time the use of coloured imprimaturas was widespread in Central Europe; research with a wider scope would be required to answer this question.

In Italy, Vasari (1550, edition 1568) had described the application of an imprimatura as an even, non-patterned layer.⁹⁸ However sometimes imprimaturas were applied with deliberate streakiness. Although Jan Brueghel the Elder is often associated with such application methods, streaky imprimaturas have also been documented in some paintings

⁹⁴ Heydenreich 2007: 101-103.

⁹⁵ Heydenreich 2007: 97-8.

⁹⁶ This is suggested by Heydenreich for the reason that oil-based grounds are more water-resistant. Heydenreich 2007: 97.

⁹⁷ Noble 2004: 330.

⁹⁸ Vasari 1550 (edition 1568): 52. In the translation of: Brown/Maclehose 1960: 230: 'this [ground] must be plastered over the panel and then beaten with the palm of the hand, so that it becomes evenly united and spread all over, and this many call the 'imprimatura''

by Lucas Cranach,⁹⁹ by Hans Memling and by Barthel Bruyn the Elder.¹⁰⁰ All these examples were created outside of Italy.

Sometimes double grounds with only oil as a binder appear to have been used. Christie (1988), who examined cross sections of a substantial number of sixteenth and seventeenth paintings, found evidence in paintings dated from the first half of the sixteenth century for the use of double grounds that consist of a lower layer based mainly on earth pigments (with additions of perhaps lead white, minium, black), covered by a top layer consisting of lead white, toned with pigments such as black, ochre, umber, red earth pigments, minium or vermilion.¹⁰¹ Notwithstanding its frequent use in seventeenth century painting, this type of ground is not described in historical recipes before 1676, when first advised as a ground for canvas preparation by Frenchman Félibien.¹⁰²

Evidence suggests that painters did not always stick to the same ground colours. In a number of case studies, variations were reported. For instance both grey, brown and pinkish-grey grounds are observed in paintings by Correggio.¹⁰³ Dunkerton and Spring (1998) describe the use of both whitish and moderately coloured grounds for Francia, Garofalo, Lotto, Veronese, Bordon and Palma Vecchio.¹⁰⁴ A relation between ground colour and subject has been impossible to establish in these cases. However, it is suggested for some later painters (see Chapter 8).

4.4 Conclusions

As can be seen from this survey of the published literature, investigations focused on the period c. 1400-1550 depend much more on instrumental analysis than on recipe research. Although a number of recipes that describe Italian practice are available, documentary evidence for artist techniques North of the Alps remains scarce. It is hoped that future research into this area will reveal more material.

By incorporating published literature that focuses on the analysis of paintings from this time period, it is possible to create an overview of techniques and materials employed in preparatory layers in North, Middle and South Europe. However, the information available is not well divided over the different geographical areas and partially consists of relatively early publications. Studies have focused on Italian Medieval and Renaissance techniques. Also the techniques employed in early Flemish painting have received considerable attention.¹⁰⁵ On the other hand, most studies dealing with techniques employed within

⁹⁹ Heydenreich 2007: 99.

¹⁰⁰ Billinge et al. 1997: 22.

¹⁰¹ Christie 1988: 89.

¹⁰² Félibien 1676: 407-8.

¹⁰³ Dunkerton et al. 1999: 272.

¹⁰⁴ Dunkerton and Spring 1998: 122.

¹⁰⁵ Systematic research on the Flemish primitives started in the 1950s at the KIK/IRPA in Brussels. The series of colloquia titled 'Les desseins sous-jacent' have made important contributions. Other examples of research are found in the work of the National Gallery London; in publications by the KIK/IRPA (see <http://www.closetovaneyck.kikirpa.be>), by Boersma et al. 2012. Also research by Van Asperen de Boer and Mollie Faries has contributed to our knowledge of techniques employed by the Flemish primitives. Notwithstanding this fact, technical descriptions of certain methods are still lacking. For instance (Nuttall 2000: 172) mentions the existence of a number of paintings by or from the circle of Van Eyck that were executed on parchment or paper attached to oak panels. No analytical data on the preparatory layers employed

German speaking countries and in France concentrate on single artists, or describe the techniques of a rather small group of painters. Information on British fifteenth and early sixteenth century painting is also very scarce.¹⁰⁶

To conclude, possibilities for a general overview of the period are limited. While a good level of knowledge has been developed on the basis of the investigation of paintings from important artistic centres and time periods, the historical recipes that are now available do not sufficiently cover the time period to allow for a meaningful overview of the time period before 1550.

for such supports is available. The earliest recipe for the preparation of paper that was found, dates from a French manuscript BnF Ms. 640 (1580-1600) and concerns unsupported paper.

¹⁰⁶ Information on a number of British paintings is available through Christie 1988 (unpublished); Hackney et al. 1999. Tate Galleries in London have recently examined their collection of Tudor paintings and a publication of the results of these investigations is being prepared. Oral communication Klaas-Jan van den Berg, RCE, May 2013.