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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

Stols-Witlox, M.J.N.

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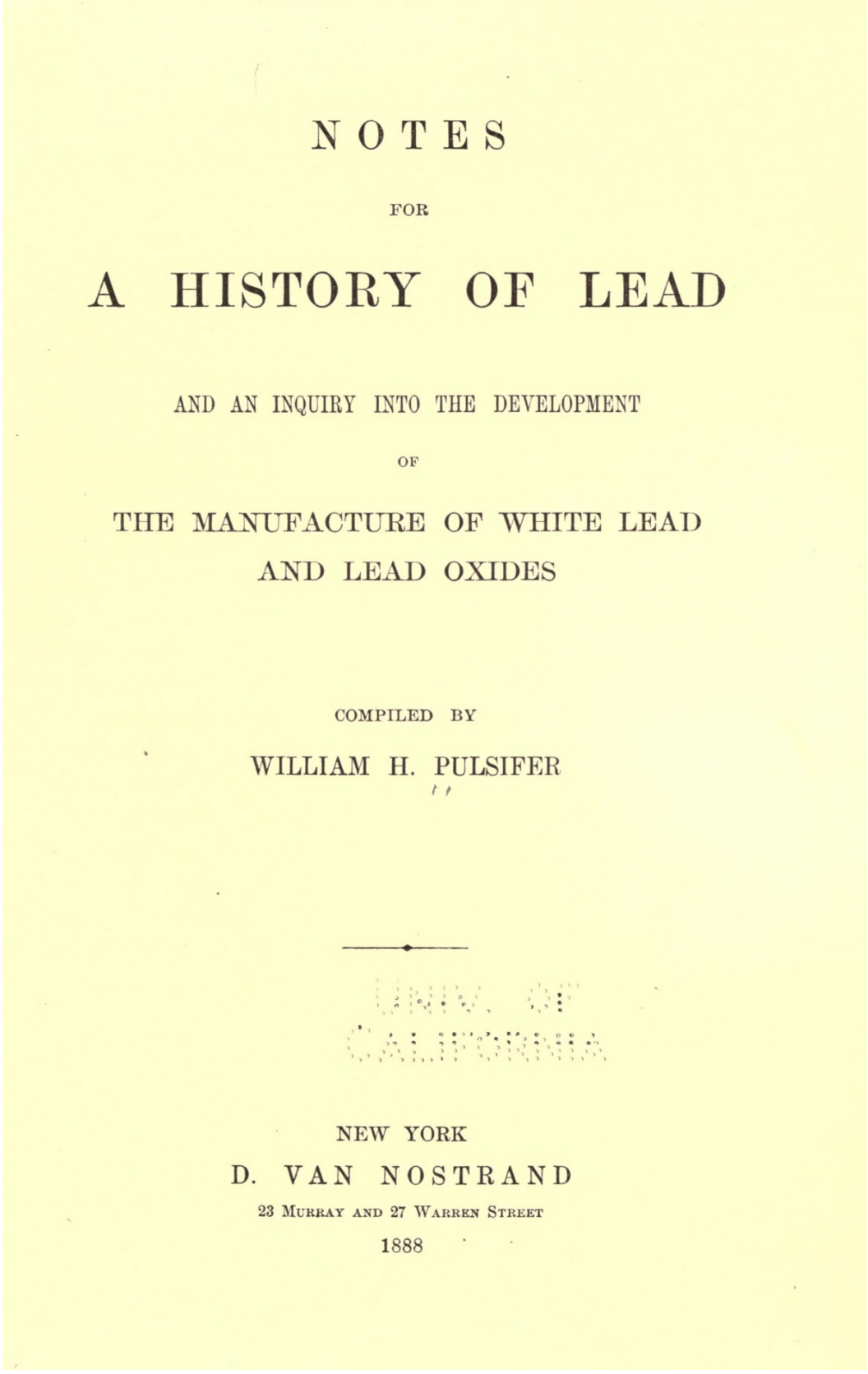

NOTES

FOR

A HISTORY OF LEAD

AND AN INQUIRY INTO THE DEVELOPMENT

OF

THE MANUFACTURE OF WHITE LEAD
AND LEAD OXIDES

COMPILED BY

WILLIAM H. PULSIFER

Univ. of California

NEW YORK
D. VAN NOSTRAND
23 MURRAY AND 27 WARREN STREET
1888

Figure 6.1 *Pulsifer's book on the subject of lead white manufacture contains a wealth of information on the different production processes employed in thee nineteenth century.*

Book digitalized from the collections of the University of California, availble through http://www.archive.org

Chapter 6. The materials described in the recipes

The solution of lac ought to be first bleached (I think) as it is rather too brown in colour & might stain the canvass to much

Winsor & Newton Archive recipe book '17' (1834-55)[1]

This chapter provides a detailed overview of the ingredients mentioned in Chapter 5 and discusses the characteristics of these materials when employed in preparatory layers. By investigating the occurrence and role of specific materials within the preparatory system, it aims to provide more insight into historical knowledge about these materials and into the reasons why authors selected specific materials or qualities of material.

In order to identify materials with instrumental analysis and in order to evaluate their role in the creation of a painting, detailed information is required on the characteristics of the fresh materials, their origin, composition, working properties and their role in the overall composition. A full chemical characterization of the composition of preparatory layers is important if we wish to understand their ageing properties and to create well designed conservation protocols.

As will be seen, working properties and optical effects play an important role in the choice of materials. However historical authors also discuss the ageing properties of the materials, describing their degradation as well as the influence of the ground materials and colour on the whole of an aged painting. Such comments are discussed separately in Chapter 10, which focuses on the influence of preparatory layers on the ageing of paintings.

General information on the material characteristics of most of the materials employed in preparatory layers is published elsewhere and is not repeated here.[2] The present chapter focuses on how the sources describe the use of materials in preparatory layers.The chapter follows the use of materials layer by layer, and concludes with a section on the preparatory layers advised for modified oil paint systems.

6.1 The size layer

In the sources consulted for this thesis, glue appears most frequently as a size layer (Figs. 6.2a and 6.2b).[3] Frequent mention of glue as a size layer material for canvas preparation in the Winsor & Newton archive shows that this material is used in commercial nineteenth

[1] W & Newton recipe book '17' 1834-55: 17P032L10

[2] General information on pigments and binders is available amongst others in Doerner 1949; Gettens and Stout 1966; the four volumes of *Artists' Pigments* (1986, 1993, 1997, 2007); Bristow 1996; Cruypelans and Malaise 1997; Guineau 2005; Eastaugh et al. 2008 and Eastaugh et al. 2012. Carlyle (1991, 2001) provides detailed information on historical descriptions of pigments and binders in British nineteenth century sources

[3] Paragraph 6.1, in particular the section on animal glue size layers, is based in part on Witlox 2008.

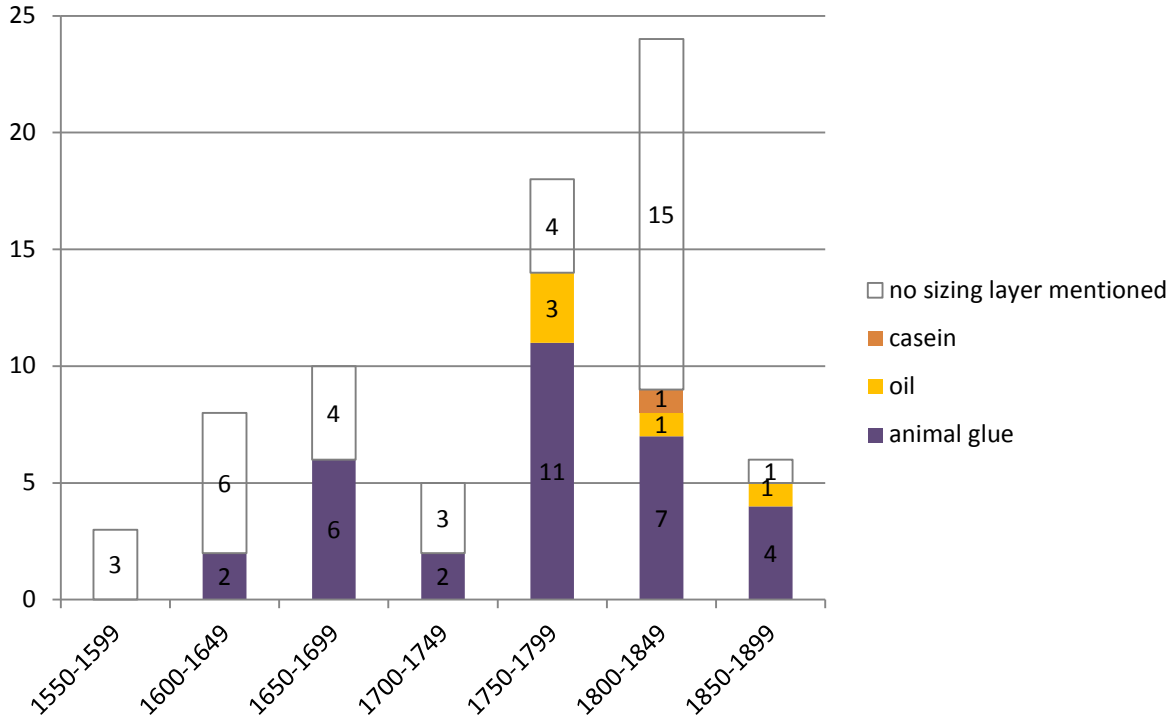

Figure 6.2a *Size layer types described in historical recipes for panel preparation*

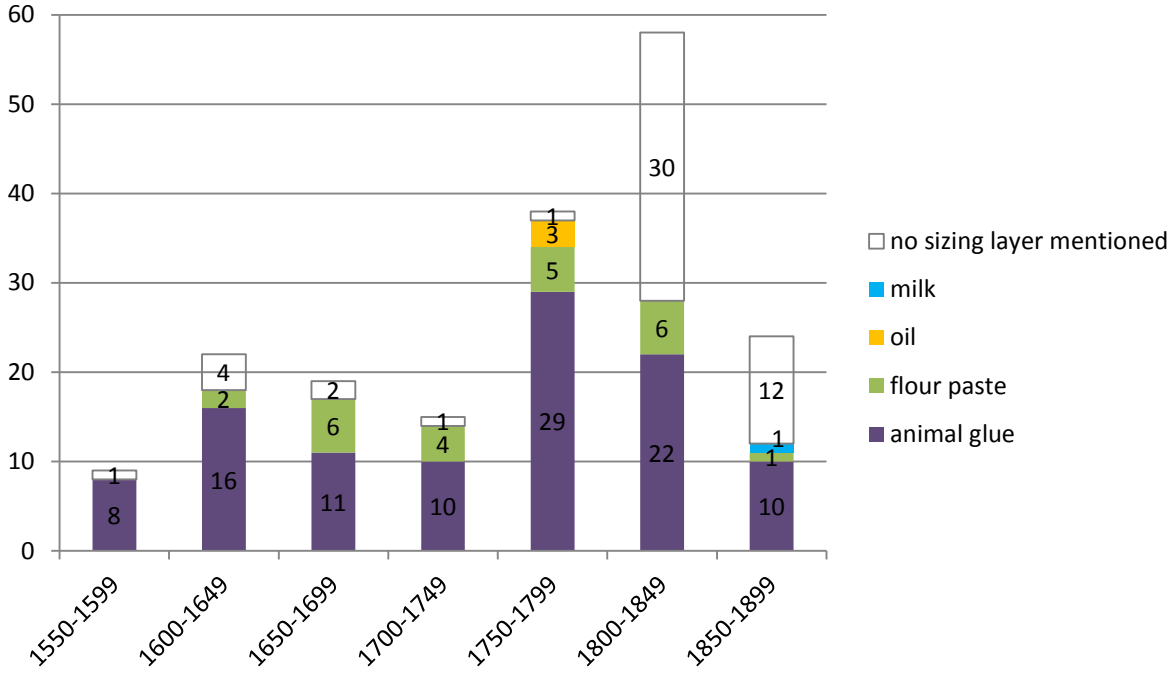

Figure 6.2b *Size layer types described in historical recipes for canvas preparation*

century canvas preparation.[4] Also starch or flour paste are regularly described. (Hot) oil, casein, milk and collodium are mentioned far less frequently. Hot oil is mentioned only in three recipes for canvas and five for panel sizing: it seems to represent more of an exception than a method in general use. As discussed in Chapter 5, starch or flour paste only appears as a size material for canvas.[5] No reasons are given why starch or flour paste are advised as a size layer material for canvas preparation in particular. Starch is traditionally associated with fabrics, and has been used to stiffen clothes in different areas of Europe since the late Middle Ages.[6] To use starch to prepare canvas for painting is therefore not a foreign concept.

Nineteenth century recipes describe the use of shellac in ammonia as addition to a size layer or used by itself for this purpose,[7] and collodium is introduced as a size layer material in a recipe in the Winsor & Newton archive.[8]

6.1.1 Its function

Analysis of the recipes demonstrates that the function assigned to a size layer depends on the support. In connection to panel supports, authors mention that the size layer serves to fill the pores of the wood,[9] to prevent absorption of binder into the support[10] and is thought to enhance adhesion.[11] However not all authors share the opinion that an animal glue size layer helps adhesion. Both for panel and for canvas, alternatives are discussed in reaction to concerns with the effect of a glue size layer.

Five North West European authors discuss such alternatives to or advise against the application of a glue size layer to panel as it is thought not to increase but to lower the adhesion between support and ground.[12] As pointed out in Chapter 5, Dossie (1758) is

[4] *See* for instance: W&N manuscript 'P.04.1836- Private Copy of Processes. Vol 1st', 1834-93: P04P110L01: 'pumiced & sized as usual'; W&N manuscript 'P8', 1840-1878: P8P049AL01: 'sized plain cloth'; W&N manuscript 'P.07. 1842-1848 Private Copy of Processes. Vol 2nd ' 1842-48: 7PP239L01: 'sized with very weak size'; W&N manuscript 'P.09.1846-1854 '1844-93: 9PP015L01: 'have your cloth well sized & rubbed down as usual'.

[5] *See* also Chapter 12 on starch and flour paste as materials for sizing and ground layers.

[6] Late Medieval and early Renaissance sources describe the use of starch for stiffening clothes. Harold A. Auden. *Starch and Starch Products*. Pitman's common commodities and industries, London: Isaac Pitman & Sons, 1922: 4-5. Starching seems to have been introduced in England in Elizabethan times. It is used by Flemish weavers to strengthen their warp threads. 'starch for karchys', meaning 'handkerchiefs' is mentioned in the first English-Latin dictionary, dated in the earlier part of the fifteenth century. Mayhew, A.L. *The Promptorium Parvulorum. The first English-Latin Dictionary. Edited from the manuscript in the Chapter Library at Winchester, with introduction, notes, and glossaries*. London: Kegan Paul, Trench, Trübner & Co., Ltd, 1908: 705.

[7] W&N manuscript 'Omnm Gath No 12', 1836-50: 12P012L18, W&N manuscript 'Omnm Gath No 12', 1836-50: 12P039L17.

[8] W&N manuscript '16', 1850-3: 16P029L23. A recipe for the use collodium is also found in a ground for painting with 'powder colours' and 'crayons' appears in W&N manuscript '24', 1856-62: 24P006L01. Strictly speaking this recipe should not be included here, as it does not concern oil painting, but as collodion also appears in the 1901 edition of Church, it is nonetheless described here. See Carlyle 1991, vol. 1: 247 and Carlyle 2001: 177 for more information on the recipe provided by Church.

[9] Tingry 1804: 491.

[10] Simis 1801, vol. 1: 154-5.

[11] Cennini c. 1400 (edition Frezzato 2003): 142-3.

[12] Besides Dossie and Simis, quoted below, these are: Mss.Hist.Helv.XVII.234 1750-1800: 85-6 (transcribed in Stettler 1987); Hampel 1846: 26; Blockx 1881: 31. Also Spanish Palomino pays attention to the effect of

against all use of animal glue in preparatory layers because of its water sensitivity.[13] Are adhesion issues the reason why size layers are mentioned less frequently for panel preparation than for canvas preparation?
Simis (1801) states: 'sizing is not done, like some think, to give better adhesion of the paint; on the contrary, the paint adheres better to the wood, through the absorption of the oil, if it were not glued'. According to Simis, a glue size layer should be used only in dry environments. It then fixes the wood fibres and gives a hard surface that can be pumiced afterwards. [14]

Reasons for sizing a canvas are given by Félibien (1676): 'glue serves to cover all the little fibres on the canvas, and fill the small holes, so that no colour passes through to the back'.[15] Several other authors also mention this function.[16] In two recipes for canvas, sizing is also considered as a means of reducing the absorbency of the support. It is thought to lower the amount of ground material and number of layers needed. De Mayerne (1620-44) makes a note to this effect. He writes that painter Elie Fetz has told him that a canvas without sizing 'eats a lot of paint' ('mange beaucoup de couleur').[17] For canvas, Mérimée (1830) recommends three or four layers of ground if no size layer is applied, but with a size layer only two or three layers are considered necessary.[18] De Montabert (1829) explains that the choice of glue type used for the size layer will influence the flexibility of the whole preparatory system.[19] He furthermore draws attention to the influence of the size layer on the ease of replacing a damaged support during conservation (a transfer[20]); he even presents this as a basic function of the size layer. In the same passage, he adds that notwithstanding this fact, he considers the presence of a size layer disastrous on account of its hygroscopic nature.[21]

Several sources point out that contact between oil and canvas is to be avoided: the Volpato manuscript (c. 1670) claims that 'when the canvas has no glue to defend it from the oil, it loses it strength, for the oil dries, so that it becomes like the bark of a tree, and when the canvas is taken off the stretching frame it cracks and splits'.[22] Similar information is also present in three nineteenth-century sources.[23] An interesting case is recorded by De Mayerne: A Flemish professional primer, living in London, who sometimes

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the size layer on ground adhesion: 'Some apply glove clippings glue, but this blocks the oil from penetrating the wood and disturbs the surface by swelling due to humidity'. Palomino advises applying the ground directly on the panel, once it is well scraped and smoothed. Palomino 1715, 1724, vol 2 1724: 33-4.
[13] Dossie 1758: 203-4.
[14] Simis 1801: 154-55.
[15] Félibien 1676: 407.
[16] De Mayerne 1620-44: 98v; Cröker 1729: 74-7.
[17] De Mayerne 1620-44: 5.
[18] Mérimée 1830: 243-244.
[19] Montabert 1829, vol. 9: 166.
[20] The author is talking about a treatment known as the transfer, where the paint layers and sometimes also the ground are removed from the support, which is replaced with another support.
[21] Montabert 1829, vol. 9: 161.
[22] Volpato c. 1670 (transcription Merrifield 1849 (1999):729).
[23] W&N recipe book 'Omnm Gathm 03' 1809-44 : 03P043L13; Vibert 1892: 100-103 ; Sully 1809-71: 046. Also Gettens and Stout (1966) are of the opinion that canvas should not be in contact with the oil to prevent the degradation of the support. They write that oxidation of the cellulose in the canvas fibres is speeded up by oxidation of oil; in addition the oxidized oil embrittles the structure of the picture. Gettens and Stout 1966 (reprint of the 1942 edition): 229-30.

does use a glue size layer, told De Mayerne that at other times he just wets the canvas before he applies the first oil ground layer.[24] The presence of water might act to temporarily prevent the absorption of oil into the canvas, although one may wonder about the long-term effectiveness of such a method, as presumably the water evaporates faster than linseed oil dries.

As with panel, some authors are of the opinion that an aqueous canvas size should be avoided as it will cause adhesion problems. Pernety (1756) explains that some artists omit the size layer because humidity will swell the animal glue, resulting in flaking. Instead, the ground layer is applied straight to the canvas, which may be covered from the back with a layer of oil with pigment deposits from the brush rinsing jar, to render the canvas less water-sensitive.[25] Dossie (1758) advises against animal glue for canvas preparation as for panel and recommends imbibing the support in hot drying oil instead.[26] Also Hallen (1761) writes that some painters omit the size layer out of fear that it will cause the ground to flake. According to Hallen, instead they apply their oil-bound grounds to the bare canvas and brush onto the front and the reverse of the canvas some of the 'schmierigen Wachs öle' [= 'pasty waxy oil'] from the tray used to wash brushes in, with the intention to keep the moisture inside walls from penetrating the canvas,[27] a practice similar to the one described by Pernety (1756).

Two nineteenth century sources suggest alternatives for traditional canvas size layer materials. After comments on the relatively low moisture resistance of animal glue size layers, Vergnaud (1831) advises casein size or 'cheese glue' instead. He gives a detailed description of its preparation.[28] The Winsor & Newton archive contains notes that demonstrate that Winsor & Newton is also considering alternatives to glue size layers in canvas preparation recipes. The fact that a recipe dated between 1836 and 1850 discusses the addition of shellac in ammonia to animal glue with the intention of creating a water resistant sizing, demonstrates that water sensitivity drove some experiments.[29] A second entry in the same manuscript, 'Omnm Gath No 12', also concerns the concept of water resistant sizings: 'If canvass are boiled in a solution of Shell Lac in Ammo then taken out and dried – would it not be by this means rendered infurious to oil or to water'.[30] The 'Expts [probably short for 'experiments'] for a substitute for size in Prepd [=prepared] Canvass', describe a mixture of borax, orange shellac and boiling water.[31] The author

[24] De Mayerne 1620-44 : 5.
[25] Pernety 1756: lxcij.
[26] Dossie 1758: 202-3. Dossie's reasons were discussed in more detail in the context of panel size layers.
[27] Hallen 1761: 322.
[28] Vergnaud 1831: 138-9. Vergnaud did not train as an artist and has a military background. Although no earlier source for this advice has been found, it is known that Vergnaud leans on earlier authors in other sections of his manuals. Cheese glue or casein is mentioned in relation to subsequent ground layers by Mérimée (1830) and Vibert (1892). Both recipes are discussed below.
[29] W&N manuscript 'Omnm Gath No 12', 1836-50: 12P012L18.
[30] W&N manuscript 'Omnm Gath No 12', 1836-50: 12P039L17. Shellac in ammonia is suggested as an addition to animal size in recipe 2P012L18 of the same manuscript, where the author wonders if it is a successful method to make the sizing insoluble in water. The term 'infurious' does not exist. It is not clear whether it is a misspelling by the author. The context demonstrates that the author intends the word to carry a meaning similar to 'resistant'.
[31] There is an interesting parallel between these ingredients and a recipe in Field 1835 for a white lac [bleached shellac] and borax emulsion paint binder, which mixes borax, water and white lac varnish. (Field 1835: 199 in Carlyle 1991, vol. 1: 169-70; Carlyle 2001: 118-9).

describes the resulting solution as 'black' and writes that it results in rather stiff canvas, 'rather brown in tint'. The reverse of the canvas is also stained brown, 'however if this soln [=solution] proves to be uninjurious to the cloth, the stain may not be of much consequence'.[32] Whether these experiments led to products that entered the artist market is unfortunately not known.
None of the size recipes for board or paper comment on the function of the layer. However, since all these recipes advise glue, in combination with the fact that in all but one case an oil ground is applied,[33] it seems logical to assume that for such absorbent supports the size layer is intended as a sealant, preventing absorption of the binder from subsequent oil containing layers into the board or paper.

6.1.2 The use of animal glue as a size layer[34]

Most recipes for glue size advise the use of a skin glue. Often the animal source is not specified. The ones that are mentioned include the skins of goat, sheep, cow, and pig as well as parchment, fish glue and 'glove clippings' (*See* Appendix 18). Glove clippings are pieces of leather discarded by glove makers. Traditionally, gloves are made from the skins of smaller animals, like deer, goat, sheep, calf or dog.[35] This is explained by the fact that for strength, gloves need the whole thickness of the skin. The skins of larger animals are too thick to be used in this manner.[36] Two methods are employed for glove making (for chamois leather): oiling and alum tawing. According to Duhamel du Monceau (1777) in his treatise on glue making, the oiled leather is not suited for glue production, but alum tawed leather is, even if it produces a small quantity of glue, and of mediocre quality.[37] Alum tawing is a treatment that makes the skin very supple and somewhat water-resistant. In traditional processes it involves alum, egg-yolk, salt and flour.[38]

Duhamel du Monceau (1777) explains that the animal source is important because of differences in strength of the extracted glue. For instance, while he considers 'colle forte', which is a stronger glue prepared from ears, nerves, and older skins, suited to carpenters, marquetry, etc., he writes that such glues are too strong for painters as they cause flaking.[39] Parchment glue has a bad reputation in some sources, but is recommended by others. According to recipes in the De Mayerne manuscript[40] and Volpato's manuscript,[41] it will cause shrinking of the canvas and/or adhesion problems.

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[32] W&N manuscript 'P.09. 1846-1854': 9PP016L01. W&N manuscript '17', dated 1834-55 also contains a reference to shellac in ammonia. This recipe discusses whether a small addition of wax would raise the layer's flexibility and also suggests the use of bleached shellac to prevent brown stains. W&N manuscript '17', 1834-55: 17P032L10.
[33] Dietrich 1871: 20; Susse 1845: 22. The one exception is a recipe where a starch ground is applied on top of a glue size layer (ground on paper or cardboard). Bouvier 1827: 577-80.
[34] This paragraph contains sections that have appeared earlier in Witlox 2008.
[35] Meunier 1903: 426-428.
[36] Oral information from Bianca du Mortier, curator of costume, Rijksmuseum, Amsterdam.
[37] Duhamel du Monceau 1777: 408.
[38] Meunier 1903: 1. For modern alum-tawing an egg-substitute is used. Oral information from a producer of leather and skins: Hewitt & Sons Ltd.
[39] Duhamel du Monceau 1777: 420-421.
[40] De Mayerne 1620-1644: 7v, 87.
[41] Volpato c. 1670 (transcription in Merrifield 1849 (1999): 729).

Historically, glue is prepared simply by heating shredded leather or parchment in water, probably at boiling temperature. Tingry (1803), writing for housepainters, provides a clear description of the glue preparation process in his recipe to produce 'third quality glue', a glue suited for less important objects:

> take the clippings and skins of sheep, of gloves, of goat's skins and clippings of parchment, boil for three to four hours in a sufficient quantity of water (seven to eight parts in weight to one of matter). When the liquid has been reduced a third, pass through a horsehair sieve or through linen. Upon cooling, it takes the consistency of a strong jelly, that may be weakened depending on the circumstances.[42]

For a glue of higher quality, Tingry advises to use of only parchment clippings. They are boiled in water for five to six hours, the glue is left to settle and the clear part scooped out of the boiling vat and preserved as 'second quality glue'. This glue is intended for delicate purposes, amongst which sizing before the application of aqueous priming layers to wooden panelling and objects.[43] In some recipes, the hide or leather is soaked prior to glue extraction (*see* Table 11.1 in Appendix 18).

On a larger scale, glue manufacture is often linked to leather or parchment production. Duhamel du Monceau (1777) explains that usually combinations of different types of skins and waste from leather-production are used. To prepare the leather, skins are cut into pieces, limed and washed several times prior to boiling to remove grease and the remains of flesh and hairs. According to Duhamel, boiling times for glues vary from twelve to fifteen hours.[44] The fact that longer boiling times are mentioned here than in Tingry's recipe may in part be explained by the larger volume of the boiling vats. Greber (1950) explains that skins should be heated gradually and slowly.[45] One may imagine that for larger quantities this would add substantially to the boiling time.

To check glue consistency, a little glue is dropped on a cold surface and its gelling evaluated. Chemist Chaptal, in his 1807 manual explaining the chemistry of the arts, describes the preparation of sheets of glue: after boiling, the glue is cooled slowly in order to allow time for impurities to settle to the bottom before the glue gels. While still liquid, the glue is poured into square moulds and allowed to form a gel. The gelled glue is cut into slices, which are placed on wire drying racks in the fresh air, out of the sun.[46] Both Duhamel du Monceau and Chaptal describe polishing the slices with a moist cloth just before they are fully dry, in order to increase their gloss and transparency, both

[42] Tingry 1803, vol. 2: 263-4. Although Tingry's recipe appears in a source discussing house painting, it is used here as an example of glue boiling because of its clear, detailed descriptions of small-scale glue production. Comparison with less 'complete' recipes intended for artists (Appendix 18, Table 11.1) shows that preparation methods are the same.
[43] Tingry 1803, vol. 2: 262-3. 'First quality glue', a fish glue, is described on page 260-2. Its use is not entirely clear. Tingry mentions that it can serve as a pastel fixative and only vaguely describes other purposes.
[44] Duhamel du Monceau 1777: 413-414.
[45] Greber 1950: 25-33.
[46] Chaptal 1807: 522-527.

considered signs of quality.[47] Additional quality indicators that are mentioned in different sources are a lack of odour, a clean glass-like break and the absence of matt areas.[48]
In some cases no boiling times but only reduction parameters are provided, as was the case in Tingry's recipe, where the solution was boiled until reduced a third. A second decision factor is the glue consistency: 'must remain a little firm below the hand when gelled';[49] 'until stiff and strong below the hand';[50] or 'a trembling jelly'.[51]
Some recipes mention the addition of honey as a plasticizer.[52] Garlic is also mentioned, unfortunately without any explanation of its function.[53] Since garlic lowers surface tension it may have been added for that purpose. Research by Pombo Cardoso (2010) also indicated that it has an effect on mould growth and lowers the internal tension of the glue during drying.[54] Late in the nineteenth century, Church (1890) suggests adding glycerine to size layers to prevent brittleness of the dry layer.[55]

Duhamel (1777) describes large-scale glue production of several types of glue, but notes that glove glue is prepared by the painters themselves.[56] Indeed, glue can be obtained ready-made from parchment makers and other professionals dealing with skins. Cennini mentions 'colla di spicchi', translated by Thompson as 'leaf glue', as early as *c*.1400,[57] and a number of more recent historical sources also assume prepared and dried glue as the starting material in size preparation.[58]

In general, dry glue is soaked in clean water before dissolution. Although excessive heat causes further hydrolysis and reduces glue quality,[59] earlier authors do not warn against overheating, simply instructing that the glue is boiled until dissolved. The first warning against overheating is issued by De Montabert (1829), who advises readers to melt glue in a water bath, since when placed directly on the fire, its gelling capacity would be destroyed.[60]

6.1.3 The use of flour paste and starch paste size layers

As noted earlier, both flour and starch based pastes are described for use as size layers. The nature of the materials employed is not always clear. If the flour type is specified, it is either wheat or rye flour. Different flour qualities are described. (*See* Table 12.1 in

[47] Duhamel du Monceau 1777: 419; Chaptal 1807: 527.
[48] Buc'hoz 1786: 164; Fokke Simonsz 1803: 85-86; Tingry 1803, vol 2: 260-1.
[49] *École de la Mignature* 1759: 102.
[50] Fokke Simonsz 1803: 85.
[51] Tingry 1803, vol 2: 620 etc.
[52] Examples of honey addition: de Mayerne 1620-44: 7v; Ms. Sloane 1990, 1623-44: 78-9; Bate 1633 (1654): 167; de Montabert 1829: 174.
[53] Garlic is mentioned by Pacheco 1649: 382-3; Palomino 1715-24, volume 2 1724: 33-4; de Montabert 1829: 169. (De Montabert also adds absinthe leaves, salt and vinegar; however that is the only mention of the addition of these ingredients.)
[54] Pombo Cardoso 2010: 280-1
[55] Church 1890: 72. Carlyle 1991 writes that glycerin is expensive and scarce during the first half of the century, but that a cheaper production method is developed in 1854. Carlyle 1991: 246.
[56] Duhamel du Monceau 1777: 421.
[57] Cennini *c*.1400 (transcribed in Frezzato 2003: 140-1); tanslated in Thompson 1960: 67.
[58] *See* Appendix 18, Table 11.1.
[59] *See* Chapter 11 about glue chemistry.
[60] De Montabert 1829: 172-173.

Appendix 19). Chapter 12 discusses the types of flour that may be considered as having been employed historically and describes historical methods for starch extraction.
Unfortunately not many authors provide details for the preparation of the flour paste employed for sizing. Possibly its preparation was considered common knowledge. A casual approach to flour paste preparation is indeed felt in historical instructions: the Spanish 'Tractato' (1656) discusses the use of a 'flour gacheta with a little bit of common oil',[61] Eikelenberg (1679-1704) simply talks about a 'paste of wheat flour',[62] Hidalgo (1693) 'gacha, sizing and a little honey',[63] a recipe in the Wiltschut manuscript (1726-9) describes the use of a 'porridge of flour, when boiled, a little linseed oil added',[64] Ibbetson (1803) talks of 'a very thin starch',[65] Grandi (1806) to make 'a thin paste' with wheat flour,[66] Sully (1809-71) writes of 'paste in which was a little Venice turpentine',[67] etc.

A small number of authors give more detail: Cröker (1729) describes how a little boiled water is added to flour, stirred to remove lumps, after which more water and flour are added.[68] The consistency is correct when, while still warm, it will form little 'towers'. De Montabert (1829) gives a general description for the preparation of flour paste, in which he explains that flour and water should first be mixed, then heated on a fire until thickened.[69]

Very detailed instructions for the preparation of flour paste are provided by Hundertpfund (1847). Although his description relates to the preparation of flour paste for a ground layer, not for a size layer, paste preparation is probably similar: flour is slowly added to water, while stirring continuously, until the mixture is as thin as milk. It is heated on a fire until it thickens. More water is then added and the mixture is allowed to boil slowly for half an hour. Hundertpfund explains that 'by continual slow boiling, it becomes smoother and smoother, so that it may afterwards be thinned with water, according to liking'.[70]

In contrast to the prolonged heating advised by Hundertpfund, Sully (1873) repeats a recipe from artist Rembrandt Peale, who advises to remove the pan from the fire immediately upon thickening.[71] Also Vibert (1892) advises removal from heat when the mixture, in this case of water and starch, has reached its boiling point.[72]

Compositional variations in flour or starch paste recipes consist of the choice of flour, either wheat or rye, but also of different additions, such as oil, glue, garlic, turpentine and

[61] 'Tractato' 1656 (translated in Veliz 1986: 111)
[62] Eikelenberg 1679-1704: 385
[63] Hidalgo 1693 (translated in Veliz 1986):137
[64] Wiltschut manuscript 1726-9: 78
[65] Ibbetson 1803: 11
[66] Grandi 1806: 85-9
[67] Sully 1809-71: 156
[68] Cröker 1729: 77
[69] De Montabert 1829, vol. 9: 176
[70] Hundertpfund 1847: 108-9, 130; quoted by Knowlton 1879: 30-1
[71] Sully 1873: 024-5. A little Venice turpentine is added to the paste after it has been removed from the fire.
[72] Vibert 1892: 190

honey.[73] Müller (1750-1800) and Mérimée (1830) advise to add linseed mucilage or linseed oil cookies, the oil cakes left after oil has been expressed from linseeds.[74]

Some recipes include the explanation that additions of plasticizers such as honey and linseed oil are made to guard against brittleness. Palomino writes (1724) that honey and linseed oil also prevent flour paste from growing mouldy.[75] Honey additions are mentioned both in recipes for glue size layers[76] and for paste size layers,[77] but additions of linseed oil to the sizing composition appear almost exclusively in recipes for flour or starch paste size layers.[78]

6.2 The use of pigments and fillers

6.2.1 General developments

Appendix 15 provides an overview of the materials described for use in preparatory layer recipes, including recipes for size layers and for isolation layers. It documents when ingredients are mentioned in North West European recipes, thus creating clarity about the impact throughout time of the different materials that are advised. The ingredients are ordered chronologically, based on their first appearance in a recipe for preparatory layers. The frequency with which specific ingredients are mentioned within each period is not represented in this figure, as it would confuse the other information. It is given in Figures 5.2, 5.3 and the frequency with which materials are mentioned is also evident from the recipe summaries in Appendices 5 to 12.

Of the pigments and fillers employed in preparatory layer recipes, lead white, chalk, clays and earth pigments as well as the different blacks are mentioned most consistently throughout the period. In contrast, some pigments appear infrequently in recipes for preparatory layers, such as scudegrun (an organic green lake), common ashes, green ashes, vermilion, red lake, ultramarine and smalt.

While the sudden growth in the variety of binders and binder additions for preparatory layers during the nineteenth century is clearly visible in Appendix 15, developments in the

[73] De Montabert (1829) in a recipe for flour paste mentions additions of garlic to increase strength, and against biological attack from mites, vinegar can be added while the paste thickens. A little resin will increase strength. Laurel essence, even laurel leaves or walnut leaves will repel flies. The recipe in which these additions appear, is not provided in the particular context of the preparatory layers but is a general instructions for paste preparation. De Montabert 1829, vol. 9: 176.
[74] Müller c. 1750-1800 (transcribed in Lehmann 2002: 50); Mérimée 1830: 244-5.
[75] Palomino 1715, 1724, vol. 2(1724: 32.
[76] Bate 1633 (1654): 167; 'the Art of painting in oyle by the life' 1664: 95-6; Salmon 1672: 178. Honey additions to animal glue are also mentioned by Smith 1756: 58; Le Pileur d'Apligny 1779: 70 and the *Golden Cabinet* 1793: 112.
[77] BnF Ms.Fr 640 c. 1580-1600: perso 86; Pacheco 1649: 68; Hidalgo 1693 (translated in Veliz 1986: 137); Wiltschut manuscript 1726-39: n.p. [pdf page 78];
[78] Oil additions to flour pastes are found in Pacheco 1649: 68; Palomino 1715, 1724, vol. 2 1724: 34-35; Wiltschut manuscript 1701, handwritten recipe in German, dated c. 1726-39: n.p.; Müller c. 1750-1800 (transcribed in Lehmann 2002: 65). But also in Mérimée's (1830) recipe for an animal glue size layer. Mérimée 1830: 244-5 describes an animal glue size layer with oil: it consists of very weak glue, a little oil and linseed mucilage. In the 1839 translation 'mucilage de graine de lin' is translated as 'mucilage of linseed meal'. Sarsfield Taylor and Merimee 1839: 220-1.

use of pigments or fillers seem to have followed a more gradual path of development. [79] As Appendix 15 shows, the range of pigments and fillers advised for use in preparatory layers is extensive already even during the sixteenth and seventeenth centuries. In the eighteenth century, a range of pigments is added to the list of materials that appear in recipes for preparatory layers: Berlin blue, indigo and a number of black pigments. While Berlin blue appears quite soon after its date of discovery (1704),[80] indigo, black chalk and peach-stone black have been available as pigments during the seventeenth century or earlier.[81] Cadmium pigments, zinc white and silver white are mentioned from the second quarter of the nineteenth century onwards, and fillers such as ground Bath brick, 'Grecian powder', pumice powder and barium sulphate are also first introduced in nineteenth century recipes.[82] Barium sulphate is mentioned in particular as an extender for lower quality lead whites in nineteenth century lead white recipes but hardly features in recipes for preparatory layers.[83]

The nineteenth century witnesses a renewed interest in the use of calcined sheeps bones in preparatory layers. First mentioned in the anonymous manuscript Sloane 1990 (1623-44),[84] Grandi (1806) and three sources from the 1820s suggest ground-up calcined bones of sheep's trotters for use as a filler for oil painting grounds. Grandi explains how the bones are calcined: they are broken into smaller pieces, boiled in water to remove the fat, then calcined in a crucible and ground to a powder.[85] Reconstructions by Carlyle (2008b) show that in contrast to leg bones, the small bones in sheep's trotters are easier to break into small fragments.[86]

The fact that Winsor & Newton manuscripts appear amongst the nineteenth century sources where materials are first mentioned (Appendix 15) shows that new materials are introduced not only by individual authors or artists interested in experimentation, but also by professional colourmen.

6.2.2 Ashes in preparatory layers recipes

'Common ashes', 'cendre commune' in French, is a material that first appears in a late sixteenth century recipe in the BnF Ms. Fr 640 (c. 1580-1600). Here, and in seventeenth eighteenth and nineteenth century sources it refers to ashes from burnt wood. Although the term 'ashes' is regularly linked to lower qualities of certain blue pigments, research by Carlyle (1991, 2001), Guineau (2005) and Eastaugh et al. (2008) about historical descriptions of such pigments shows that in cases when the term 'ashes' refers to blue

[79] *See* for an overview of pigments introduced in the nineteenth century: Carlyle 1991, vol. 2, appendix 28; Carlyle 2001: appendix 26. *See* also Eastaugh et al. 2012: 205-6.
[80] Guineau 2005: 141.
[81] *See* entries for these pigments in Guineau 2005 and Eastaugh et al. 2008.
[82] Bath brick and 'Grecian powder' both only feature in the Winsor and Newton Archive.
[83] *See* Chapters 13 and 14 for detailed information on lead white quality and the use of extenders for lead white.
[84] Manuscript Sloane 1990 1623-44: n.p. [78-9]
[85] Cawse 1822: 9-11; Smith 1825: 357-8; De Montabert 1829, vol. 9: 167-8. These recipes all seem to be based on Grandi. Cawse acknowledges Grandi as the source for his information on calcined bone grounds. De Montabert, who only mentions 'powder of calcined bones' in passing, gives the Bibliothèque Brittanique of November 1807 as his information source.
[86] Carlyle et al. 2008b: 124.

pigments, the term is generally further defined, for instance as 'blue ashes', 'ultramarine ashes', cendres bleues', 'cendres d'outremer', etc.[87]
Green ashes are advised for use in preparatory layers by Eikelenberg (1679-1704).[88] Savery de Brulons (1724) explains that 'green ashes' are actually 'blue ashes', and are only called 'green ashes' by some, because of their tendency to turn green when used in oil. According to this author, they are 'a composition, or sometimes a natural stone that has been powdered, which in colour approaches a little that of pale ultramarine'. Savery de Brulons writes that green ashes come from Dantzig, and are traded through England and the Netherlands.[89] According to Eastaugh et al. (2008), the term 'blue ashes' is used both for natural and synthetic blues and that the term most likely refers to copper blues. They mention the possible production or mining of the blue in copper mines in Poland, but the historical sources that Eastaugh et al. quote, also describe alternative origins for this pigment.[90] Both Guineau (2005) and Eastaugh et al. (2008) write that in nineteenth century sources, the name 'green ashes' refers to an artificial copper and arsenic containing compound.[91]

6.2.3 Chalk-based ground layers and gypsum in grounds

While Chapter 5 demonstrates that chalk-based grounds are frequent in North West European recipes, gypsum only plays a minor role and is mentioned only in nineteenth century recipes.[92]

Prior to the nineteenth century, chalk is described mainly as a filler for aqueous layers, most frequently bound in animal glue.[93] Chalk in oil is described very infrequently. Simis (1801) gives a recipe for a canvas ground consisting of chalk and oil,[94] and according to

[87] Carlyle 1991, vol. 2: 195-6; Carlyle 2001: 158, 475; Guineau 2005: 199-200; Eastaugh et al. 2008: 31-2. *see* for seventeenth and eighteenth references to use of the word 'ashes' as a term for burnt wood: Ambroise Paré, Adriaan van den Spiegel. *The workes of that famous chirurgion Ambrose Parey*. London: John Clarke, 1649: 760; Vitaliano Donati, 'New discoveries relating to the history of coral', in: *Philosophical transactions*, volume 47, London: C. Davis, 1752: 98; Thomas Mortimer's *General dictionary of commerce, trade and manufactures.* London: Richard Phillips, 1810: entry for 'pearl ashes'. The BnF Ms. Fr 640 (1580-1600) provides circumstantial evidence that 'cendre commune' should not be identified as a blue pigment: elsewhere in the manuscript, the term 'cendres dazur' ('azurite ashes') appears, on f 11 and on f 62. 'Cendre' or 'ashes' are mentioned on page perso 2 in a recipe to degrease a ground that has obtained a greasy layer with age. Since the use of lye (ashes mixed with water form an alkaline solution) to remove grease is commonly described in recipes for the cleaning of paintings, an identification of 'common ashes' as the remains of burnt organic matter seems plausible. (*see* Stols-Witlox, Maartje, 2011 for historical recipes for cleaning paintings).
[88] Eikelenberg 1679-1704: 159
[89] Savery de Brulons. *Dictionnaire universel de commerce*. Amsterdam: Jansons à Waesberg, 1724, vol A-E: 587.
[90] Eastaugh et al. 2008: 59-60
[91] Guineau 2005: 201; Eastaugh et al. 2008: 180
[92] Mérimée (1830) describes slaked plaster ('platre éteint') as an alternative to chalk. Mérimée 1830: 241. Gypsum is mentioned in relation to glue-bound preparatory layers by Cawse (1840: 20-1, 26), who advises an addition of gypsum ('Plaster of Paris') to a chalk and glue ground or the use of this gypsum instead of chalk. A. Reith advises gypsum for its whiteness. *Technische Mitteilungen*, nr 123 (1891): 91-2.
[93] As demonstrated by the recipes in Appendices 5 and 6 and in the recipe database (DVD), chalk, whiting, whitening, craye, croye, krijt, kryt, Kreide are the words usually employed in English, French, Dutch and German recipes.
[94] Simis 1801: 158

Ibbetson (1803) a combination of 'stiff paint, the greatest part of which is whiting', is is often used by colourmen.[95]

Glue-bound layers are less frequent for canvas preparation than for panels. However in those recipes that do specify glue binders for canvas grounds, chalk is the filler described most frequently. A link between the use of chalk and glue and the materials used for panel preparation seems evident.[96] For chalk and glue layers, as for animal glue size layers, honey is regularly described as a plasticizer. Sully (1809-71) describes the use of treacle as a plasticizer.[97]
The preparation of the chalk and glue mixture by adding chalk to warm glue is described by Norgate (1640) and Fokke Simonsz (1803-4).[98] A detailed description of chalk and glue ground preparation is provided by Andreas Reith (1886). His recipe in the *Technische Mitteilungen* includes a full description: chalk is added gradually to warm glue until the glue takes no more chalk. After stirring, more chalk is added until the liquid is almost too thick to be stirred. It is then passed through a sieve.[99]

The term 'Spanish white' appears in a number of recipes that describe glue-bound first layers on canvas. The fact that nomenclature for Spanish white is confusing, is discussed by Eastaugh et al. (2008).[100] Some authors of historical recipe books write that this term is used to describe chalk, for instance De la Hire (1730)[101] Leuchs (1825)[102] and Vergnaud (1831).[103] Dossie (1764) provides a recipe for Spanish white in which chalk is 'neutralized' with alum water and washed.[104] Others identify Spanish white as a white clay or as bismuth white.[105] Confusingly, Spanish white is presented as a synonym for lead white in a French dictionary (1792).[106] Only a little later, in the 1811 *New family receipt-book*, the pigment again appears alongside lead white in a recipe for ground preparation.[107] In general, the conclusion may be drawn that although references to Spanish white as chalk are numerous, it is possible that another white pigment was intended. Only if a description of Spanish white is provided within the same source does some certainty exist about the identity of the material.

[95] Ibbetson 1803: 11
[96] Paragraph 5.5 compares materials and techniques advised for preparatory layers on different supports.
[97] Sully 1809-71: 006
[98] Norgate (1640 (edition Hardie 1919): 91; Fokke Simonsz 1803-4: 84-5
[99] *Technische Mitteilungen*, nr 25 (1886): 39. The application of this ground, with different ratios of chalk to glue, is described in Paragraph 7.2.1. A difference in ratio of filler to binder in different layers of the ground is also described in a recipe for a ground on millboard in W&N manuscript 'A relic of old times 1833 . P.01', 183?-1876: REP043L08. This concerns a ground with 'gritt' as a filler.
[100] Eastaugh et al. 2008: 55, 356
[101] De la Hire 1730: 663-4
[102] Leuchs 1825: 12-3. While Leuchs in these pages describes Spanish white as a chalk, on page 14 he also mentions that the name is used to describe Bismuth white.
[103] Vergnaud 1831: 11
[104] Dossie 1764: 127
[105] Eastaugh et al. 2008: 55, 356
[106] Boyer, *Dictionnaire François-Anglais et Anglais-François*. 1792: 117
[107] *New family receipt-book* 1811: 313

As alternatives to chalk in glue-bound layers, lead white and pipe clay (De Montabert 1829),[108] and bole or equal amounts of China clay and white bole, (A. Reith 1886), are advised.[109]

6.2.4 Recipes for ground layers based on earth pigments and on clays

Throughout the period, earth pigments and clays are advised regularly for use in preparatory layers, lead white and chalk being the only other pigments with equally important roles.[110]
Yellow ochre, brown-red ochre/earth (natural or burnt), bole, umber, potter's clay, earth for bricks, pipe clay, China clay, kaolin, barium sulphate, Bath brick, pumice powder, Grecian powder, all feature in historical recipes. Employing these pigments or fillers, artists have at their disposal a range of relatively cheap and (mostly) stable powders with which to create a base tone that ranges from white, through yellow, orange, red, purple and brown to the murky grey regularly employed by sme seventeenth century painters. Not only do these pigments provide colour, but they also give body to the preparatory layer. Manganese containing earths (umbers) in addition can function as a siccative. This role of umber was known in the seventeenth and eighteenth centuries, as demonstrated in recipes for the preparation of drying oil that include umber.[111] Notwithstanding this fact, the role of umbers as a siccative is only alluded to once in a historical recipes for preparatory layer, in the De Mayerne manuscript.[112]

An important characteristic of earth pigments is their variety in colour and composition. An essential cause for this variety is local mining. It results not only in a large variation in composition but also in a complicated nomenclature, which also existed historically. The variety in names, geographical origins as well as the widespread use of earths is demonstrated in Gray's 1821 *Supplement to the pharmacopoeia*, which lists: yellow bole from Strigau, yellow ochre from Oxfordshire, Tripoli found 'on the east coasts of England', Tripoli from Staffordshire, 'clay ochre' and 'coarse ochre' from Mendip hills, yellow earth from Saxony, 'Roman ochre' from Somersetshire and from near Rome, red earth from Lemnos, 'Mahogany earth' from the Isle of Wight, 'Redstone-ochre' from Warwickshire, and Persian purpre from Urduz amongst 29 different ochres and other yellow and reddish earth pigments.[113]

It is not surprising therefore, that the exact nature of earth pigments is not always clear. This is also true for the red ochre used as the 'brown red' advised in a number of recipes for preparatory layers, which identity cannot be established with absolute certainty. Haack Christensen's (2011) research on the account books of the Danish court from the period

[108] De Montabert 1829, vol. 9: 167-8
[109] *Technische Mitteilungen*, nr 25 (1886): 39.
[110] Studies focusing on the specific use of clays and of reddish and brownish earth pigments in prepatory layers have been executed by: Hamsik 1993, Groen 2005a, Groen 2005b, Martin 2008.
[111] Recipes for the preparation of drying oil with umber appear amongst others in Stalker and Parker 1688: 72; Smith 1692: 69; Dossie 1758: 147-8; Osborn and Bouvier 1845: 73-4.
[112] De Mayerne 1620-44: 5.
[113] Gray, Samuel Frederick, *A supplement to the Pharmacopoeia: being a treatise on Pharmacology in general; including…*, new and improved edition, considerably enlarged. London: Thomas and George Underwood 1821: 265-267.

1610-26 describes a 'brown red' which was frequently employed to paint barns and boats. Such large-scale use suggests a relatively cheap material, which is stable if exposed to the outside environment.[114] A description in the *Dictionaire abrégé de peinture et architecture* (1746) is rather vague: 'brown red is the name of a kind of ochre of a strong red tone'.[115] Also Jombert and De Piles (1766) describe the pigment as a 'natural earth'.[116] The description of De Massoul (1797) indicates that a number of pigments qualify as 'brown red', and his description points in the direction of a reddish clay: 'Brown red is an argillaceous iron ore, known by the name of bole, or bolaire earth. There is some naturally red, as the bole Armeniac; others are yellow and made red by torrefaction. English red, or biauty is of this number'.[117]
Also the term Spanish brown knows different meanings. Eastaugh et al. (2008) quote a number of historical authors on the composition of Spanish brown and explain that the term either refers to a burnt ochre, which does not necessarily come from Spain, but can also refer to an English burnt ochre. The same term is also used for Vandyke brown, a dark brown humic earth, and as a synonym for 'Spanish liquorice', a gum from the *Glycyrrhiza* species.[118]

Confusion about earth pigment identity is aggravated by the fact that earths were sold under names that allude to a geographical origin, while in fact the pigments were mined in an entirely different area. For example De Massoul (1797) explains that most of the English red 'comes from Berry, a province in France, and is sold in Holland by the name of English Red'.[119] Other compositions or origins of English red cannot be exluded. Eastaugh *et al*. (2008) mention that it may also have been the product of the calcination of yellow ochre, and quote Watin (1785) and Tingry (1804), who describe the pigment as a synthetic red iron oxide, a byproduct of sulphuric acid production.[120]

Processing of earth pigments seems to have been common. Recipes concentrate on burning ('calcination' or 'torrefaction') and on washing. Raw and burnt varieties of ochres, sienna and umbers are mentioned in recipes throughout the period. Gray's (1821) list of earth pigments includes information about their colour change upon burning.[121] In addition, Gray mentions the 'hardening' effect that this treatment can have on an earth pigment. Opinion on the effect of burning on the hardness earth pigments is however not uniform. The anonymous author of the *Arts companion* (1749) writes that certain ochres are 'softened' by burning:

> There are colours which purify by fire, such as the yellow oaker, brown red, ultramarine, and umber; all others blacken thereby: But if you burn the above-nam'd colours with a strong fire they change; for the brown red turns yellow, the yellow oaker turns red, the

[114] Haack Christensen 2011a: 3.
[115] *Dictionaire abregé de peinture et architecture*, Paris: Nyon fils, Barrois, 1746, vol I: 88
[116] Jombert and De Piles 1766: 190
[117] De Massoyul 1797: 158.
[118] Eastaugh et al. 2008: 355
[119] De Massoul 1797: 158.
[120] Eastaugh et al. 2008: 156
[121] Both colour changes from orange or reddish to yellow and from yellow to reddish or even purplish tones are described. Gray 1821: 265-7. According to Gray, depending on the earth, burning may result in hardening or does not have an effect on the hardness of the pigment. Gray 1821: 265-8.

> umber reddens also, and white lead becomes of a lemon colour, and is call'd masticot. Observe, that the yellow oaker burnt becomes softer and kinder by far than before, and more so than the pure brown red: and reciprocally the brown red being burnt becomes more soft and agreeable than the pure yellow oaker; they are both very good.[122]

Unfortunately it is not entirely clear from this description whether the author is talking about hardening or softening the colour of the pigment or changing physical properties. Gray's description does make clear that he refers to the physical properties, as he describes the effect of the burning of French ochre as resulting in 'a stony hardness'.[123] Robert Dossie (1758) provides a description of the relatively simple process of burning, or 'calcination' of raw sienna:

> The calcination may be performed by putting lumps of it, either in a crucible, or naked, in a common fire: and continuing it there, till the colour be changed from yellow to red in the proportion wanted; after which, it must be well levigated and washed over.[124]

The 'levigation' mentioned by Dossie refers to a second purification process that may be employed for earth pigments: the process of washing and decanting with the intention to remove impurities and to separate particles of different sizes. Dossie describes how the earth pigment 'Spanish brown', or 'brown red' can be used 'in the preparation of the cloths for pictures and other course work' in the state that it is sold in, but must be rendered fit for use as a pigment 'by washing over'.[125] Washing is also advised for other pigments, according to the *Painter, gilder and varnisher's companion* (1854) most importantly for yellow ochre, charcoal, bone black, Spanish brown, red lead, white chalk, verditer and Saxon blue.[126] The washing process described in this source consists of stirring the pigment in a dish filled with water, decanting half of the water while the smallest pigment particles are afloat, repeating this process until all that remains in the dish are the 'gritty particles', and allowing the pigment in the decanted water to settle. This pigment, after it has settled at the bottom and has dried, is 'fit for use'.[127]

6.2.5 The variety of clays employed in preparatory layers

Clays are advised in seventeenth century recipes by Eikelenberg (1679-1704) for the preparation of both panel and canvas. Eikelenberg advises 'potters earth' in an oil

[122] *Arts companion or a new assistant for the ingenious*, part 1. 1749: 110.
[123] Gray 1821: 265-8.
[124] Dossie 1758, vol 1: 53.
[125] Dossie explains that this pigment probably originally came ' from abroad' but was now 'dug up in several parts of England'. Dossie 1758, vol 1: 52-3.
[126] Anonymous. *Painter, gilder, and varnisher's companion*. Philadelphia: Baird, second edition 1854: 85. Saxon blue is another name that was employed both for smalt, indigo or for Prussian blue. Eastaugh et al. 2008: 340.
[127] Anonymous. *Painter, gilder, and varnisher's companion*. Philadelphia: Baird, second edition 1854: 85-6. This process is similar to the process described by Daniel King (1653-7) for washing and decanting lead white. *See* Chapter 15.

binder.[128] Clays are also described in nineteenth century sources, pipe clay being the type that appears most frequently in these recipes.[129]

Clays are usually considered a separate category in relation to earth pigments such as ochres, umbers and siennas. Although these also contain clay minerals, as well as iron and manganese oxides, the other earth pigments contain 'a wide variety of other mineral and even organic components'.[130]
Clays all contain major amounts of aluminium silicates and are characterized by their plate-like particle morphology and the small size of the aluminium silicates (below 4 micron). Raw clays have the ability to adsorb water.[131] As they are soils, they contain impurities such as quartz, feldspar and mica. Their colour depends on the presence of other minerals; in pure form they are whitish, but impurities may also render them greenish, yellow to orange, brown, grey or blue.[132] When a clay is mentioned in a recipe, its colour is unknown, unless specified in the recipe.

Upon firing in a furnace, the colour of clays (as is the case with other earths) changes. A high iron content causes a reddish colour and a high calcium content a yellowish tone, although low firing temperatures may result in a light red colour in calcium containing clays.[133]

Some research has been executed into the colour of the 'Sevilla clay' described in Spanish sources for use in grounds. According to González-Garcia and Garcia Ramos (1966) and González-García *et al.* (1990), modern clay samples taken from different sections of the Guadalquivir valley near Sevilla, range in colour from blue, yellowish, reddish to brown, greyish being the most prevalent tone.[134] Hale, in a paper discussing Diego Vélazquez's *Supper at Emmaus* (1622-3), states that the ground of this painting, which consists of 'a single layer of finely divided material, essentially an iron earth or naturally occurring heterogeneous mixture of minerals colored by iron oxide, with 'much larger inclusions of calcite and silica', is composed of 'Sevilla clay'. The colour of this ground is dark and brownish.[135]

Kaolin, a whitish clay used in porcelain manufacture, is also described as an ingredient in grounds. Bersch (1894) uses the term China clay as synonymous to kaolin.[136] This is in

[128] Eikelenberg 1679-1704: 403, 404-5. Potter's clay is also mentioned in seventeenth and eighteenth century Italian and Spanish recipes.
[129] *See* Appendices 5 to 12
[130] Eastaugh et al. 2008: 152.
[131] The degree and rate of water absorption of raw clay depend on the clay composition. Grim 1962 provides the following list, from a lower water absorbing capacity to a higher absorbing capacity: attapulgite, calcium montmorillonite, poorly ordered illite, poorly ordered kalinite, well-ordered kaolinite, well order illite. Grim 1962: 143. Upon heating, clay minerals lose their ability to absorb water. The exact temperature at which this occurs depends on the clay mineral; it takes place between c. 105 and 490 ^{o}C. Grim, *Ibid*. The terms employed by Grim do not occur in historical recipes, where other names are employed to identify clays. Eastaugh et al. 2008: 113-5 discuss the composition and terminology of clays employed in historical paint manufacture.
[132] *See* for more information and references for clays: Eastaugh et al. 2008: 113-5
[133] Hollestelle 1961: 95-6.
[134] González-García et al. 1990: 363, González-Garcia and Garcia Ramos 1966: 230-2
[135] Hale 2005: 71
[136] Bersch 1894: 362

accordance with the description of China clay by Eastaugh et al. (2008), who give its composition as a mix of kaolinite, smectite, mica, quartz, and amorphous silicates.[137] Eastaugh et al. write that the largest deposit of China clay is located in Austell in Cornwall, and that other deposits are found in India and Greece.[138] In their entry for kaolin, Eastaugh et al. include other mining locations (Georgia (USA), Cornwall and Devon in the UK, Germany, France, Brazil, Malaysia, Brazil and South Africa) and explain that there is some confusion in terminology, as the term white bole is also employed for kaolin. In a recipe for a canvas prepared for photographic purposes from the Winsor & Newton archive dated 1874, China clay appears on this list of ingredients with behind it in brackets: Cornish clay.[139] A note from Winsor & Newton manuscript '15' indicates that 'China clay' consists of the 'steatites or soap rock' from Cape Lizard in Cornwall.[140]

The term bole is often used to describe iron containing red ochres or clays that are suitable to be applied below gilding or other metal leaf that will be burnished. Their plate-like structure is compressed upon burnishing, which allows the metal leaf to achieve a high polish. However both red and white boles are mentioned in historical sources and the term bole was sometimes used in a wider sense. Eastaugh et al. (2008) quote Harley (1982), who writes that in some seventeenth century sources the term bole also refers to red earth.[141] Also Cröker (1729) writes that bole is 'a kind of earth', sometimes mixed with some sand. However he does indicate that Armenian bole, a clay, is the best quality,[142] a statement that demonstrates the fact that in his mind there is a clear connection between 'bole' and clay. The nineteenth century German periodical *Technische Mitteilungen* uses the term 'bole' in a wider sense:

> Bole is in its widest sense the same as clay. There exists a white, a yellow and a red bole (clay). The last sort owes its color to an iron oxide content and often also to manganese oxide. It belongs to the clays that separate in water and in it falls apart as little particles while crinkling and with the development of many air bubbles. Several yellow, red and brown earth paints are types of bole, for instance Siena earth, red sinopia bole, Cyprian umber.[143]

Pipe clay is another term encountered in recipes for preparatory layers. While it is often used as a synonym for kaolin, the historical composition of this material is more diverse. Seventeenth and eighteenth century smoking pipes were most likely made from ball clay, with a composition that varied according to the mining area. According to Hale (1758), smoking pipes were made from a greyish clay that burns white, which was mined in Nottinghamshire, and Martin (1813) writes that pipes were made from a white clay that

[137] Information that Eastaugh et al. derive from an earlier source, which is identified as Rutley 1988.
[138] Eastaugh et al. 2008: 100
[139] Winsor & Newton manuscript 'P.04', 1834-93, recipe date 1874: P04P110L01
[140] Winsor & Newton manuscript '15' 1843-50: 14P002L16
[141] Eastaugh et al. 2008: 63.
[142] Cröker 1729: 98-9
[143] *Technische Mitteilungen*, nr. 6 (1885): 20.

was mined in England on the island of Purbeck.[144] Eastaugh et al. (2008) write that sepiolite was used for the Meerschaum pipes depicted in some seventeenth century paintings.[145]

6.2.6 Bath brick, Grecian powder

Bath brick and Grecian powder are mentioned only in recipes from the Winsor & Newton Archive. As their use as paint materials was previously unknown, their properties have not yet been studied in this context. A number of nineteenth century geographical publications discuss Bath brick. While different geographical origins are described, the nature of the material, a brick produced by drying river clay, are constant. Gray (1821) writes that Bath brick is made from 'Windsor loam' (found at Hedgery, near Windsor), a yellow brown, hard and heavy loam used to set the bricks of wind and glasshouse furnaces.[146] According to the nineteenth century geologist Ansted (1865), Bath brick is made from the mud deposited along the river Parret near Bath. He describes its composition as 'almost pure silica in a fine state of division' and says that its colour is more pale and yellow than Tripoli.[147] Parfitt (1867) has examined the nature of a specimen taken from the 'banks of the narrow channel at and in Bridgewater'. It consists of 'two-thirds of exceedingly fine grains of quartz, or some silicious compound, and about one-third of calcareous matter'.[148] Dugdale and Burnett (1854) give a short description of the simple production of Bath brick: the 'mud' is cast in moulds and dried.[149] Gray (1821) writes that powdered Bath brick is used as a 'coarse polishing powder',[150] and Parfitt (1867) mentions its suitability for cleaning knives.[151]

Unfortunately the precise nature of Grecian powder remains uncertain. The ingredient appears in the Winsor & Newton archive recipes alongside the following fillers or pigments: 'plaster of Paris' [gypsum], pumice powder, chalk, lead white, 'yello' and Venetian red. Therefore it cannot be identical with any of these materials. In one entry, the Grecian powder is included as an alternative to 'levigated fluid from the potteries', levigated fluid being a side product of washing and decanting pottery clay.[152] This may give an indication of its properties and use. It could be a clay-like material.
Or is Grecian powder a synonym of marble powder? A Winsor and Newton recipe for a ground for flower painting in 'powder colours' and crayons, is titled 'flower painting on Grecian or marble grounds',[153] and Carlyle notes Grecian grounds being sold by Winsor & Newton, according to the catalogues from c. 1830 to 1846.[154] In the recipe text the ground

[144] Hale, Thomas. *A compleat body of husbandry*, vol. 1, 2nd edition/ London: Osborne, 1758: 60; Martin, Thomas. *The circle of the mechanical arts, containing practical treatises on the various visual arts, trades, and manufactures*. London; Curtis, 1813 : 478-9
[145] Eastaugh et al. 2008: 306
[146] Gray 1821: 268.
[147] Ansted 1865: 97. Eastaugh et al. 2008: 374 describe Tripoli as a white fine-grained silica.
[148] Parfitt 1867: 305-6.
[149] Dugdale and Burnett 1854: 246.
[150] Gray 1821: 268.
[151] Parfitt 1867: 306.
[152] W&N manuscript '13', 1824-50: 13P039L01.
[153] W&N manuscript '24', 1856-62: 24P006L01.
[154] Carlyle 2001: 174

is described as consisting of marble powder that is sifted over a 'distemper or size' preparation.
The question remains unresolved. If Grecian powder is similar to levigated fluid from potteries it would be a clay-like material with a fine, smooth texture. If on the other hand it is synonymous for marble powder, it would be of a more gritty texture and would probably lead to a granular surface. And another identity of the material cannot be ruled out.

6.2.7 Ground layers based on lead white

As the primary opaque white pigment for oil painting prior to the introduction of zinc white, lead white plays an important role in preparatory layers, in particular in recipes with an oil binder. Lead white based grounds appear throughout the period under investigation.

The fact that nineteenth century painters are not entirely happy with lead white is alluded to by Bouvier (1827), who writes:

> lead white, as a lead chalk, makes a ground, which is bad for other paints, unless the ground has dried very well, which only happens after 8 months to a year. At the same time there is no other paint, which can be used instead of lead white in an oil ground; you can only work without it when you prepare a ground with glue paints.[155]

During the last circa ten years, more insight has been gained into the exact mechanism by which the lead is incorporated into the three-dimensional network of dry oil paint and stabilizes this network.[156] Also the degradation of lead white-containing layers is the focal point of recent resarch. Typical degradation characteristics include lead soap agglomerates or protrusions, increased transparency. They are the result of saponification reactions, and the formation of surface crusts of recrystallized lead salts.[157]

The quality of the lead white pigment, determined both by the quality of the starting materials, by production and processing methods and by additions of extenders, influences its chemistry and may thus co-determine the stability of lead white-based layers. As demonstrated in Chapter 13, some authors of historical recipes books suggest that lower quality or cheaper materials can be employed for preparatory layers. If lower quality lead whites are used, this may result in a less stable ground layer.[158] Chapters 13 and 14 analyze historical recipes that discuss the influence of production methods on lead white quality, how painters can ensure themselves of a high quality pigment through selection of lead white with specific characteristics, and also investigate through

[155] Bouvier 1827: 567-70
[156] Van den Berg 2002; Keune 2005.
[157] *See* Noble, Boon, Wadum 2002; Van der Weerd, Boon, Geldof, Heeren, Noble 2002; Keune 2005; Noble, Van Loon, Boon 2008; Keune, Van Loon, Boon 2011.
[158] This was first explored by the HART Project, where lead white washing experiments were executed in order to determine whether a correlation could be found between washed and unwashed lead white and lead carboxylate aggregation. *See* Carlyle 2006.

reconstruction, recipes for treatments that improve the quality of the pigment. The basic properties of the pigment and historical terminology are discussed in those chapters.

Lead white features in single-layer grounds. Both for panel and canvas preparation, lead white based layers also often appear as a second layer above a first layer that has a different composition. Some indications are present in historical sources that such two-layer systems have the purpose of reducing the thickness of the layer containing the relatively expensive lead white pigment (*see* Paragraph 5.3).

Oil is the binder advised most often for lead white based layers, although in a smaller number of recipes varnish binders are prescribed, and exceptionally aqueous binders appear (*See* Figs. 5.2 and 5.3 and below).[159] In an oil binder, lead white not only provides a base tone, but also acts as a siccative, a fact painters are aware of from very early on, as demonstrated in a canvas ground recipe by Vasari (1550), who writes: 'but first it is convenient to prepare a layer of pigments with siccative properties, such as lead white, 'giallolino', and 'earth for bells'.[160] Lead white is often combined with umber in oil-bound preparatory layers.

A small number of nineteenth century recipes for canvas preparation describe lead white-based grounds with an emulsion binder (starch or flour paste with linseed oil), or with an aqueous binder. However such binders are exceptional. Not a single recipe for panel preparation advises lead white in an aqueous binder, while canvas preparation recipes calling for lead white in an aqueous medium only appear in a small number of nineteenth century recipes, those provided by Sully (1809-71, bound in milk), De Montabert (1829, bound in parchment glue with some honey) and Grace (1881, in egg).[161]

6.3 The binders and binding media employed

6.3.1 General observations

Appendix 15 shows that a number of binders are mentioned almost without interruption throughout the period.[162] As Appendix 15 concentrates on the individual ingredients, it does not show whether binders appear individually or in mixtures (for instance as emulsions). The combination of binders resulting in emulsions is discussed throughout the main text of this dissertation.

6.3.2 Aqueous binders

Of the aqueous binders, both animal glue and flour paste appear in recipes dating from the last quarter of the sixteenth century through to the end of the nineteenth century. While starch is also regularly mentioned throughout the period, it appears at more irregular intervals. Animal glue and flour paste are used individually as a binder for

[159] Copal varnish is employed by Sully 1809-71: 066; (Roberson 1840: n.p.) describes the use of copal and 'goldsize'.
[160] Vasari 1550 (1568): 52.
[161] *See* Appendices 5-7
[162] The variety in materials mentioned in recipes within the period 1700-1725 is low as only three recipes are available that date from this period.

preparatory layers, but they also appear in emulsions, where they are combined with oleous media.[163] Other aqueous binders, introduced in nineteenth century recipes, are discussed further below in Paragraph 6.3.5, which focuses on nineteenth century innovations to ground binders.

As the same types of animal glue, flour paste and starch are advised for ground layers as those that are incorporated in size layers, information on the properties of these ingredients is not repeated here and the reader is referred to Paragraph 6.1.

Additions to the binders of aqueous grounds often play the role of plasticizer or insect repellent: honey is advised by a number of authors as a plasticizer for aqueous grounds or for emulsions[164] and appears in recipes dating from the end of the sixteenth to the end of the nineteenth century, with some intervals. The role of alum (potassium aluminium sulphate or aluminium sulphate[165]), mentioned in the sixteenth century French Ms Fr 640 (1580-1600) as an addition to an animal glue intended to prepare taffeta for painting, is not specified in the recipe. Carlyle (1991, 2001) discusses the possible positive effect of alum on the flexibility of animal glues.[166] Wehlte (1975) and Guineau (2005) both advise alum to render animal glues less water-sensitive.[167] Other plasticizers for aqueous binding media and emulsions, such as treacle, egg white, waxes (beeswax, spermaceti wax), soap, borax and glycerine, only appear in nineteenth century recipes.[168]
De Montabert (1829) advises to add vinegar to flour paste or starch paste to prevent infestation with mites; laurel essence or leaves of laurel or walnut are added to flour paste to repel flies.[169]

6.3.3 Oleous binders and volatile solvents

Of the oil binder ingredients, linseed and walnut oil are mentioned most consistently throughout the period. Although poppy oil is prescribed during the late sixteenth, early

[163] *See* Chapter 5.
[164] *See* for instance Manuscript Sloane 1990 1623-46: 78/9?: 'with the brush give it a layer of white mixed with glue, & a little honey out of fear that it breaks, or without dries'; Smith 1756: 58: 'if you add a little honey to your size it will keep it from cracking'; Montabert 1829, vol. 9: 167-8:'the addition of a little honey [to a glue-bound ground] provides suppleness' .
[165] Guineau 2005: 56-7
[166] Carlyle 1991, vol. 1: 246, Carlyle 2001: 176.
[167] Wehlte 1975: 350; Guineau 2005: 57. Schellmann (2007) writes that the alum bonds to hydrophililc sites in the glue molecule, thus increasing the level of cross-linking between the protein molecules and raising the wwater resistancy. Schellmann 2007: 62
[168] Bouvier 1827: 570-1 points to the plasticizing role of wax in preparatory layers. Field 1835: 213 writes: 'To preserve the elasticity of grounds, some drying oil should be introduced into the glue or size with which they are prepared; for the same purpose bees'-wax, sugar, treacle, albumen, &c. have been added with various degrees of eligiblity and success', this recipe is quoted by Carlyle 1991, vol. 1: 239 and Carlyle 2001: 176 in this context. *See* Carlyle 1991, vol. 1: 239-240 and Carlyle 2001: 176 for a discussion and evaluation of nineteenth century British recipes for plasticizers. Carlyle includes information on the use of glycerine in grounds, which she writes is limited at first by the price of the material, but grows after the development of a more economical preparation method (in 1854). Carlyle 1991, vol. 1: 246; Carlyle 2001: 176. Knowlton (1879) gives a recipe for an aqueous ground that contains soap mixed with animal glue as a binder. Knowlton 1879: 29-30. This recipe is discussed in Carlyle 1991, vol. 1: 234; Carlyle 2001: 168.
[169] Montabert 1829, vol. 9: 176. In an eighteenth century Spanish source, Palomino (1715, 1724), an addition of honey or linseed oil to flour paste was discussed as preventing mould. Palomino 1715,1724, vol. 2 1724: 32.

seventeenth century and the second quarter of the nineteenth century, it is not a regular feature in historical recipes for the preparation of grounds for oil painting in North West Europe. In the De Mayerne manuscript (1620-44) and in Wilhelmus Beurs's treatise (1692) it is explained that poppy oil is considered a suitable alternative to linseed oil for light and cool colours in particular, since it has a paler tone.[170] The lighter colour would have been less important in preparatory layers, which are subsequently covered. However the fact that poppy oil is known as the slowest drying binder of the three drying oils, would have been of interest.[171] Although both linseed and poppy oil dry through polymerisation and oxidation, the rate at which poppy oil dries is lower than that of linseed oil. While nut oil dries more slowly than linseed oil, its speed of drying is slightly faster than that of poppy oil.[172] Naturally local availability and cost would also play a role, which further defines this hypothesis. In fact, it may explain the fact that walnut oil is mentioned throughout the period under consideration, even though its drying speed is only a little higher than that of poppy oil.

Some authors advise to use oils which have undergone a particular processing method. Recipes for preparatory layers mention boiled oil, fat oil and drying oil. A clear distinction between these terms is difficult to make, as preparation recipes discuss similar procedures.

Historical oil recipes reveal that boiling oil does not necessarily mean heating as high as boiling.[173] Heating results in a more highly oxidized and polymerized binder.[174]

Fat oil is made by exposing fresh oil to oxygen, executed in some recipes by placing the oil in a dish for a prolonged period.[175] A recipe in the De Mayerne manuscript (1620-44) specifies water-washing in combination with air exposure.[176] Some fat oil recipes employ siccatives: King (1653-7) provides a recipe for a fat oil that is prepared by placing linseed

[170] De Mayerne 1620-44: 7 advises poppy oil in particular for white and blue. Beurs 1692: 8 advises poppy oil in particular for grinding lead white. *See* the next note for more historical references to the use of poppy oil for pale colours.

[171] As A.P.S., author of the *Nauwkeurige beschrijving* 1770: 25 writes: 'When using poppy or nut oil, one does not have to fear yellowing of the tender colours; the only inconvenience is, that they dry slowly'. Hopman (1856) writes that poppy oil is used for white, bright colours and that it does not yellow in the dark. He advises to add some sugar of lead to remedy its slower drying. Hopman 1856: 5. Nineteenth century De Montabert (1829) is more critical of poppy oil: 'Its qualities are its whiteness and the facility to dry with time, not that it is more susceptible than others to dry to a perfect cristallinity; I think the contrary; linseed oil is its superior on that point; but nowadays one preferably employs it on account of its whiteness, and because linseed oil needs to be bleached in the light, and nut oil is slower to dry.' De Montabert 1829, vol. 9: 91.

[172] According to Horie (2010), linseed oil consists of 10% palmitic, 15% oleic, 16% linoleic and 56% linolenic acids and has an iodine number of 170-190, walnut oil consists of 5% palmitic, 18% oleic and 73% linoleic acids and has an iodine number of 140-150, while poppyseed oil consists of 10% palmitic, 16% oleic and 72 % lineoleic acids and has an iodine number of 135. The the iodine number, which is the degree of unsaturation in the oil, is a measure for the drying speed of these oils. Linseed oil, containing the highest proportion of double bonds, is the fastest drier, followed by walnut oil, which is a slightly faster drier than poppy oil. Horie 2010: 264.

[173] *See* Keller 1973.

[174] Van den Berg et al. 2004: 15.

[175] Bate 1633: 168 (transcribed by Talley 1981: 174) gives a recipe for 'fat oyl' made by exposing linseed oil 'to the weather'. A recipe for the preparation of fat oil in Stalker and Parker 1688: 54 specifies placing linseed oil in the sun in a shallow leaded vessel for five or six months.

[176] For instance: De Mayerne 1620-44: 145 v.

oil in the sun for three weeks after the oil had been mixed with lead white, minium, sawdust and crumbs of brown bread.[177] Stalker and Parker (1688) advise placing linseed oil in the sun in a lead glazed vessel.[178] Dossie's (1758) recipe for a fat oil specifies water washing, sun exposure and subsequent heating.[179] Dutens (1779) describes how fat oil is made by slowly heating litharge (lead II oxide) and lead white with linseed oil.[180] In a later edition, Dutens (1803) gives a recipe for a 'fat or drying oil' that is prepared by exposing linseed oil with lead white and litharge to the sun for eight days, stirring it once or twice per day.[181]

Although these recipes show that the term drying oil can also be applied to oils treated by sun exposure in combination with siccatives, in other recipes 'drying oil' is made with siccatives only[182] or by adding resins. The historical recipes for oil processing show that combinations of different methods are sometimes advised, or that a succession of methods is employed.[183] Descriptions of recipes for 'painter's varnish' or 'painting varnish' described below, demonstrate that these terms are also employed to describe oils treated with siccatives.

Carlyle (1991, 2001) notes a degree of confusion in nineteenth century British sources regarding the exact meaning of the term 'drying oil'. She writes that both the terms 'drying oil' and 'fixed oil' are used to describe oils that dry to a hard film, while the term 'drying oil' can also refer to an oil that has been treated further to develop it into fast-drying binder.[184]

A curious use of linseeds is described in the eighteenth century 'Werkstattbuch' by Müller (1750-1800): it advises to treat the linen canvas with linseed oil cakes, linseeds meal after the oil has been expressed. The linseed oil cakes are boiled in water and applied to the canvas. According to the recipe, the layer 'closes' the canvas in preparation for painting.[185] Mérimée (1830) describes an addition of meal from linseed mucilage ('mucilage de graine de lin') to the size layer.[186] Such additions may lead to relatively thick size layers with an irregular, fibrous texture.

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[177] King 1653-7: 46v in Talley 1980: 223.
[178] Stalker and Parker 1688: 54.
[179] Dossie 1758: 372-4. The oil is poured into a wide earthenware dish, mixed with water. It is placed outside in the sun and rain for five to six weeks, until it had reached the consistency of treacle. The oil is separated from the water and is heated over the fire in a glass viol. Heating liquefies the oil, which allows all impurities to sink to the bottom. The warm liquid is filtered and ready for use.
[180] Dutens 1779: 63.
[181] Dutens 1803: 61.
[182] Van den Berg et al. 2004: 15, 18 conclude that linseed oil treatment with litharge results in a more oxidized and polymerized oil. Litharge influences the auto-oxydation process in the oil.
[183] *See* for research on and reconstructions of oil-processing methods and oil treatments involving siccatives described in historical recipes: Keller 1973: 74-105, who investigates and reconstructs a number of 13th-19th century recipes; Carlyle 1991, vol. 1: 49-77 or Carlyle 2001: 31-52, who provides an overview of British nineteenth century recipes for oil processing. See also Carlyle 2000 and Carlyle 2005.
[184] Paraphrased from Carlyle 1991, vol. 1: 42; Carlyle 2001: 23.
[185] Müller 1750-1800 (transcribed in Lehmann 2002: 50). Oil pressing experiments executed by the HART Project team demonstrate that the linseed oil cake that remains after pressing of the oil is a rather crumbly, sticky material with flaky skins of linseeds. It is rather course in structure, like a very course wholemeal flour.
[186] Mérimée 1830: 244-5. The English translation of Mérimée (Mérimée and Sarsfield Taylor 1839: 220-1) translates the term as 'mucilage of linseed meal'.

Siccatives, metal salts such as those containing lead, manganese or zinc, which act as a catalyst for the polymerisation of the oil binder, not only appear in recipes for the preparation of oil binders advised for use in preparatory layers, but are also included as additions during the ground preparation itself. For instance, recipes specify additions of small amounts of lead white or of minium for earth or clay-bound layers.[187] For the lead white containing layers themselves, small additions of additional siccatives are also described, as the umber mentioned to speed up the drying of a lead white based second ground layer in a recipe in the De Mayerne manuscript. [188]
In some cases it is not clear whether a material is added to tone the lead white or to assist in the drying. This is the case also with the yellow massicot, which is mentioned in the manuscript Bnf Ms. Fr 640 (c. 1580-1600).[189] The most frequently mentioned traditional siccatives are litharge (lead II oxide), lead-pigments such as lead white (lead carbonate), minium (lead IV oxide) and massicot**.** Eastaugh et al. 2008 explain that the meaning of massicot changed. While they found evidence that in seventeenth century texts massicot is used for the pigment lead tin yellow, some sources use the term to refer to lead II oxide. Eastaugh et al. conclude that 'at some point in the eighteenth or early nineteenth century the term 'massicot' came to be applied to lead monoxide'.[190] Copperas appears in a number of recipes as well. It is referred to in nineteenth century British artists' manuals, where according to Carlyle it should be identified a zinc sulphate.[191] Eastaugh et al. (2008) discuss the historical use of the term copperas and write that it was used for different protosulfates of copper, iron and zinc, while in English it generally refers to green vitriol, ($FeSO_4$).[192]

Advice about siccatives remains constant for a long period of time. However in the years 1825-1850, a number of new sicatives are introduced in recipes for preparatory layers. Lead sulphate and lead acetate ('sugar of lead'), or siccative mixtures called 'patent dryers' partially replace the traditional siccatives in the recipes.[193] In addition, 'gold size' or 'gilder's size', a sticky oil boiled with siccatives,[194] is also advised to assist in the drying of

[187] For instance in Manuscript Sloane 1990 (c. 1623-44): 78-9, a little minium is added as a siccative to an ochre in oil ground. Félibien 1676: 407-8 explains that the a little lead white is added to a layer consisting of 'brown red' earth pigment to speed up the drying.
[188] De Mayerne 1620-44: 5.
[189] BnF Ms.Fr 640 c. 1580-1600: perso 8.
[190] Eastaugh et al. 2008: 262.
[191] Carlyle 1991, vol. 1: 69; Carlyle 2001: 46-7.
[192] Eastaugh et al. 2008: 136
[193] By 'patent dryers' a mixture of different siccatives is meant, which is prepared by the Winsor and Newton company, as stated in the recipe. The exact composition of the siccatives involved in this mixture may have varied. *See* for a description of the materials and processes mentioned in the Winsor and Newton manuscripts, Chapter 9 of this dissertation, which discusses the commercial preparation of supports for oil painting. *See* Carlyle 1991, vol 1: 60-80, vol 2: 99-102 and Carlyle 2001: 41-54, Carlyle's Appendix 8 about siccatives according to nineteenth century British paint recipes. For a summary of siccatives in nineteenth century Britain see Carlyle 1999.
[194] Spon provides two recipes for gold size. It is unclear which one he intends for use in his ground recipes. For the first recipe, 'Gold size is prepared from ½ lb. of linseed oil with 2 oz. of gum animi'. The mixture of oil and powdered resin is boiled until 'somewhat thicker than tar' and strained through a cloth. Spon 1879: 18. The second recipe for 'gold size' calls for 1 part yellow ochre, 2 parts copal varnish, 3 parts linseed oil, 4 parts turpentine and 5 parts boiled oil, all mixed. Spon 1879: 305. Spon furthermore gives recipes for a 'bronzing gold-size', for a 'flock gold size', 'fat-oil gold-size' and also describes 'Japanners gold-size'. Spon 1879: 305-6. Since in his recipe for a preparatory layer he does not add any specification to the 'gold-size'it seems less likely that he wants to indicate one of the latter gold sizes. Information on the use of and recipes

oil-based preparatory layers. Research of nineteenth century British manuals by Carlyle demonstrates that lead acetate is available as a powder but also mixed with a binder in bladders and tubes. The lead acetate is criticized in a number of nineteenth century sources since it is said to induce colour change in the paints as well as efflorescence on the surface of paints.[195]

Soap is advised in nineteenth century recipes as a plasticizer for oil grounds.[196] Soap is also an emulsifier. Sully (1809-71) provides a recipe that combines yellow soap and oil paint in a first layer for a 'flexible canvas' and in another recipe includes brown soap, which is mixed with lead white paint and applied in two coats.[197] The Winsor & Newton archive also contains a recipe that calls for a combination of oil paint and soap as a canvas ground, and includes the notation that prior to the introduction of soap, treacle was used in its place. This suggests a similar function in the composition. The recipe combines linseed oil with beeswax, soap, siccatives and flour.[198]

Late in the nineteenth century, Church (1890) advises to add a small amount of non-drying oil such as olive and almond oil to preparatory layers for canvas that requires rolling, to prevent cracking.[199]

Volatile oils are mentioned in recipes for preparatory layers as additions to the oil binder or to emulsion binders. They include turpentine oil or 'spirit of turpentine', spike oil and benzoline, naptha or petroleum. Turpentine oil is also present in the commercially available product 'flatting': lead white ground in oil to which a large proportion of turpentine oil has been added.[200]
Turpentine oil or spirit of turpentine is a water-thin liquid obtained by distillation of the syrupy turpentine balm that extrudes from pine trees when they are scarred or

for 'gold size' from a number of British nineteenth century manuals are found in Carlyle 1991, vol. 1: 58-9 and Carlyle 2001: 37-8.

[195] Carlyle 1991, vol. 1: 62-8; Carlyle 2001: 42-6.

[196] Carlyle (1991, 2001) discusses additions of soap to oil paint in British nineteenth century sources. Carlyle 1991, vol. 1: 157-8; Carlyle 2001: 110-1.

[197] Sully 1809-71: 046, 156.

[198] W&N manuscript 'A relic of old times P.01' 183?-76: REP036L11. Field (1835) describes the role of treacle as a plasticizer. Mayer and Myers 2011: 100 describe soap as a material that is added to oil-based grounds for oil painting to raise the layer's flexibility by artists preparing their own grounds in the late 1820s, both in the Britain and in the United States. They mention its use by artists Peale, Sully, Neagle and King. They furthermore write that King and Sully both believe that the soap will prevent rotting of the canvas that can occur when it is in contact with oil. Mayer and Myers 2011: 151.

[199] Carlyle 1991, vol. 1: 240 and Carlyle 2001: 172 notes that non-drying oils in preparatory layers are described in Church 1990 and Laurie 1895. Olive oil is mentioned much earlier for another purpose. It was described as an addition to lead white or umber paints to prevent them from drying too quickly in hot weather by Smith 1692: 73 (transcribed in Talley 1981: 380).

[200] Bristow 1996: 103-4 discusses the term flatting and its origin. He explains that 'flatting' is a technique in interior house painting that created 'flat' or 'dead' surfaces, by which are meant very matt surfaces. This technique is apparently highly fashionable from the 1740s on. Bristow writes that such matt surfaces are often created by adding a layer of turpentine oil-diluted lead white and oil paste to an 'ordinary oil finish'. The technique is not cheap. Bristow cites a source who placed a higher price on a flat finish than on a finish with 'ordinary' lead white paint and the same is evident from the table of prices for painter's work per yard provided on page 108 of Bristow's publication.

damaged.[201] Different qualities of turpentine oil or spirit are described in historical sources, their purity depending on the details of the distillation process.[202]
According to Gettens and Stout (1966), the term 'turpentine' is used to refer to the oil made by distillation, not to refer to the balm as it extrudes from the pine tree.[203] Historical recipes demonstrate that although the term was certainly used to refer to turpentine oil,[204] this is not always the case. The term may also refer to turpentine balm. For instance Stalker and Parker (1688) provide a recipe for 'fat oyl' that describes the thickened oil after sun exposure to be 'thick as turpentine'. Since the distilled product is thin as water and only turpentine balm can have a consistency which is more like honey, these authors obviously refer to the balm, not the oil.[205] Van Leen (c. 1800) talks about 'turpentine water' to thin the ground mixture and 'turpentine' to mix with the oil binder.[206] Here the word 'turpentine' refers to the balsam. Care should therefore be taken with the interpretation of the term 'turpentine' if authors do not provide additional information on the viscosity of the liquid.
A particular type of resin balm that is mentioned in historical recipes for preparatory layers is Venice turpentine, an extrudate from the *Larix decidua.*[207] Hill (1751) describes Venice turpentine as the 'thinnest and most fluid of all the turpentines'[208] and Strother (1727) in his description of materials used in medicine, writes 'it is the best, but because it is dearer, it is not so common'.[209]

Spike oil, a volatile oil obtained through distillation of spike lavender,[210] is mentioned as a diluent in a number of recipes for preparatory layers only from 1829 onwards,[211] even though the use of spike oil to thin oil paints has already been advised in the seventeenth century.[212] The choice between turpentine oil and spike oil may have been made on the basis of their working properties. Gettens and Stout (1966) mention that spike oil is not as volatile as turpentine oil.[213]

[201] Gettens and Stout 1966: 72.
[202] *See* for instance the description of nineteenth century British recipes discussing the quality of turpentine oil or spirit of turpentine in Carlyle 1991, vol 1: 19-5 or Carlyle 2001: 139-40. *See* for earlier use and the influence of distillation methods on the properties of turpentine oil: Woltman 2010.
[203] Gettens and Stout 1966: 72.
[204] (Sully 1809-71: 129) refers to the use of 'turpentine' to thin megilps that are too thick and (Field 1850: 138-9) to thinning boiled oil with turpentine.
[205] Stalker and Parker 1688: 54. This recipe was repeated in the eighteenth century (*School of wisdom and arts* 1783: 211).
[206] Van Leen c. 1800: 18. Van Leen's recipe is the first recipe in which the use of turpentine balsam is certain.
[207] According to Gettens and Stout (1966) Venice turpentine does not contain abietic acid crystals, which cause discolouration in common turpentine qualities. Gettens and Stout 1966: 73. To obtain it, a hole is bored into the core of a *Larix decidua* tree. The hole gradually fills itself with the balsam. Cruypelans and Malaise 1990: 42-3.
[208] Hill, John. *A history of the material medica*. London:Longman, Hitch, Hawes 1751: 707.
[209] Strother, Edwards. *Materia medica or a new description of the virtues and effects of all drugs*. London: Rivington, 1727.
[210] Gettens and Stout 1966: 197.
[211] It is puzzling that Carlyle 1991, vol. 1: 197, Carlyle 2001: 143 found 'spike oil of lavender' only in late nineteenth century and early twentieth century colourmen catalogues, while it is mentioned in recipes much earlier in the century. She found that Roberson purchased spike oil between 1861 and 1871.
[212] De Mayerne 1620-44: 7; Félibien 1676: 407-8.
[213] Gettens and Stout 1966: 197.

Petroleum, benzoline and naptha are crude oil distillates. The distinction between naptha and petroleum is not entirely clear from the descriptions, they appear to be interchangeable. According to Carlyle (1991, 2001), naptha is available in the second half of the nineteenth century in Britain, possibly earlier, as she has found sources published in the 1830s who describe naptha as a material frequently used in varnish preparation.[214] However by the second half of the nineteenth century, a change in meaning seems to have occurred. According to British chemist Ure (1860 edition), the term 'naptha' has, even though it was formerly used only to describe fluid hydrocarbons, gained a wider meaning, and now includes 'most inflammable fluids (except perhaps turpentine) obtained by distillation from organic matters'.[215]
Benzoline, mentioned as a solvent to thin oil paint for use as an isolation layer by Grace (1881),[216] is a synonym for benzin consisting of heptane 'and its homologues', according to a paper read to the British Association in 1879.[217] Crooked (1874) describes it as a 'volatile liquid hydrocarbon'.[218]

6.3.4 Varnishes in binders

Varnish is mentioned as a binder or binder addition only in the more recent North West European historical recipes for preparatory layers.[219] To date, the earliest ground recipe containing varnish is provided by Cröker in 1729. Unfortunately authors do not always specify the nature of the varnish to be used, and Cröker is one of them. Prior research has shown that the term varnish can apply to different combinations of resins, oils and/or solvents.[220] The term is used both to refer to non-pigmented layers of binder that contain only oil and siccatives and to refer to resins dissolved in oil or in volatile solvents. Therefore there is no absolute certainty about the composition of varnish in recipes when no further details are provided.

Some recipes advise the addition of specific types of varnish, for instance 'painting varnish' or 'painter's varnish'. Often the term is not further specified, as in a recipe for a ground on canvas in the Wiltschut manuscript (c. 1726-39) and in Vibert's (1892) recipe for a panel ground. Varnishes to mix with paint are however described in several other sources and these recipes provide indications for the possible composition of the varnishes described by both authors. Buonanni (1733) gives a recipe for a varnish to mix

[214] Carlyle 1991, vol. 1: 198-200 and Carlyle 2001: 43-4
[215] Ure 1860, quoted in Forbes 1959: 57.
[216] Grace 1881: 88.
[217] Quoted by Forbes 1959: 66.
[218] Crooked, W. (ed.). *The chemical news and journal of industrial science*, April 24, volume 24 (1874): 187. On page 231 of the same periodical, it is called 'product of petroleum'.
[219] While in Italy, already Armenini (1587) advises to use 'vernice commune', 'common varnish' as a binder for preparatory layers for canvas. Armenini 1587: 124-5. The exact composition of 'vernice commune', or 'common varnish' may vary. Merrifield concludes that in early medieval manuscripts the term is used to describe a varnish made from sandarac dissolved in linseed oil, but that in slightly later recipes the term is often used for varnishes made from nut or linseed oil and 'Greek pitch' (colophony), possibly with an addition of mastic resin. Merrifield 1849 (reprint 1999): cclxiv-v. Fioravanti 1566: 173, in an Italian *book of secrets* almost contemporary to Armenini, describes 'vernice commune' as consisting of linseed oil, Greek pitch and pine resin.
[220] *See* Phenix 1993 for more information on historical varnishes, Carlyle 1991 and 2001 for British nineteenth century varnish recipes and Stols-Witlox 2001 for information on Dutch recipes for final varnishes for oil painting between 1600 and 1900.

with paints that consists of linseed oil first sun treated and filtered and then heated with litharge, crystal (glass) and lead white.[221] Müller (c. 1750-1800) gives a recipe for an 'oil varnish which is called painter's varnish' that consists of linseed oil with siccatives litharge, minium and umber.[222] Next to these oil-and-siccative varnishes, varnishes consisting of resins dissolved in oil or in solvents are also described for use in painting.[223] Therefore it is not entirely certain that the painting varnish or painter's varnish consists of a drying oil.[224]

The composition of 'oak varnish', which appears in recipes in the Winsor & Newton Archive, varied. The archive contains a number of entries dealing with the preparation of oak varnish. The 1840s recipes for oak varnish call for anime, linseed oil and siccatives, while in some recipes additional ingredients appear, such as South American copal and colophony. However oak varnish is also made by mixing previously made varnishes with varnish deposits and with whatever useful materials are left from other processes, subsequently diluted with oil and thinned with turpentine. Recipes for oak varnish specify that ageing of the fresh varnish is required before use, in some recipes months or even years of ageing are described.[225]

Resin-containing binders are also encountered in a different ground layer formulation in a recipe from the Winsor & Newton archive (dated 1854). This recipe describes 'megilp' as the binder of a single ground pigmented with zinc oxide.[226] The composition of the megilp is given in another recipe in the same manuscript. It consists of beeswax, turpentine and 'double mastic varnish'. To prepare this 'megilp', the beeswax is melted with turpentine and mixed with the 'double mastic varnish'.[227] Carlyle (1991, 2001) provides a number of nineteenth century recipes for megilps of an entirely different nature, consisting of lead-

[221] Buonanni 1733: 86-8
[222] Müller c. 1750-1800 (transcribed in Lehmann 2002: 26-7)
[223] Stols-Witlox 2001
[224] *See* also Carlyle 1991 and Carlyle 2001 for British nineteenth century varnish recipes.
[225] Winsor and Newton's oak varnishes invariably contain anime resin, dissolved in linseed oil (which can be a mixture of 'clarified oil', 'mixing oil' and 'drying oil'), with the addition of siccatives (litharge and burnt copperas) and thinned with turpentine. (Compare for instance recipes in W&N manuscript 'Varnish 2': V2P097L01; V2P105L01; V2P178L01). According to a recipe in the 'Varnish 2' book, 'Mixing oil' is prepared by heating linseed oil with Copperas and Sugar of lead (V2P003L01). For 'Drying oil', some recipes used the oil prepared on page 148 of this manuscript. In this recipe, linseed oil is heated with burnt copperas and dried sugar of lead (V2P148L01). An addition of South American copal (S Amer copal') is described in (recipe date Feb 24 1852: V2P061L01), colophony in (recipe date May 30 1853: V2P233L01) and 'damar' in (May 20 1853: V2P217L01). A number of entries in the same recipe book describe the production of 'oak varnish' by mixing previously made varnishes (oak varnish and carriage varnish), varnish deposits ('varnish bottoms'), and/or 'returns' from other processes, with oil and turpentine as binder or thinner. These recipes are: V2P078L01 (April 8 1852); V2P175L01 (Oct 19 1852); V2P330L01 (8 December 1854); V2P459L01 (April 1857). A comparison between recipes for coach varnish and recipes for carriage varnishes in the 'Varnish 2' manuscript show that both terms are used interchangeably. Ingredients and preparation details do not differ (This becomes clear from a comparison between the previously mentioned recipes for oak varnish and the the following recipes for Carriage varnishes: V2P006L01 (23 December 1852); V2P023L01 (Jan 1st 1852), V2P029L01 (Jan 3rd 1852), V2P221L01 (May 21 1853). Remarks that accompany these recipes show that the varnishes need to rest for a number of months, sometimes years, before they are ready for sale. *See* for instance: V2P023L01, a carriage varnish prepared on January 1st and considered ready for use by April 8th 1852. In some instances, varnishes are kept even longer. The oak varnish prepared on May 20, 1853 (V2P217L01) is tested repeatedly. In May 1854 its quality is not ready: 'when dry went into rings & pinholes & did not dry sufficiently firm'. By May 1856 it is found 'rather stout'.
[226] W&N manuscript 'P.09'1844-93, recipe date 1854: 9PP017L01. The recipe refers to a recipe on page 14 of the notebook (recipe code 9PP014L16) for the composition of the megilp.
[227] W&N manuscript 'P.09' 1844-93: 9PP014L16. The recipe is titled: 'AHN's Meguilp'.

treated oil mixed with mastic varnish, shaken together to form a gel.[228] Such megilps differ significantly from the Winsor & Newton recipe, which does not contain any oil.
The term 'oil varnish' is used to describe binders that are very similar in composition, although not necessarily in proportion, to the oil and siccative based painter's varnishes as well as to 'fat oil' and 'boiled oil' binders, even to gold size. In a recipe provided by Hampel (1846), oil varnish is prepared by heating linseed or poppy oil with a siccative on a slow fire until the volume of the oil had been reduced to half. The suggested siccatives included litharge, lead acetate and zinc sulphate ('zinc vitriol'). As an alternative to heating on a coal fire, a dish filled with oil and siccatives can also be placed in the sun or close to a warm stove for eight to twelve weeks. Alternatively, a closed bottle can be placed in the sun for a number of months.[229]

'Retouching varnish' is mentioned by Vibert (1892) for use as an intermediary layer between ground layers. Vibert does not provide indications about the composition of this varnish. According to De Montabert (1829), retouching varnishes are employed to retouch and saturate areas of a painting that have sunk in.[230] He describes a number of older recipes for retouching varnishes that he has heard or read about. These varnishes are all very viscous and consist of oil and siccatives mixed with turpentine/resin varnish. In one of these recipes, wax is added. Although he describes them, De Montabert does not advise to use such retouching varnishes in painting. He is particularly concerned that the wax may yellow the colours.[231] Instead, De Montabert advises to rub copal varnish (copal in volatile oil) into the areas that have sunk in.[232] A somewhat later author, Tripier-Devaux (1845), advises to use a varnish containing copal and turpentine essence as a 'vernis à retoucher'.[233] Viscous, buttery materials similar to those described by De Montabert do however appear in later nineteenth century sources as well. Hampel (1846) describes 'Malbutter' or 'Retouchierbutter' ('painting butter' or 'retouching butter') to treat sunk in areas. It contains mastic, Venice turpentine, poppy oil, sugar-of-lead (lead acetate).[234] Sully in his manuscript also includes a recipe for a 'painter's butter', consisting of nut oil, mastic and lead acetate.[235]

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[228] Carlyle 1991 and 2001 describe a number of recipes in nineteenth century British manuals for the preparation of megilps. The most simple recipe consists of a mixture of oil treated with lead siccatives and of mastic varnish. Oil and varnish are shaken together until they form a gel. British sources advise different ratios of varnish to oil. Carlyle 1991, vol. 1: 143-6; Carlyle 2001: 101-6. Wax is not added to such megilps. Carlyle does describe a recipe for a 'megilp-like medium, known as 'Wilson's vehicle', where a mixture turpentine and sun-thickened linseed oil is thickened in the sun, after which melted beeswax is added. Carlyle 1991, vol. 1: 159; Carlyle 2001: 111. Carlyle describes other mixtures of wax, resin and oil, such as Italian varnish and Flanders medium. She also describes 'megilps' with other resins (copal and amber), but notes that there are only a few references. Carlyle 1991, vol. 1: 146-7, Carlyle 2001: 104-5.
[229] Hampel 1846: 127-8
[230] De Montabert 1829, vol. 9: 68: 'c'est surtout depuis la fin du dix-huitième siècle, époque où les peintres des grands sujets pensèrent à quitter la manière froide et monotone des coloriste précédens, qu'on fit usage de ces ressources et qu'on se servit d'un vernis particulier pour retoucher les peintures et pour aviver les embus. On appeal cette mixture vernis à retoucher'.
[231] De Montabert 1829, vol. 9: 69-71.
[232] De Montabert 1829, vol. 9: 72-3.
[233] Tripier-Deveaux 1845: 292-5. 4 kilo of 'copal 1/2 dur', 7 to 10 kilo of turpentine essence. The resin is first dissolved by heating, then the turpentine essence is gradually added.
[234] Hampel 1846: 62-3
[235] Sully 1809-71: 135-6. Sully points out the similarity between this material and the Gumtion ('Gumshon', as he spells it). Carlyle 1991, vol. 1: 149-154 and Carlyle 2001: 106-8 discusses British 19th century recipes

Besides references to varnishes, references to specific resins are also present in recipes for preparatory layers. Shellac appears for the first time in a preparation layer recipe by Dossie (1758). Without further treatment, shellac has a rather dark tone, which limits its uses. In the first half of the nineteenth century, improved methods for bleaching shellac are developed. Carlyle (1991, 2001) found that bleached lac becomes available in Britain after 1835.[236] Within the preparatory system, shellac is described both for use as a binder in ground layers, for use as a size layer and size layer addition, with ammonia (in the Winsor & Newton Archive).[237]

Copal varnish first appears in a 1798 recipe for a preparatory layer by Sheldrake.[238] De Montabert (1829) writes in a recipe for a preparatory layer for canvas that copal is very strong. He advises combining it with elemi resin, which he describes as supple.[239] The term copal in fact refers to a number of resins that come from *Caesalpinaceae* trees. Some are semi-fossile amber-like resins and others are fresh resins harvested straight from the tree. Copals have different properties and geographical origins, all are tropical or sub-tropical and are characterized by a relatively high melting point, high hardness and high resistance to solvents.[240]

Amber varnish, thinned with turpentine, is advised as a binding medium for a panel ground by Fernbach (1834), and the layer that results of its mixture with lead white and chalk is so hard that, according to the author, a knife cannot penetrate it.[241] Amber is a fossil resin that is found amongst others on the shores of Baltic sea, in Sicily and mined in some Central European mines.[242] As with the harder copals, it has a high melting point. For use in a varnish or binding medium, it is first melted or distilled.[243]

Nineteenth century recipes that advise employing copal and amber in preparatory layers appear at a time when the general interest in the use of fossil resins (copal and amber) in paint binders is growing. In their search for more permanent, non-yellowing paint materials, artists become interested in such varnishes as a partial replacement for the oil

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for gumption. Recipes for 'painter's cream' in Carlyle 1991, vol. 1: 173 and Carlyle 2001: 121 are probably similar to those for 'painter's butter'.

[236] Carlyle 1991, vol. 1: 122, 126, Carlyle 2001: 131-2.

[237] W&N manuscript 'Omnm Gath No 12', 1836-50: 12P039L17. The shellac is dissolved in ammonia. Shellac in ammonia is suggested as an addition to animal size in recipe 2P012L18 of the same manuscript, where the author wondered if it is a successful method to make the sizing insoluble in water.

[238] Copal varnishes are advised for a number of purposes in nineteenth century recipes. Carlyle 1991, vol. 1: 81-94 and Carlyle 2001: 124-9 describe their use as a binder, as addition to oil binders and as final varnishes. Also De Montabert advises varnish-based media. De Montabert 1829, vol 9: 395-409.

[239] De Montabert 1829, vol. 9: 163. De Montabert describes copal as 'très-ferme' and elemi as 'liante'. In another section of his treatise, he advises to use linseed oil with an addition of copal for 'strong tones' and elemi for 'very fresh' tones. De Montabert 1829, vol. 9: 408. This suggests that the copal varnish has a more pronounced tone than an elemi varnish.

[240] Cruypelans and Malaise 1990: 39-40.

[241] Fernbach 1834: 5-7

[242] Guineau 2005: 60. Amber varnishes are mentioned much earlier for other purposes. (Merrifield 1849, vol I, ccliv and further) discusses medieval recipes for amber varnish.

[243] Gettens and Stout 1966: 4. Carlyle 1991 and 2001 provide an overview of nineteenth century British recipes for amber-containing binding media and amber varnish recipes.

binder.[244] De Montabert (1829) believes that a paint medium that combines oil and copal has many advantages: paints do not sink in, dark colours dry as quickly as the light colours, the colours are more beautiful, there is hardly any alteration, the handling properties are good, and very transparent colours can be made at will by adding more binder.[245]

6.3.5 New binding media and binder additions in the nineteenth century

The increase in 'new' binders or binding medium additions in recipes from the second quarter of the nineteenth century onwards is striking. Besides some binders or additions described above, also casein, wax, egg and soap, as well as caoutchouc containing grounds all appear for the first time in recipes dating from the second quarter of the nineteenth century, as noted by Carlyle (1991, 2001). Copaiva balsam is introduced by De Montabert in 1829 for use as a varnish to prepare paper for oil painting and as an addition to a varnish bound ground layer for panel.[246] Liquorice extract is mentioned by the same author as an isolation and toning layer for white aqueous grounds.[247]

Judging by the large number of references in Appendix 15 for 'first use in preparatory layers', De Montabert's treatise (1829) can be identified as an important document for the introduction of new binders or binder additions in the second quarter of the nineteenth century.

Casein is also mentioned first as a ground binder by De Montabert.[248] It is advised both as the main binder and as an addition. Mérimée writes that if painters want to execute their underpainting with an aqueous binder, they need to add casein to their ground to reduce its absorbency to prevent it from dissolving during the underpainting stage.[249] Vergnaud (1831) gives a recipe for casein preparation: soft cheese made from skimmed milk is triturated and washed with hot water to remove soluble parts, compressed in a sieve or cloth to express the water. The resulting crumbly material is dried. Vergnaud explains that this material is not soluble in water but when adding lime and grinding the mixture, it becomes a viscous cream to which more water can be added, depending on the purpose.[250] Vibert's (1892) recipe for casein is different: it advises adding ammonia to white cheese. After stirring the cheese turns into a paste, and glycerine is added.[251]

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[244] *See* Carlyle 1991 and Carlyle 2001 on copal varnishes in British nineteenth century recipes and Carlyle 2004: 47-8 on the use of copal binding media by the Pre-Raphaelite painters. Mayer and Myers 2011 discuss the use of copal varnishes by American artists.

[245] De Montabert 1829, vol. 9: 408-9. Carlyle 1991, vol. 1: 176-7, Carlyle 2001: 123 writes that around 1800, some British sources consider varnish additions to the paint binder a suitable method to reduce the amount of oil within the paint layers with the goal of increasing the painting's durability.

[246] De Montabert 1829, vol. 9: 163.

[247] De Montabert 1829, vol. 9: 169. Liquorice is described as having been used for other purposes by American nineteenth century artists. Mayer and Myers 2011: 207.

[248] De Montabert 1829: 169-70. Here, De Montabert lists a number of binding media for canvas grounds that he has read about in different sources: quicklime in pigs blood, calcined oyster shells and fermented milk ('partie butieuse et calseuse du lait'), a mixture of egg white and quicklime and of egg white and linseed oil.

[249] Mérimée 1830: 249-50.

[250] Vergnaud 1831: 138-9. Vergnaud did not train as an artist but has a military background. Although no earlier source for this advice has been found, it is known that Vergnaud leans on earlier authors in other sections of his manuals. Cheese glue or casein is mentioned in relation to subsequent ground layers by Mérimée (1830) and Vibert (1892).

[251] Vibert 1892: 107.

De Montabert (1829) suggests egg white both as a binder for grounds and in an emulsion binder (with linseed oil)[252] and egg white is described as a plastifier for glue grounds by Field (1835).[253] A recipe in the *Technische Mitteilungen* (1892) concerns a recently patented binder that combines beaten egg white with animal glue. While this ground is introduced firstly for tempera and 'majolica' painting, it is advertised as suited to oil painting as well.[254]

Spermaceti wax is advised by De Montabert as an addition to a binder consisting of copal and caoutchouc dissolved in spike oil.[255] Spermaceti is a liquid wax present in the head of the sperm whale. Similar waxes are found in some other whale types, spermaceti is also found in the head of the Amazone river dolphin. Würsig and Thewissen (2002) describe spermaceti as 'similar to paraffin but not as hard'. Spermaceti wax consists of triglycerides and wax esters in some whale species combined with diacyl glyceryl esters. The exact proportion of the different consistutents varies with the age of the whale.[256]

India rubber or caoutchouc is first mentioned in a ground recipe in a manuscript from colourman Roberson (1831-c. 1840). India rubber is however associated with ground preparation as early as 1821 in an Italian source, the anonymous *Introduzione allo studio delle arti del disegno*. There it is explained that 'recently, imprimaturas have been made which contain a solution of 'gomma elastica'.[257] De Montabert describes the use of caoutchouc as a varnish for sketching paper.[258] Carlyle (1991, 2001) discusses the use of caoutchouc or natural rubber in nineteenth century Britain, where caoutchouc containing grounds are available in the 1840s.[259] Labreuche (2011) has investigated caoutchouc in grounds in Britain and France and writes that caoutchouc grounds were commercially available from c. 1835 to the 1850s. He stresses the link with the development of new waterproofing techniques for clothing that are based on the same material.[260] A manuscript from the Winsor & Newton archive dated 1824-44 records that the company is considering experiments with a mixture of India rubber and shellac for canvas

[252] De Montabert 1829, vol. 9: 167-8.
[253] Field 1835: 213.
[254] *Technische Mitteilungen*, nr. 162 (1893): 238. The recipe is patented by Alfons Freiherr von Pereira in December 1891.
[255] De Montabert 1829, vol. 9: 135
[256] Würsig and Thewissen 2002: 1163-4.
[257] *Introduzione* 1821: 157
[258] De Montabert 1829: 132-5. Carlyle (1991, 2001) and Mayer and Myers (2011) provide detailed descriptions of what is known about experiments with caoutchouc or natural rubber as an ingredient for preparatory layers . Carlyle 1991, vol. 1: 237-8, Carlyle 2001: 170, Mayer and Myers 2011: 118-9. Carlyle 1991 and 2001 also provided information on experiments for the use of caoutchouc or liquids distilled from caoutchouc as solvent or binder or binder addition. *See* Carlyle 1991, vol. 1: 90, 205, Carlyle 2001: 63, 122. Carlyle quotes a nineteenth century source (Muspratt c. 1860), who places the introduction of caoutchouc in Europe in the early eighteenth century but says that 'for a considerable period' its use is limited to 'erasing the streak of black-lead pencils on paper'. Muspratt c. 1860, vol. 1: 441 in Carlyle 1991, vol. 1: 223, note 35; Carlyle 2001: 136, note 38. Labreuche (2011) discusses French and English use of rubber in preparatory layers, based on actual paintings, patent literature and information from suppliers. Labreuche 2011.
[259] Carlyle 1991, vol. 1: 237-8; Carlyle 2001: 170-1. Byrne 1981: 47 reports on a canvas painting with a stamp at the back identifying the ground as an india rubber ground.
[260] Labreuche 2011: 14-30. Labreuche describes the availability of India rubber canvases, which were sold amongst others by Cowen & Waring, Winsor & Newton, Roberson & Co. A number of paintings executed on india rubber grounds are also described in his article.

preparation. This confirms their interest in this material within the period described by both Carlyle and Labreuche.[261] Mayer and Myers (2011) describe a note in an 1837 notebook of American artist John Neagle, which gives first-hand information on the experience of an artist with a canvas from Corven & Waring in London, prepared with a rubber ground. Apparently Neagle is dissatisfied. He writes that the painting 'had cracked most frightfully in the course of about four hours exposure to the sun'. Mayer and Myers mention that Sully and another American artist (Shaw) also tried out rubber grounds.[262]

Borax (this term refers to several sodium borates)[263] is also mentioned both as a plasticizer and as an emulsifier for ground binders.[264] In addition, it is cited as an ingredient in an experiment for a substitute for a glue size layer in the Winsor & Newton Archive, mixed with orange shellac and boiling water.[265]

Newly introduced materials in the later nineteenth century include milk, collodium and glycerine. Milk is first mentioned as a binder for preparatory layers by Thomas Sully (1809-71, 1873), who records his satisfaction with lead white and milk grounds. Carlyle notes the introduction of collodium (cellulose nitrate) through Church (1901),[266] but this research found an earlier mention, in a recipe for a ground for miniatures that appears in the Winsor & Newton manuscript '16' (1850-3) and in a recipe for painting with so-called 'powder-colours' and crayons.[267] Glycerine in the context of a preparatory layer ingredient appears for the first time in a recipe in the Winsor & Newton archive, dated 1874.[268] Earlier, Carlyle had noted that glycerine was discussed as a plasticizer for grounds by Church (1890) and Standage (1892), while according to a letter by the artist Frederick Leighton, he had experimented with its use in canvas grounds.[269]

The variation in materials mentioned in nineteenth century recipes is in accordance with earlier remarks on the innovative character of this period. However Appendix 15 makes it equally clear that while some authors discover the possibilities offered by 'new' materials and other innovations, more traditional recipes continue to appear alongside. While new binders are introduced, the more 'traditional' binding media do not seem to have been

[261] W&N manuscript 'P.2'1824-44: 02P014L03.
[262] Mayer and Myers 2011: 118.
[263] Guineau 2005: 154-5
[264] Borax was suggested together with shellac as an alternative size layer in the W&N manuscript 'P.09', 1844-93: 9PP016L01. An earlier reference in the Winsor and Newton Archive that discussed the possibility of Borax as a size layer material appeared in W&N manuscript '17' 1834-55: 17P032L10/17P033L10. The use of borax was described by Carlyle 1991, vol. 1: 169-172, Carlyle 2001: 118-121 as an ingredient in a number of emulsion binding media recipes for paint layers. Cruypelans and Malaise (1990) write that borax (disodium tetraborate) is a white powder or consists of white lumps that easily dissolve in hot water. They mention it use to render resins water soluble and its application in dissolving casein, and as a preservative to starch that speeds up its drying. Cruypelans and Malaise 1990: 105-6.
[265] W&N manuscript 'P.09. 1846-1854': 9PP016L01
[266] Carlyle 1991, vol. 1: 199, Carlyle 2001: 177. Colloidon is not mentioned in the 1890 edition of Church.
[267] W&N manuscript '16', 1850-3: 16P029L23. The recipe for collodium in a ground for painting with 'powder colours' and 'crayons' appears in W&N manuscript '24', 1856-62: 24P006L01.
[268] W&N manuscript 'P.04.1836- Private Copy of Processes. Vol 1st/ 1834-93, recipe date 1874: P04P110L01. It is an ingredient of a recipe for canvas prepared to order 'for photographic purposes'. According to Church (1915, quoted in Carlyle 2001: 182, note 19), Winsor and Newton had introduced glycerine in 1847 in moist watercolours.
[269] Carlyle 1991, vol. 1: 110, 176; Carlyle 2001: 156, 239

abandoned. Animal glue, flour, linseed oil, and walnut oil, all continue to be mentioned in nineteenth century recipes.

6.4 Materials employed for intermediary layers

Unpigmented intermediary layers are advised throughout the period under consideration, both in between ground layers and as a final layer of the preparatory system, between the preparation and the paint layers.

Throughout the period, animal glue is mentioned for use as intermediary layer. For instance the Ms BnF Fr 640 (c. 1580-1600)[270] advises to apply a layer of animal glue before a second oil-bound ground. De la Fontaine (1679) advises two coats of animal glue over a chalk and glue ground on panel, both before the application of a second oil-bound ground and to seal the chalk and glue layer when it was used as a single ground.[271] A recipe in the Winsor & Newton archive recipe book 'A relic of old times 1833. P.01' (183?-1876) describes a 'thin coat of fine clear parcht [parchment] size' as an isolation layer for a millboard ground 'to bind it'.[272]

Several authors advise brushing on a layer of oil to prepare the more absorbent grounds types for painting. For instance, Grandi's recipe for a flour paste ground (1806) includes the advice to brush on raw linseed oil or poppy oil[273] and De Montabert advises to apply a 'frottis d'huile' over a glue-bound canvas ground.[274] An 1886 recipe in *Technische Mitteilungen* advises a layer of shellac or thin layer of oil paint to a glue-bound ground before painting to prevent the subsequent layers from being underbound.[275] Mangold (*Technische Mitteilungen* 1895) advises to cover a chalk and glue ground with boiled linseed oil before painting to make painting easier.[276] The modification of absorbent grounds is discussed in more detail in Paragraph 10.5.5.

Resinous varnish was also employed as an intermediary isolation layer according to two nineteenth century recipes. A Danish magazine for artists and craftsmen, the *Nyt magazin for kunstnere og haandværkere* (1838) advises a varnish isolation layer, either copal and colophony-based or amber-based, over a linseed oil (with litharge) bound ground that contains slaked chalk or slaked pipe clay mixed with ochre, umber or cologne earth.[277] Vibert (1892) describes an intermediary layer of 'retouching varnish' between casein-bound zinc white ground layers.[278]

[270] BnF Ms. Fr 640 c. 1580-1600: 57 perso 115.
[271] De la Fontaine 1679, seconde partie: 27-8
[272] W&N manuscript 'A relic of old times 1833 . P.01', 183?-1876: REP043L08.
[273] *Transactions* 1806: 85-9.
[274] De Montabert 1829, vol. 9: 158.
[275] *Technische Mitteilungen*, nr 25 (1886): 39.
[276] *Technische Mitteilungen*, nr. 20 (1895): 1-2.
[277] Ursin and Hummel 1838: 261-2 (ground recipe), 210-3 (varnish recipes). The varnishes are made from litharge treated linseed oil, to which copal and colophony are added, or melted amber. Both varnish types are prepared by heating the resins with the oil until dissolved.
[278] Vibert 1892: 186-8, 107-8.

As demonstrated in Chapter 5, during the nineteenth century new materials are introduced as isolation or toning layers. De Montabert (1829) advises liquorice sugar ('sucre noir de réglisse') both to seal and tone white glue-bound grounds and considers this material as beneficial for the adhesion of subsequent layers.[279] Although liquorice does not feature in any other European recipe for ground preparation, its use as a pigment in glazes is mentioned in the historical documents related to nineteenth century British and American painting techniques, which are discussed by Carlyle (1999, 2001) and Mayer and Myers (2011).[280]

6.5 Preparatory layers in alternative painting methods (wax painting, the Kingstonian system and emulsion painting)

Although not entirely within the subject area of a dissertation which focuses on oil painting, mention should also be made of alternatives to oil binders that were 'invented' and described in historical recipe books during the period, since they employ or introduce materials in preparatory layers that also find use in preparatory layers for oil painting.

The first of these methods is painting with melted wax, described in the very popular treatise by the Comte de Caylus and Majault (1755),[281] which is quoted in a number of nineteenth century British sources during the first years of the century, as can be read in Carlyle (1991, 2001).[282] For wax painting, De Caylus and Majault advise to paint on bare wood. Canvas can be prepared with two layers of wax dissolved in turpentine oil, to which some varnish may be added. After both coats have dried, the canvas is heated from behind so the wax melts and saturates the canvas. Alternatively, the bare canvas can be heated until it is so hot that as wax is applied to its surface, it will melt into the canvas surface. Copper and stone are prepared with a number of layers similar to the layers applied to canvas.[283]

Around 1800, Dutch author Horstok (c. 1800) publishes the results of his experiments to design a water thinneable oil paint system, which he calls the 'Momverw' (literally translated: 'disguised paint'). His process, which is nothing more than the preparation of an emulsion, consists of grinding pigments with egg and adding linseed or poppy oil on the palette. If wished for, a little gum can be added to the egg.[284]
Horstok's treatise includes a section on panel grounds, which calls for the same egg and oil emulsion paint. The first ground layer is pigmented with lead white and the second ground

[279] De Montabert 1829, vol. 9: 169.
[280] (Carlyle 1991, vol. 1: 345, Carlyle 2001: 252, note 27), quotes Whitley who in 1928 recounts that 'Alexis Delahante' an art dealer, applied 'a temporary glaze of Spanish liquorice mixed with oxgall' over an old oil painting. American Artist William Sidney Mount, who had an interest in spiritualism, received two letters that are apparently transcripts of 'letters sent by the spirit of Rembrandt'. In one of these letters, 'Rembrandt' advises a brown glaze with 'finely powdered Spanish liquorice' (quotation from the original letter, reproduced in Frankenstein 1975: 285-97.) Mayer and Myers (2011) mention that liquorice, according to Dunlap's *History of the rise and progress of the arts of design in the United States* (1834), was used by American painters Benjamin West and Richard Wilson. Mayer and Myers 2011: 207.
[281] Caylus and Majault, *Mémoire sur l'encaustique*…, Paris 1755. *See* Massing 1995: 25
[282] Carlyle 1991, vol. 1: and Carlyle 2001: 116-7.
[283] Caylus and Majault 1755: 121-7.
[284] Horstok, J.P. van, *Bericht wegens de uitvinding om de gewoonelyke olyverw couleuren zodanig te vermommen, dat zy met water vermengbaar zyn, alsmede* ..., Haarlem, ca. 1800: 9-11.

layer can be pigmented according to the wishes of the artist. The ground is smoothed with a duck's feather and a thin layer of linseed oil is brushed over the dried ground.[285]

Another nineteenth century alternative to oil paint, which is described by Carlyle (1991, 2001), is the *Kingstonian system of painting in dry colours*, published in 1835. Dry pigments are used to create an image on a granulated ground and are then fixed with varnish.[286] Kingston's ground consists of a layer of lead white in nut oil or poppy oil with the addition of a siccative (lead acetate). While this layer is wet, marble powder is sprinkled on, thus creating a textured surface. According to Kingston's advertisement regarding commercially available boards prepared according to his system, they are 'applicable also for oil, water, chalk, and crayon'.[287]

6.6 Concluding remarks

This chapter has demonstrated how by combining historical information with descriptions of materials in modern literature, a more complete image of the materials can be obtained.
The entries on different materials demonstrate that terminology can be complicated or vague, as is the case for the pigment 'brown red'. Name changes confirm the need for detailed investigations of recipes from a larger collection of historical sources and for background research involving other types of sources.
Besides identifying changes in the meaning of certain names, the present chapter showed that some terms used for materials employed in preparatory layers relate to a whole range of materials. Examples of this are 'turpentine' and 'bole'. Both terms according to the modern literature refer to a well-defined material, while historical sources demonstrate that they knew a wider application.

By placing the ingredients in chronological order depending on their first mention in a recipe for a preparatory layer, the explosive growth in binders that took place in the nineteenth century and the (less extreme) expansion in the use of pigments or fillers became evident. While Carlyle (1991, 2001) already comments on the large range of materials described in nineteenth century British manuals, the comparison of this range of materials with materials advised in earlier sources, confirms the uniqueness of this time period in that respect. What is clear from Appendix 15 is the fact that the introduction of new materials in the nineteenth century does not lead to the complete abandonment of traditional materials and procedures. They continue to be mentioned until the end of the period. Another interesting observation from Appendix 15 is the fact that some ingredients appear in recipes for preparatory layers only centuries after their use in painting is first documented, as is the case for instance with turpentine oil/balsam or spike oil. The appearance of materials in descriptions of preparatory layers apparently does not necessarily correlate closely to their discovery or first synthesis.

Descriptions of the procedures and ingredients employed in the preparation of binders that are advised in recipes for preparatory layers reveal that researchers must be aware of

[285] Horstok c. 1800: 19-21.
[286] Kingston 1835: 3-4.
[287] Kingston 1835: 2.

the possible presence of ‘hidden ingredients’, materials that are not mentioned in the recipe for the preparatory layer itself but are present because of pre-processing or preparation of an ingredient prior to its use in a preparatory layer recipe. The ground preparation recipes in the Winsor & Newton Archive clearly demonstrate this, as they contain different ingredients depending on the ‘varnish bottoms’ that were available on the factory floor.