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The Structural Conservation of Panel Paintings

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Historical Overview of Panel-Making Techniques in the Northern Countries

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Through manuscripts, as well as through documentation and research in conservation studios, the methods used by old master panel makers to manufacture panels used as painting supports have become much clearer. The guild rules that have been preserved are also an important source of information to the extent that they mention points applicable to the joiners or panel makers (Miedema 1980).

In Antwerp, the earliest documents from the guild of Saint Luke date to the last quarter of the fourteenth century, with the first regulations dated 1442 (Van Der Straelen 1855). The guild comprised not only painters but many members of the various crafts related to art production, including lace makers, instrument makers, and panel makers (Miedema 1980; Rombouts and Van Lerius 1864–76). Joiners were not members of the guild of Saint Luke in Antwerp, but panel makers were. Both groups made panels, but for different purposes. The sculptors had the specialized boxmakers (box makers) make boxes and panels for their retables; however, joiners were also allowed to make panels. When the production of altars began to slow down in the sixteenth century, the box makers began making panels on a larger scale. Thus, the box makers actually became the new generation of panel makers. During the seventeenth century, when canvas became the preferred support for paintings and the demand for panels decreased, panel making again shifted, this time to the frame makers. During the same time period, frames developed increasingly sophisticated profiles and elaborate carvings, a development that demanded a separate association of frame makers (van Thiel and de Bruijn Kops 1995). Aside from producing frames, these frame makers continued making panels for painters who preferred this rigid support.

In Germany quality control had already been introduced in the late Gothic period. In Munich the regulations of 1424 stated that four representatives from the guild of cabinetmakers were to control all panels made by fellow cabinet and panel makers (Hellweg 1924). Any irregularities were to be reported to the head of the guild, and the panel maker was to be punished accordingly.

However, as the guild rules and the relationships among the different crafts varied from town to town, a comparison is difficult (Verougstraete-Marcq and Van Schoute 1989; Dunkerton et al. 1991).
The artists would often use wood native to their region. Albrecht Dürer (1471–1528), for example, painted on poplar when he was in Venice and on oak when in the Netherlands and southern Germany. Leonardo da Vinci (1452–1519) used oak for his paintings in France (Nicolaus 1986); Hans Baldung (1484/5–1545) and Hans Holbein (1497/8–1543) used oak while working in southern Germany and England, respectively (Fletcher and Cholmondley Tapper 1983). In the Middle Ages, spruce and lime were used in the Upper Rhine and often in Bavaria. Outside of the Rhineland, softwood (such as pinewood) was mainly used. A group of twenty Norwegian altar frontals from the Gothic period (1250–1350) were examined, and it was found that fourteen were made of fir, two of oak, and four of pine (Kaland 1982). Large altars made in Denmark during the fifteenth century used oak for the figures as well as for the painted wing panels (Skov and Thomsen 1982).

Lime was popular with Albrecht Altdorfer (ca. 1480–1538), Baldung Grien, Christoph Amberger (d. 1562), Dürer, and Lucas Cranach the Elder (1472–1553). Cranach often used beech wood—an unusual choice. In northern Europe, poplar is very rarely found, but walnut and chestnut are not uncommon. In the northeast and south, coniferous trees such as spruce, fir, and pine have been used (Klein 1989). Fir wood is shown to have been used in the Upper and Middle Rhine, Augsburg, Nuremberg, and Saxony. Pinewood was used mainly in Tirol and beech wood only in Sachen.

In general, oak was the most common substrate used for panel making in the Low Countries (Peres 1988), northern Germany, and the Rhineland around Cologne.

In France, until the seventeenth century, most panels were made from oak, although a few made of walnut and poplar have been found. The oak favored as a support by the painters of the northern school was, however, not always of local origin. In the seventeenth century about four thousand full-grown oak trees were needed to build a medium-sized merchant ship; thus, imported wood was necessary (Olechnowitz 1960). In recent years dendrochronological studies have traced the enormous exportation of oak from the Baltic region to the Hansa towns. This exportation lasted from the Middle Ages until the end of the Thirty Years War (Klein 1989). Oak coming from Königsberg (as well as Gdansk) was, therefore, often referred to as Cominberg tenvoethout (10-ft., or 280 cm, planks) (Fig. 1) (Sosson 1977; Ważny 1992; Bonde 1992). The longest planks available on the market (12 ft., or 340 cm) were used by Peter Paul Rubens (1577–1640) for his Elevation of the Cross in the Antwerp Cathedral (Verougstraete Marcq and Van Schoute 1989; D’Hulst et al. 1992; Verhoeff 1983). Karel van Mander (1548–1606) was aware that oak was being imported by ship from the North Sea, although he thought it came from Norway. The ships did come to the Netherlands from the north, after passing the Sound, the strait that now divides Denmark from Sweden, on their way from the Baltic. However, the Sound-dues records show that in 1565, 83% of the ships carrying wainscots set out from Gdansk (Ważny and Eckstein 1987).

In the last decade of the seventeenth century, Wilhelmus Beurs, a Dutch writer on painting techniques, considered oak to be the most useful wooden substrate on which to paint. Beurs reported that not all wood is favorable for panels, "and what was used by the old masters who had very durable panels, then we today can say, so much seems to be known, that we can use good oak wood" (Beurs 1692). If possible, smaller paintings
Figure 1
Vistula River basin with the main sources of wood (marked by dots). Political borders are those of the first half of the fifteenth century.

should be of only a single plank free from sapwood. The text of Beurs implicitly suggests that the use of other wood species would probably have been experimental in nature.

This recommendation for using oak is in accordance with practice. However, exceptions are seen rather early in the seventeenth century; sometimes walnut, pearwood, cedarwood, or Indian wood were used instead. Mahogany was already in use by a number of painters during the first decades of the seventeenth century and was used often in the Netherlands in the nineteenth century. Even so, when canvas or copper was not used, the main oeuvre of the northern school was painted on oak panels.

Quality of Wood

The quality of an oak panel can be seen from its grain. If the medullary rays in an oak panel are visible, the quality should be good, because this shows that the plank was radially split or cut out of the tree trunk (Fig. 2). The density of the wood is also important to the quality. Before 1630-40 the year rings (whose formation depends on age, physical location, and climatological factors) are often found to be narrower than those of oak trees available after this date.

In the sixteenth century sapwood is rarely seen on panels, but in the seventeenth century a narrow edge of it is often recognized on one side—in violation of guild rules that threatened a fine for the use of sap wood (Van Der Straalen 1855). However, as panels inspected by the guild keurmeesters (assay masters/inspectors) also show faults in the wood, this may well be a consequence of the higher price of wood during the politically turbulent years in the beginning of the seventeenth century; or perhaps there was such a high demand for panels that less control was exercised over their production.
Sometimes oak shows the signs of insect attack in a light area in the middle of a plank. This light part of the wood is called a Mondring, and it consists of sapwood that has not transformed itself into hardwood. This phenomenon is due to an incomplete enzymatic reaction in the wood tissue, usually caused by strong frost (Fig. 3).

Splitting the timber was the usual method for obtaining radial planks of good quality, and this procedure was used by Dutch and German artisans until the sixteenth century, when the sawmill became standard for cutting large planks (Tangeberg 1986). The saw, which was known in classical times but forgotten until rediscovery in the fourteenth century, was mainly used from the fifteenth century onward. Later the wood was further treated with axes and scraping irons. The wood plane was also known to the Romans, but planing of panels did not become common until the fourteenth century (Fig. 4).

In some cases a wedge-shaped plank would be used directly; in other cases, it would be planed down. The planing would often be per-
HISTORICAL OVERVIEW OF PANEL-MAKING TECHNIQUES IN THE NORTHERN COUNTRIES

Figure 4
Gillis Mostaert, A Landscape with Christ Healing the Blind Man, ca. 1610. Oil on panel, 35.5 × 93 cm. Woodworkers cutting trunks with different types of saws. To the right, planks are stacked for seasoning.

Figure 1a–d
Toolmarks on the backs of panels: (a) After joining, the panel has been partially thinned by a roughening plane. The untreated areas in the lower right and upper middle show the surface created when the wood was split into planks. (b) Three planks, all showing saw marks from a hand-held saw, giving the surface a slightly (here, horizontally) wavy surface; thicker parts were planed down with a narrower roughening plane. (c) Pits a broad plane, with two dents in the blade clearly visible on the wood, and later a narrow plane were used to thin the planks down; remains of the saw marks are still visible in the center. (d) Three planks having been treated transversely to the grain, after having been previously treated as in Fig. 5c.

formed after the gluing of the separate planks (Fig. 5a). Plane marks crossing the joins were very common in sixteenth- and seventeenth-century planks. Tools used for this work were planes, scrapers, and, in rare instances, small axes (Marette 1961).

The toolmarks on the backs of panels constructed of multiple planks do not always reveal the same treatment. One plank, for instance, might show saw marks, where other planks on the same panel show either the use of a plane or an ax (Fig. 5b–d). The plane would often have a dent in the blade that created a ridge. These ridges have, in some instances, established that the same plane was used on different panels, which then
could be attributed to the same panel maker (Christie and Wadum 1992; Wadum 1988). Tools for carpentry dating from the seventeenth century are not particularly rare, but Skokloster Castle in Sweden houses more than two hundred planes, axes, and gouges produced in Amsterdam around 1664; they are in excellent condition (Knutsson and Kylsberg 1985).

The guild rules emphasized that the wood used in the construction of panels should be well seasoned. Seasoning the wood is very important for its stability. Wood shrinks during drying, and it may warp or show diagonal distortions if seasoning is not completed before the thinner planks are made ready for joining.

Based on dendrochronological studies, we have been able to estimate that the seasoning period in the sixteenth and seventeenth centuries was approximately two to five years, whereas it was eight to ten years in the fifteenth century (Fletcher 1984; Klein et al. 1987). The regulations of the Antwerp guild of Saint Luke were very specific about manufacture of panels for altars, wings, and smaller paintings. In 1470 a set of standards was issued stating that all altar cases and panels should be made of dry wagenschoot and that no painter was allowed to paint on either sculpture or panel if the wood was not dry (Van Der Straelen 1855).

Gothic altar frontals in Norway were, on average, approximately 20 mm thick. The planks were aligned (but not glued) in the join by wooden dowels 100–150 mm long and 10–15 mm thick. The joints of the planks were secured by parchment or canvas strips before a relatively thick (1–4 mm) ground was applied (Kaland 1982).

When more oak planks were joined together to form a large panel, planks could vary in width, although they were usually 25–29 cm wide. The panels were usually 8–30 mm thick. Panels from the fifteenth and sixteenth centuries tend to be thicker than those from the seventeenth century (Nicolaus 1986).

Planks of varying thickness were joined and then planed. In other cases, the backs were left uneven. Traditionally, when two or more planks were glued together, heartwood was joined with heartwood, and sapwood with sapwood (Klein 1984). The planks were usually joined in such a way that the heartwood was on the outer edges. Smaller panels consisting of two planks glued together sometimes show the remains of the lighter colored sapwood in the center of the panel (Fig. 6). This arrangement may have created problems because the remains of the weaker sapwood could cause joins to break open, and the softer sapwood would attract insects, whose infestation would be further stimulated by the animal glue used for the join.

Planks were joined in various ways (Fig. 7a–h). The majority of planks were butt-joined (Fig. 7a). Some planks would have the two edges roughened to make a better tooth to receive the animal glue (Fig. 7b). Butterfly, or double-dovetail, keys and dowels were commonly applied for reinforcement. In the Middle Ages, the panels were glued and further reinforced with butterfly keys (Fig. 7c). If butterfly keys were used, they were placed mainly on the front of the panel, and with time they often began to show through the paint layer (Fig. 8). Butterfly keys on the backs of panels were usually later additions. As panels became thinner toward the end of the sixteenth century, dowels replaced the butterfly keys for stabilizing and aligning the joints during gluing (Fig. 7d). On X radiographs the dowels...
and dowel holes can easily be traced, revealing the differences in method between one panel maker and another (Vadum 1987). In small panels (48 x 63 cm) consisting of two planks, two dowels would normally be placed in the join, whereas larger panels (75 x 110 cm) made of three planks would have three dowels in each join. Smaller panels (50 x 60 cm) made for portraits were sometimes composed of three planks—the middle one wide and the two at the edges much narrower—so that there would be no join down the middle of the panel that might run through the subject’s face.

Lip joins and tongue-and-groove joins do occur in some instances: the wedge-shaped joins are rarer (Fig. 7e–g). Additions on a panel made by Michiel Vrient for Peter Paul Rubens show a refined Z-shaped chamfered join (Figs. 7h, 9). This type of join was used to make a large overlap for better adhesion when the grain of the added plank ran transversely in

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**Figure 7a–h**

Different types of joinery of planks: (a) butt join, (b) butt join with previous roughening of the surface for better adhesion, (c) butt join reinforced with butterfly keys on the front, (d) butt join aligned with dowels, (e) lip join, (f) tongue-and-groove join, (g) wedge-shaped join, (h) Z-shaped chamfered join (mainly used where planks with transverse grain are assembled).

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**Figure 8**

Maarten van Heemskerck. The Resurrection of Christ, ca. 1550. Detail. Oil on panel, 172 x 131 cm. Department of Conservation, Statens Museum for Kunst, Copenhagen. Original butterfly keys on the front of a panel (see Fig. 7c) show through the paint layer.
The panel maker was obviously aware that the joining of boards with the grain running perpendicular to each other would cause instability—something the conservation history of the panels confirms only too well. The south German Benedictine monk Theophilus (ca. 1100) describes the process of making panels for altars and wings (Theophilus 1979). The individual pieces for altar and door panels are first carefully matched with the shaping tool that is also used by cask and barrel makers. The pieces are then affixed with casein. Once the joined panels are dry, Theophilus writes, they adhere together so well that they cannot be separated by dampness or heat. Afterward the panels should be smoothed with a planing tool such as a drawknife. Panels, doors, and shields should be shaved until they are completely smooth. Then they should be covered with the hide of a horse, an ass, or a cow (Fig. 10). On some altar frontals in Norway, several of the cracks in the wood of the panel were filled with parchment prior to application of the ground (Wichström 1982).

If the panel maker lacked hide, panels might be covered with a new medium-weight cloth, with glue made from hide and staghorns (Cennini 1971:chap. 19).
The method of applying linen to the panels was also used by panel makers of the northern countries, as in a large (28 m²) painted fir wood lectern (1230–1300) in Torpo, Norway, in which the joins were glued and covered with canvas prior to the application of size and ground (Brenne 1982).

In Germany canvas was also applied to panels. The Adoration of the Magi by Stefan Lochner (active 1442–51) in the cathedral of Cologne has two wings and a main panel made of oak wood (Schultze-Senger 1988). The butt ends of the single planks (2.5 cm thick) have been glued together (Verougstraete-Marcq and Van Schoute 1989). The completed panels—on what was to become the inside of the wings and the front of the middle panel—were then completely covered with canvas. In 1568 Vasari described this method in some detail (Berger 1901:26). A rather thick (1.5 mm or more) ground was used, which became somewhat thinner on the outside of the wings. Applying ground and paint on both sides of the wings naturally reduced movement in the wood.

The joins, knots, and resinous areas of softwood panels were continuously covered with strips of canvas. In the fifteenth century Danish cabinetmakers used the same procedure—joins and knots were covered with pieces of coarse canvas before sizing with a strong glue (Skov and Thomsen 1982).

The method of securing joins by applying parchment and gluing horse or cow hair transversely to the join, while used mainly in the fifteenth and sixteenth centuries, also continued in the first quarter of the seventeenth century (Sonnenburg and Preusser 1979). The use of canvas as a reinforcing material for panels is documented into the seventeenth century.20 The Last Judgment by Lucas van Leyden (1494–1533) was painted around 1526–27. The triptych consists of a center panel, with an unpainted back, and two wings, which are painted on both sides. All three panels are constructed of vertical oak planks glued flush and secured with wooden dowels placed at regular intervals (Fig. 11). The back of the center panel shows planks worked rather roughly with a curved spokeshave. The panels...
were not glued but instead were fitted into a groove in the frames. The center panel has a rabbet around the edge on the back that enhances the join with the frame. Four horizontal battens, all fastened with wooden pins, hold the center panel in place in the frame.

Although the altar was made in Leiden, it appears that the Antwerp regulations were applicable to its construction. The rule for Antwerp altars more than 2 m high required the back to be secured by transverse battens—one at the neck, with more behind the main corpus (Van Der Straelen 1855). The whole construction would have its original greenish gray paint layer (probably original) on the back. Analysis has revealed lead white and carbon black in an oleaginous binding medium. Translucent particles (glue) were also present. It can be seen that frames and panels were all grounded in one sequence. A burr is visible along the edges of the panels, where they have been shrinking slightly (Hermesdorf et al. 1979).

Some of Rubens's panels present a particular problem: that of enlargement with odd planks on more than one side (Sonnenburg and Preusser 1979). Sometimes the grain of these additional planks ran perpendicular to the grain of the other planks, making the composite panels especially vulnerable to fluctuating environmental conditions (Brown, Reeve, and Wyld 1982). In The Watering Place by Rubens, the grain of ten out of eleven planks runs horizontally. The construction of the panel took place in four successive stages, starting from a standard-sized panel of 35.9 x 56.7 cm (Fig. 12a, b). This panel was extended with additions of oak planks all having the same grain orientation, except for the final plank on the right side, which has a vertical grain. It was likely not possible to find a plank with a horizontal grain of the same height as the panels (approximately 1 m) (Brown 1996). The joins between the planks are butt

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**Figure 12a (right), b (opposite page)**

Construction of the panel used by Peter Paul Rubens for The Watering Place, ca. 1620. Oil on panel, 99.4 x 135 cm, National Gallery, London. The sequence of added planks (a) is indicated by the numbering, and the direction of the grain is indicated by the arrows. The joints are all butt joints, except for the join of plank 10, the only plank with vertically oriented grain. Here the planks are assembled with the Z-shaped chamfered join (see Fig. 7). The front of the painting (b) is also shown.
joins, except for that of the large vertical plank, which has a chamfered 3–5 cm overlap. Such additions were often done by professionals (Kombouts and Van Lerius 1864–76). On X radiographs these additions appear to have been made after Rubens began his composition (Poll-Frommel, Renger, and Schmidt 1993)—toolmarks beneath the latest paint layer are observed (Sonnenburg and Preusser 1979).

In the northern Netherlands we see that Rembrandt’s panels from the Leiden period are all on oak. The grain always runs parallel to the length of the panels, and joins are always butt joins (van de Wetering 1986). The panel makers in Leiden belonged to the joiners and cabinet-makers guild but are not mentioned in the guild regulations until 1627. At that time the joiners and cabinetmakers requested that the Leiden guild specify them as the producers of these panels. This request was made because a certain woodturner—not a guild member—was making and selling panels, and the joiners wanted him stopped (van de Wetering 1986).

The tradition of the Netherlandish school of the seventeenth century was applied to the French methods of the eighteenth century (Berger 1901:416). Studies of English panels show that up to about 1540, many are of crude workmanship and often have uneven joins (Fletcher 1984). However, in 1692 Marshall Smith recommended the use of old wainscot for panels because it was less likely to warp (Talley 1981).
Smaller panels used for easel painting were often made in standard sizes. By the fifteenth century, altars had already been standardized (Jacobs 1989), and in the late sixteenth century, standardization was then further applied to panels made for use as painting supports (Bruijn 1979). Naturally, this standardization also became the rule for canvases (van de Wetering 1986).

The use of standard sizes for panels has been questioned (Miedema 1981); however, it has become clear that this was indeed the case for dozijn panels—made by the dozen (Van Damme 1990). The term has erroneously been understood by some as an evaluation of the artistic quality: it was thought that paintings on dozijn panels were made by mediocre painters for trade on the year markets (Floerke 1905).

The standard sizes may also have varied between towns rather than between individual panel makers.24 The inventory made after the death of Frans Francken I in 1616 records nineteen tronit-sized (portrait) panels and forty-nine smaller, stooter-sized (a designation referring to a seventeenth-century coin) panels in one of his rooms (Duverger 1984). The fact that the standard sizes were also evident in the north is shown in the inventory of Jan Miense Molenaer (1610–68), which indicates that he had twenty-six single-plank panels of one size and thirty-two of a slightly larger size (van de Wetering 1986). Standard sizes are still commonly available for painters—nowadays they are called landscape, marine, or portrait sizes.

Frans Hals (1589–1666) also used standard-sized panels for many of his portraits. Hals bought panels made by members of the joiners guild in Haarlem; almost all his panels consist of a single plank (Groen and Hendriks 1989).

In prints or paintings depicting a painter’s atelier, frames for temporary use are often seen on the short sides (perpendicular to the grain) of a panel (Fig. 13). On panels from the fifteenth and sixteenth centuries, at the sides of the panel, one can see a small tongue that would fit into the grooves of such a temporary frame.

Panels from the fourteenth and fifteenth centuries were constructed with a fixed frame. The ground was applied at the same time to the frame and the panel, the two forming an inseparable ensemble (Dunkerton et al. 1991). If the temporary frame that was originally fixed at the short end of a panel or the full frame were removed, one would find a small beard of ground indicating the former presence of a fixed frame (Fig. 14a–d).

Frames in Antwerp were also made of beech wood—but only inner frames, in accordance with guild regulations. Additionally, for altar panels or other large works, the panel makers were never to use beech wood, only oak.25 Original frames from the early seventeenth century are rare, but in Rosenborg Castle, Copenhagen, more than fifty are still preserved (Wadum 1988).

Beveling at the edges of a panel, often down to a few millimeters, makes it thinner and therefore easier to mount in a frame. If a panel has been reduced in size, part or all of such beveling has been removed. On small single-plank panels, however, beveling may be visible only on three sides, because when a plank is split out of a tree trunk, a wedge shape is automatically formed, so that beveling at the pointed edge is often unnecessary.
Among the hundreds of items found in the inventory made after the death of the widow of panel and frame maker Hans van Haecht (1557–1621) are thirty-six eight-stuivers-sized (another seventeenth-century coin) double frames in a storage room, sixty-eight more of the same size in the attic, and two dozen small ebony frames (Duverger 1987; Van Roey 1968).

Members of the various disciplines within the guild of Saint Luke manufactured articles such as frames that would fit the standard panels (Wadum 1988; van Thiel and de Bruijn Kops 1995). Standard frames were also constructed with a groove in which the beveled edge would fit—a method that originated with the large altar panels. The beveled edges, often varying slightly in thickness, were kept tight in the frame by means of wedges (sometimes secured by glue) placed at regular intervals on the back (Figs 14c, 15). Frames were also made with a rabbet so panels could...
A panel framed in Antwerp in 1620, with the method shown in Fig. 14c. The double frame consists of a narrow beech wood frame that is itself fitted into an oak frame; the tongue-and-groove principle is followed throughout. Royal Danish Collection, Rosenborg Palace, Copenhagen.

Figure 16
A panel framed in Antwerp in 1620, with the method shown in Fig. 14d. Beech wood has been used for the narrow frame; all is mounted in rabbets and held in place by handmade iron nails. Royal Danish Collection, Rosenborg Palace, Copenhagen.

be mounted with iron nails, an easy method of framing, as the frame itself could have been assembled before the panel was fitted into it (Figs. 14d, 16) (Wadum 1988; Verougstraete-Marcq and Van Schoute 1989).

Mainly on the back of Brabant panels, one can sometimes see lines cut with a gouge that cross one another, creating a pattern of complicated marks. It is interesting to note that these marks do not continue across joins between two planks. It has been suggested that the marks may have been made by timber tradesmen or made as a sort of quality mark for wood in stock (Marijnissen and Michalski 1960). It was also most convincingly suggested that the large planks may have been marked by the lumberjacks in the Baltic area (Glatigny 1993). The planks with such marks never have saw marks—a phenomenon showing that the planks were all split from tree trunks.

All the panels with longitudinal cut marks, found in altars or on panel paintings, seem to have been made between the end of the fifteenth century and the last quarter of the sixteenth century (Fig. 17). Most of the panels with these marks were used by painters in Brabant, Antwerp, Bruges, Brussels, or Louvain; however, a number of north German altars also have these cut marks (Tangeberg 1986). Such cut marks are to be expected on panels used in other regions in northern Europe, if the wood originated in the Baltic area where it was marked before shipment to the Hansa towns for further manufacturing.

In the early seventeenth century, when an Antwerp panel or frame maker had a large number of panels ready in his workshop, he would call for the dean, who would then pay a visit to the panel maker and check the quality of his panels (Fig. 18). If, however, the panel maker had only a few
Historical Overview of Panel-Making Techniques in the Northern Countries

Figure 18
David Ryckaert II (1586–1642), A Painter’s Atelier. Oil on panel, 74 × 108 cm. Musée des Beaux-Arts, Dijon. The Antwerp branding mark (upside down) appears on the reverse of the small panel leaning against the back wall.

If the panels had no worms, rot, or sapwood, they were accepted and branded with the hands and castle, the Antwerp coat of arms (Van Damme 1990; Wadum 1997). If, however, any faults in the wood were observed, it was the dean’s duty to break the defective panel without any intervention from the panel maker or assistant (Van Damme 1990). (There are, nevertheless, numerous examples of approved panels that did have faults.) After approval and branding of the panels, the panel maker would stamp his own personal mark into the wood (Van Damme 1990). It appears that not all panel makers’ marks were stamped into the wood; some were also written in red chalk directly on the board. These inscriptions are often overlooked. Yet they can be seen when the backs of panels are viewed in ultraviolet light (Fig. 19a, b) (Wadum 1990).

Figure 19a–b
The same panel back photographed in normal (a) and in UV-fluorescent (b) light. The UV-fluorescent light reveals the panel maker’s check marks, the number of the panel and frame (no. 68), and the personal mark (GA in ligature), just below the join and as a fragment on the left side of the frame. The identification of the panel maker, Guilliam Aertsse, and his different inscriptions are made visible only by UV-fluorescence photography. Royal Danish Collection, Rosenberg Palace, Copenhagen.
Brandling of panels generally took place before the ground was applied. This can be illustrated in two particular incidents, where in both cases the ground for one reason or another was applied on the same side of the panel that had just been branded. In the first example, an X radiograph of a Rubens panel in Munich shows a white letter A, indicating that the impression of the mark had filled with ground (Sonnenburg and Preusser 1979). In a similar example, a pair of hands from the Antwerp brand shows up on an X radiograph of a panel in Copenhagen (Fig. 20).27

Panel marks existed a few years before 1617 (a panel with the maker's monogram, RB, has been found dated 1612) (Wadum 1993),28 but were not standardized and regulated until a guild rule was designed to that effect the same year (Van Damme 1990). Twenty-two panel makers, as well as their respective marks, were recorded in a list.29 The year 1617 has therefore in the past been regarded as the terminus post quem in the manufacture of panels with a maker's mark, and in general this still seems to be the case today (Figs. 21, 22). Only three other panels show the same grain and panel mark as the aforementioned panel dated to 1612, and all originate from the same large tree. The planks have been separated only by the panel maker's saw cut (Broos and Wadum 1993).30 As none of the four panels show any sign of the Antwerp branding mark, one could speculate that this panel maker was a joiner, rather than a registered panel maker.
Both the panel makers and the joiners received a new set of regulations in 1617, but the marking decree was, in fact, based on an already existing practice. The panel maker Guilliam Gabron was already using his own mark in 1614, this mark being identical to the one we find in his early period (Fig. 23). These exceptions only prove the rule: marking on a larger scale took place mainly after 1617.

Although ready-made panels were exported from Antwerp to other countries (Duverger 1972; Fletcher 1994), the archives mention a number of works by panel makers who were active in Holland during this period. In 1607 Evert Gerritsz of Amsterdam charged the painter Gilles van Coninxloo sixteen guilders for frames and panels. In Rotterdam in 1631 the panel and frame maker Cornelis was owed money by an art dealer, and in 1648 Dirk Willemsz received twenty-five guilders for frames delivered to an art dealer (van Thiel and de Bruijn Kops 1995).

Because panels with ready-made grounds were available in the painters' materials shops from the late sixteenth century onward, a short survey of the way the ground is described in the guild regulations, manuscripts, and painters' manuals is included here.

The application of the ground is a natural step after the panel's production; even the back of some panels may still have their original ground. This ground is generally of the same material as that used on the front, and it is often covered by a single layer of brown and/or green pigment in an oily binding medium. There are even examples of an almost black layer that is bound in thick glue. Hans van Haecht, who also operated as a dealer in paintings, had large quantities of ready-ground panels available for his customers. From an inventory we know that he had eleven gulden-sized, eighteen long eight-stuivers-sized, and one large sixteen-stuivers-sized panel geprimeerd (primed) on both sides ready in his shop (Duverger 1987). A perusal of the panel makers' rules from the end of 1617 makes it clear that panel makers were taking over panel preparation as well. The regulations state that no panel maker may allow a panel to leave his workshop, or let it be grounded, before inspection by the dean (Van Damme 1990). Interestingly enough, the rule specifically stresses that a fine for breaking this law would be imposed, regardless of whether the offender is a man or a woman (tsij man oft vrouwe). Thus it is indicated that a woman, in the case of her husband's death, could take charge of a panel maker's workshop and fall subject to guild rules herself. It is also interesting to consider that women may very well have been grounding the panels produced in the workshops. This would be a fascinating piece of information regarding the division of work within the social structure of Antwerp art production, but to current knowledge, no women are titled as witters (grounders) in the official guild records from the seventeenth century.

It is not completely clear exactly when panel makers in Antwerp began making ready-to-paint-panels (Wadum 1993). However, when Philips de Bout (d. 1625) was registered in the Liggerei (the archives of the Antwerp guild of Saint Luke) in 1604, he was the first to have the title of witter en lijstmaker (grounder and frame maker) (Rombouts and Van Lerius
The availability of panels fully sized and grounded would save time and labor for an artist’s atelier, so that work on a painting could start straightaway. Perhaps this is the reason why there are only three recipes in the de Mayerne manuscript (nos. 1, 2, and 4) that record how to ground panels, but many recipes (nos. 6–20) that describe how to ground canvases (Berger 1901:22–408). Canvases were also sold ready-made, although the practice was not common in this early period. On the pregrounded panel, the artist could immediately apply the imprimatur, or primuerrsel, a semitransparent colored insulation layer placed directly on the ground before painting, in whatever tone desired.

What is believed to be the mark of Philips’s son Melchior (d. 1658) has been observed and recorded a number of times. In the year that he succeeded his father (1625 or 1626), Melchior de Bout is referred to as a witter en paneelmaecker (a grounder and panel maker); in the same year his late father is recorded only as a witter (Rombouts and Van Lerius 1864–76). Panels bearing the MB monogram have been recorded four times; the mark is placed close to a corner and pressed into a ground layer also present on the back of the panels (Fig. 24). No Antwerp brands have been found in conjunction with this monogram. These witters were the initiators of this special profession of preparing panels for the artists’ studios (van de Wetering 1986). In 1627 Hans van Haecht (1557–1621) had six dozen stooter-sized panels, as well as seventy-five panels of half that size, that were ready-ground with primuur, several on both sides (Duverger 1987).

In 1643 Leander Hendrickx Volmarijn from Rotterdam got permission to sell paintings and painters’ materials in a shop in Leiden. Permission was granted since no such shop existed there at that time. This fact meant that prior to this time, the painters had bought their panels directly from the joiner and panel maker (van de Wetering 1986).

In the early years, the tradition of grounding panels appears to be parallel to the method used south of the Alps. The colored ground, or imprimatura, originated in Italy and is described by both Filarete and Vasari. The Italian painter would make his preparatory drawings on top of the insulating, nonabsorbing, colored ground.
In the north this practice changed during the sixteenth century. The underdrawing would be made directly onto the thin white ground, on top of which a translucent insulating layer, the primuersel, would be placed. This primuersel would leave the drawing visible for further development in the painting process. It is obvious, then, that the primuersel was applied in the artist's studio, not by the writer.

Karel van Mander wrote in 1605 that his predecessors ground their panels thicker than in his time and that afterward they planed or scraped the surface as smooth as they could (Miedema 1973:256-57). The technique of Hieronymus Bosch (ca. 1450-1516) is described by van Mander as a method used by many other old masters: Bosch drew his images on the white ground, placing over them a thin translucent, flesh-colored primuersel that would allow the ground to play a role in the finished painting. The fact that the old masters did indeed draw directly on the ground, using a thin, flesh-colored layer in oil as an isolation layer, has been duly confirmed by intensive studies on this subject (Federspiel 1985). It is this pigmented oil layer that van Mander named primuersel (Fig. 25) (Plesters 1983; Coremans and Thissen 1962; Sonnenburg and Preuss 1979).

In 1620 de Mayerne gave advice on priming a panel. If one wants to paint on wood, he wrote, it is the custom first to size with chalk. One can mix a little honey in it in order to prevent cracking; but in de Mayerne's opinion it is better not to size wood too much. Then one should apply a good and strong ground (imprimeur) in oil, with a knife or horn spatula.
order to close the pores of the wood. An English manuscript from 1622 by Peacham describes a similar method (Talley 1981:61-71). 42

In 1692 Wilhelm Beurs wrote that a ground should first be applied to the panel with a weak glue mixed with chalk. After this, the panel should be scraped again in order to make it even and plane, so that the grain stays filled (van de Graaf 1978). The same year that Beurs published his manual, the Englishman Marshall Smith gave the recommendation to apply six to eight layers of whitening mixed with a strong size. After drying, the layer should be smoothed "with a Joiners Palm, then water plain’d with a rag dipt in water" (Talley 1981:375-96). Finally, an unspecified priming is applied before a layer of colored oil imprimatur. In France in 1757, Perteny gave the advice to apply a layer of Handschuhleim (hide glue) on both sides of the panels, on top of which the ground should be applied (Arnold 1826:101).

The recipes are consistent with what one actually sees on sixteenth- and seventeenth-century northern European panels. In the northern Netherlands, increasingly less ground was used, so that sometimes only the holes between the more pronounced parts of the grain in the oak panels were filled. This minimal grounding caused the grain of panels painted in the seventeenth century to be partly visible through the paint film (Gifford 1983). Also, the double ground is found to have been applied to panels from the Gothic period well into the eighteenth century.

It is necessary to mention that caution must be exercised in drawing conclusions about artists’ practices from the analysis of the ground layers on paintings dating from the end of the sixteenth century onward. Indeed, the grounding—be it a single or a double ground layer and an oil, a glue, or an emulsion ground—may very well show the characteristics of what was in the pot of ground at the wrapper’s workshop. Therefore, no relation to the tradition of a painter’s studio may be deduced from a sample of ground. The imprimatura, or primersel, layer was often the first layer applied by the artist on the already grounded panel; it, therefore, can be considered to reflect a specific practice in the painter’s studio.

It becomes clear that, over the years, thick split panels for large altars evolved into smaller panels for easel painting. This shift was caused by social, religious, and economic changes. The manufacture of panels by the panel makers also underwent a development: from rough surfaces with primarily untreated backs to panels with backs that were either planed or, in some cases, protected by an isolating layer to prevent warping. The evolution of different tools, from ax to saw to plane, shows a progress in the finishing of the painter’s board that seems to decline toward the end of the seventeenth and eighteenth centuries. This development occurs along with a drop in the quality of the raw material, the wood; the presence of sapwood and broader year rings clearly tell a story about a less-consistent quality check and an apparent scarcity of dense oak.

Information garnered from treatises and manuscripts is consistent with what can be detected from the analysis of the supports, and guild rules emphasize the care and concern brought by the art-producing society to the inspection of its members. This careful oversight partly derived from a syndicalistic concept, but it is clear that its purpose was also to guarantee a purchaser works of art made of materials of high quality.

Conclusion
Acknowledgments

The author is grateful for help and suggestions from Nicola Costaras and Feroza Verberne. A special thanks is also extended to Aleth Lorne and Victor Wadum for their support during preparation of this article.

Notes

1 In 1581 the painters guild was founded in London; in 1595 it was founded in Prague by Rudolf II. In Leiden, however, it was founded after 1641. In Haarlem the guild of Saint Luke had been in existence since 1497 (Miedema 1980).

2 See Miedema (1980:84) for the structure of the guild in Haarlem; see Rombouts and Van Lerus (1864-76:694f.) for the list of professions in the Antwerp Liggeren.

3 The size of the foot in selected towns in Europe in the fifteenth to the seventeenth century (one duim is the distance between the tip of the thumb and the first joint):

<table>
<thead>
<tr>
<th>Town</th>
<th>Foot Size (duim; 1 ell = 54.8 cm)</th>
<th>Distance (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riga</td>
<td>12 duim; 1 ell = 69.5 cm</td>
<td>28.69</td>
</tr>
<tr>
<td>Gdansk/Königsberg</td>
<td>12 duim; 1 ell = 69.5 cm</td>
<td>28.69</td>
</tr>
<tr>
<td>(39 Gdansk feet = 32 Rhineland feet)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rheinland</td>
<td>12 duim</td>
<td>31.38</td>
</tr>
<tr>
<td>Rhineland timber foot</td>
<td></td>
<td>29.43</td>
</tr>
<tr>
<td>Antwerp</td>
<td>11 duim; 1 ell = 69.5 cm</td>
<td>28.69</td>
</tr>
<tr>
<td>Brussels</td>
<td>11 duim; 1 ell = 69.5 cm</td>
<td>28.69</td>
</tr>
<tr>
<td>Gent</td>
<td>11 Parisian duims; 1 ell = 69.8 cm</td>
<td>29.77</td>
</tr>
<tr>
<td>Herentals</td>
<td>10 duim; 1 ell = 68.8 cm</td>
<td>29.18</td>
</tr>
<tr>
<td>Ljóðge</td>
<td>10 duim; 1 ell = 65.6 cm</td>
<td>29.47</td>
</tr>
<tr>
<td>Amsterdam</td>
<td>11 duim; 1 ell = 68.6 cm</td>
<td>28.31</td>
</tr>
<tr>
<td>Copenhagen</td>
<td>12 duim; 1 ell = 62.8 cm</td>
<td>31.38</td>
</tr>
<tr>
<td>London</td>
<td>12 inches; 1 ell = 113.9 cm</td>
<td>32.48</td>
</tr>
</tbody>
</table>

4 Here, Miedema's study, Karel van Mander: Den groote der ald der schilder-const (1973), has been used. In chapter 4, verse 3 (fol. 34v), van Mander writes, "Die ons al dienen om Landtschap te stichten / Op vlas-waede / oft Noorweeghsch hard' eycke plancken / Komt, which will serve us in making a landscape on either canvas or on hard Norwegian oak planks?" (see Miedema 1973:285).

5 Dendrochronological dating of the two panels in the Mauritshuis, by Dr. P. Klein in 1993, visualized this statement. On a small panel painted by Hans Memling (inv. 595), measuring 10.1 × 22.3 cm, 167 year rings were present on its narrow edge, whereas a panel approximately three times larger, measuring 62.5 × 101.1 cm, by Abraham Govaerts (inv. 45; signed and dated 1612) showed only 158 rings on its short edge. Both oak planks came from the Baltic area; the felling date, at the earliest, of the former was 1474. of the latter 1608.

6 The German term Mondring, literally "moonring" in English, does not seem to have an English equivalent when used in this context.

7 Long thin oak planks sawn out of the full length of the split pieces of timber.

8 On 9 November 1470 the rules of the guild of Saint Luke were further specified (Van Der Straeten 1859:13-14).

9 The dowels were inserted from the front, through the frame and into the panel. On the back, the ends of the dowels were split, and wedges were hammered into them in order to prevent movement of the dowels.

10 For the frontals of Norwegian altars, this was far from the case. As previously mentioned, the planks were not glued; also the back and front of the tangentially split fir wood were not oriented in the same direction. This arrangement caused an inward and outward warping of the single planks, resulting in a wavy frontal surface.

11 Lindberg (1990) and Skans (1990) demonstrated that ancient glues, such as those recommended by Cennino Cennini, contained from 4.5% to 8% animal fat. They state that in fifteenth-century Italy, manufacturers of glue knew the different working properties of fat and lean glues and had the capability to control the fat content of their products.
12 Peter Paul Rubens, Portrait of Helena Fourment, ca. 1635. Oil on panel, 98 x 76 cm. Royal Picture Gallery Mauritshuis (inv. 283), The Hague.

13 Courtesy of the archives of the Mauritshuis Conservation Department.

14 See chapter 17, "Panels for altars and doors; and cheese glue."

15 A drawknife is curved and sharp on the inside of the blade; it has two handles so that it can be drawn with both hands over the panel.

16 The hide was first to be soaked in water, then wrung out, and while damp laid on top of the panels with cheese glue.

17 It is interesting to note that the parchment (ca. before 1300) had some writing upon it. Apparently the parchment was scrap from the royal library in Bergen. The panel maker or the groundier must have been in possession of this scrap parchment for use in filling the unevenness prior to grounding.

18 Cennino Cennini (ca. 1437) advised his fellow Italian painters to take some canvas or whitethreaded old linen cloth, soak strips of it in sizing, and spread it over the surface of the panel or aronca. See chapter 114: "Come si dà impannare in tavola [How to put a cloth on a panel]."

19 Vasari describes the method of applying canvas or linen to the panels before grounding and painting them. In his description, the linen not only had the advantage of covering unevenness and joints in the board but also offered a good grip for the ground (Berger 1901:20).

20 A premature conclusion regarding this should be avoided before thorough research has been employed, since later paintings on canvas were glued onto panels—a conservation measure already practiced by the seventeenth century.

21 This requirement was incorporated in a new set of rules received by the Antwerp guild of Saint Luke on 20 March 1693 (Van Der Stael 1885:30–35).

22 This is comparable to the addition perpendicular to the grain on the Helena Fourment portrait in the Mauritshuis (see nn. 12, 13).

23 On 22 April 1626 the churchwardens of the Cathedral of Our Lady agreed that the panel set created for Rubens to paint for the high altar was too narrow. The panel maker Michiel Vrient was therefore asked to glue another plank onto the existing panel. On 11 May 1626 Vrient was paid thirty-eight guilders for enlarging the panel, and a painter named Adriaen Schut was paid to ground the panel. Drinking money was additionally given to four men who carried the panel back to the church. The artist’s sole payment on 30 September 1626, however, was the gratitude of the churchwardens.

24 Information courtesy of chief conservator Martin Bijl, Rijksmuseum, Amsterdam, who is currently preparing an article on this topic. See also Verhoeff (1983).

25 These stipulations were incorporated in the regulations of 11 December 1617 for the joiners’ trade (Van Damme 1990).

26 Also note the frame maker Reynier Roovaert (from Antwerp), who produced simple square frames or “dozen frames” (“simpel viercame lijsten oft dosynwerck”) and in 1637 became a master of the kistmakersgilde (guild of cabinetmakers).

27 This information was kindly made available by conservator Mimi Bang, Statens Museum for Kunst, Copenhagen.

28 The panel in question is Abraham Govaerts, First View with Gypsies, 1612. Oil on panel (single plank), 62.5 x 106.2 cm. Royal Picture Gallery Mauritshuis (inv. 45), The Hague. Signed and dated: “AGovaerts / 1612.”

29 The most important contributions on panel makers’ marks, organized chronologically by publication date, are as follows: A. Heppner (1940), G. Gepts (1954–60), H. von Sonnenburg and F. Preusser (1979), B. Cardon (1987), J. Wadum (1990), J. Van Damme (1990), M. Schuster-Gawlowksa (1992), and J. Wadum (1993).
The panels in question, all of which are single planks, are (1) Jan Brueghel the Elder and studio of Peter Paul Rubens, Nymphs Filling the Hawn of Plenty (see Fig. 25); (2) Hans Jordaens III (attrib). The Flora in Entering Rome, ca. 1615, oil on panel, 67 x 110.5 cm. National-museum (inv. FM 4444), Stockholm; (3) Abraham Govaerts, Landscape with Figures, oil on panel, 64 x 101 cm, Kunstsammlungen des Universitats, Detingen (inv. 389), signed: A.GOWERTS.

Meetings concerning the new regulations seem already to have taken place by the summer of 1616, when the panel makers' deans and representatives from the guild of Saint Luke met at the Bobijn (the Ruby). An agreement was not, however, reached at this point. See Rooses 1879:71-84.

The mark of Gobron can be seen on the back of a pair of landscapes painted by Abraham Govaerts: "Woudlandschap with Houtsmen" and "Panoramic Landscape with Fishermen" (1614). Both are oil on panel, 35.5 x 51 cm. The Panoramic Landscape is signed: A. Govaerts 1614. Galette De Jonckheere (cat. 7, "Oeuvres de Pierre Brueghel le Jeune", nos. 28, 30), Paris. His device of interlinking the twoGs in the monogram with a small four-leafed flower was already in use before he registered on the act of 1617, where he used only the two Gs. It bears mention that neither of the two Govaerts panels has any sign of the castle and hands of the Antwerp binding mark. Several panel makers used more than one punch during their career. The author will attempt to determine when the punchies changed in a forthcoming article.

In 1657 Persery advised applying a layer of Handschakeren (hide glue) to both sides of the panels, in order to prevent swelling of the wood. As soon as the glue is dry, the side to be painted is scraped, and both sides subsequently grounded, with a soft brush and a mixture of chalk and glue. Two or three layers of ground are applied. The surface of the side to be painted is evened with a damp sponge. Finally, a thin, even layer of oil paint is brushed on. Persery refers to this layer as the isolating layer. It is stated that oil is normally mixed with lead white, a bit of "Braunrot" (the precise meaning of this term is not clear), and carbon black, in order to obtain a reddish gray layer. A second layer of this ground is often applied after the first one dries; this layer transforms the ground into a colored ground (an imprimatura). The last step is to smooth the final layer with a pumice or to scrape it with a knife.

Panels prepared in this way, Persery concludes, have far more value than canvases and can furthermore be used for small and detailed works.

The surname de Bout can be found in other versions: de Bont, de Baut, and Deboub. No panels with the monogram of Philips de Baut (PDB), as recorded in 1617, have been found up to the present. Other writers besides de Baut lived in Antwerp during this period: one of his neighbors in St. Antoniusstrasse, Adriaen van Lokeren, was also a waterer, and a little farther away, in Hoplairst, lived Frederick de Baut, another waterer from the de Baut family (A Frederieh de Baut is mentioned in 1581 as a master violin maker) (Rumbrooks and Van Lionel 1864-70).

The B is written in reverse on the inside of the right leg of the M.

The four panels are as follows: Sebastiaen Stoskopf (1597-1637), A Bowl of Fruits, oil on panel, 26 x 34.5 cm, Galette Leegenhof, Paris; Wouter Giljaerts (1649-74), Fruits, oil on panel, ca. 30 x 25 cm. Kunsthandel Xavier Schüdewimmen, Munich; a pair of pendants by Peter Gysela: A Market, oil on panel, 40.3 x 52.2 cm, and A Market in a Town, oil on panel, 40.4 x 52.1 cm. On the second of the pan, the monogram of M. Bout has been pressed into the ground of the back twice. The pair of pendants is in the Bonnefantenmuseum (inv. 326, 325 [RBM-NL.1790, 1862]), Maastricht.

At this stage it is useful to make a short excursion to the Southern European countries in order to examine their method of applying the ground. Cennino Cennini (ca. 1437) (see Lindberg 1989) describes how to start work on a panel by first covering it filling holes, knots, nails, etc., with caution, so as not to smooth the surface too much. Next the panel is sized with a glue made from the clippings of sheep parchments. Two or three coats of glue are recommended, the first coat is thus in order to give the wood an "appetizer." Then the coarse glue and the gesso sinter would be applied subsequently and, finally, made completely smooth (chap. 113).

Antonio Filarete (ca. 1400-1469), tells us that the colored imprimatura is applied in an opaque layer. First, the panel is made smooth, and then a layer of size is applied. Following this, a layer of paint ground in oil is applied. (The obvious color choice is lead white, but another color would also be acceptable.) Finally, the drawing is made on top (Berger 1901:6-9). Vaast (Berger 171)
172

Wadum

1901:27) says the méristica should first be mixed to an even color out of drying pigments such as lead white, Naples yellow, or terra da campagna. When the ready-sized panel is dry, the mixture is applied to the entire panel surface with the palm of the hand. Vasari claims that this layer is called the imprimatura by many. Another earlier Italian recipe by Armenini uses this practice of mixing different pigments with a varnish or oil, in order to make a necessary color base for the other colors to be applied during the painting process. See van de Graaf (1958:22).

39 This extensive study is devoted to an explanation of creating a spatial illusion through the use of a primersel, the thin colored isolation layer between the ground and the paint layer.

40 This primersel is noted by some to have been applied in an aqueous medium, but no particulars of the testing methods are given.

41 De Mayerne does in fact state here that the grounding of wood does not have to be done exclusively with chalk and glue-water—a weak glue and a strong oil ground on top will suffice as well. However, earlier in his manuscript the contrary is stated: first, he advises the application of a ground of chalk with glue, with glue in two pots of water. When the glue is diluted, enough chalk is added to give the mixture a good consistency; the mixture is then applied smoothly and evenly with a knife. After this procedure, etern andumber ground in oil are applied, and the panel is left to dry. Later in his manual, he recommends first priming the panel with calf- or goat-skin glue mixed with chalk. When dry, the primer should be scraped and planed with a knife and finally given a thin layer of lead white and umber. He adds that rawumber spoils the colors, suggesting instead brunner yellow or red ochre, lead white, and carbon black (de Mayerne, in fact, got this recipe from Abraham Latombe in Amsterdam). He later concludes that the ideal ground consists of lead white and a touch of ochre, red lead, or another color.

42 First the panel is planed quite evenly, and then three layers of ground (with glue) are applied. The last layer should be scraped with a knife in order to create a smooth surface, to which a final layer of colored priming, containing red lead or some other color, can be applied. After this step the underdrawing is made.

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1960

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1973

1980

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