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

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Frans Hals: a Technical Examination

Over the period 1984 to 1988, ten paintings by Frans Hals in the collection of the Frans Halsmuseum in Haarlem, including the five militia pieces, have been restored. This has provided important information about Hals's working methods and materials, and laid the foundations for a broader investigation into the artist's painting technique revealed in the works in this exhibition. Until embarking upon this most recent research programme, reports on comprehensive technical examinations of Hals paintings have been rare; in recent decades, only three have been published. Taking advantage of an exhibition which brought together a number of works by Hals, the art critic M.M. van Dantzig attempted their visual analysis. In the present research programme, additional analytical and photographic techniques have been used to substantiate our observations.

Our technical examination involved forty of the two hundred and twenty-two paintings attributed to Hals by Seymour Slive. During the course of it, we came to recognise a number of common characteristics, while some of these are in line with the known practice in other seventeenth-century Netherlandish workshops, others would appear to be hallmarks of Hals's own personal style. Most distinctive of these is the apparent virtuosity displayed in his handling of paint. Our research not only confirmed this characteristic, but also indicated that he applied such a technique to earlier stages in the painting process, which are largely hidden from view. Bringing together these paintings on exhibition provides a rare opportunity to revise and build upon the knowledge gained from this initial look at Hals's painting technique.

Painting Supports

Apart from three works on copper panel which survive from the first three decades of Hals's known career, including Theodorus Schrevelius (cat. 5) and Samuel Ambzing (cat. 40), roughly three-quarters of his surviving attributed works are on canvas and the rest on wood panel. This preference for canvas as a painting support conforms to the general tendency for canvas to supersede wood as the dominant support in this period. Like Rembrandt, Hals consistently used wood panel for small portraits throughout his career, though the proportion of his works on wood panel to those on canvas declines progressively.

A progression in picture size, associated with the material of the support, conforms to Netherlandish paintings of the period. Hals's three smallest works are on copper panel, whilst at the size of the largest of these, 19.9 x 14.1 cm, wood panel takes over as the most common support. The dimensions of most wood panels lie between this size and around 45 x 55 cm, and the use of canvas predominates once the format of a picture moves above c.60 x 50 cm.

Panel

Seventeenth-century sources suggest that Hals would have bought his panels ready-made from specialist craftsmen, members of the guilds of cabinet-makers and joiners. It would appear that he could have been limited to what might have been standard size frames. To ascertain whether Hals's panel paintings conform to possible standard-size panels, height to width ratios of forty upright rectangular panels were plotted on a graph. Although no grouping of standard-size panels emerged, a general proportional relationship of 1:2.5:1 was found. This agrees with the value found for other Netherlandish vertical format panel paintings of the period. It is not remarkable that this standard proportion is found to be used for the uniform subject matter of half or three-quarter-length portraits which Hals painted on panel.

Nearly all of the wood panels examined, including the larger pendants of Portrait of a Woman (cat. 2, 3) are made from a single plank. However, one relatively small panel, the half-length portrait of Zeffius (cat. 1), shows the more complex construction of two vertical planks butt-joined (the edges fastened end to end without any overlap) and glued. New technical information has revealed that the panel was not cut down at a later date, as has been previously suggested (see cat. 1).

Microscopic examination and paint samples show that the ground and paint layers continue around the top, left and bottom edges of the panel and have been lightly smoothed away along the right edge (pl. viiter). This suggests that the panel was primed and painted in its current size. Furthermore, the reverse of the panel retains its original bevelling on all four sides, which appears to have been standard practice at the time in order to facilitate framing (vitril). Thus a different explanation has to be found for the
three-quarter-length depiction of Zaffius in a reversed engraving of 1630 by Jan van de Velde II, traditionally thought to be a copy after this painting before it was cropped (see cat. 1).

Those wood panels examined which retain their original state show a thickness of around 1 cm, usually bevelled at the reverse along all four edges to a few mm thickness. However, the radially cut panel of Portrait of a Woman (cat. 79) shows beveling on three sides only, to a thickness of 8 mm. The bevels along the top and bottom edges taper out towards the right edge which is 6-8 mm thick without beveling. This is the thin side of a wedge-shaped board which is produced by the radial manner of sawing a plank from the tree (at right angles to the annual rings).16

Another distinct variation from the norm is in the pendant portraits of Cornelia Vooght and Nicolaes van der Meer (cat. 44, 41). These are exceptionally large for works on wood panel by Hals. Uniform both in size and composition, they are made up of three vertical planks of an average width of 33 cm, which are butt-joined and glued.17 However, the construction of the two panels differs in the cut of the planks. Most of the planks examined were sawn radially from the tree, as was the
usual practice in order to minimize the tendency to warp. This applies to the three planks which make up the panel of *Cornelis Vooght*. However, whereas the outer two planks of *Nicolaes van der Meer* are cut radially, the middle plank was cut strictly tangentially (parallel to the annual rings) from the trunk. This unstable construction, made worse by later thinning of the panel and the addition of a heavy cradle on the back, accounts for the fact that old splits in the wood and flaking losses of the ground and paint layers occur chiefly in the weaker middle plank. Similarly, whilst *Anna van der Aar* (cat. 20) is painted on a wood panel of radial cut, its pendant *Petrus Scrieverius* (336, see cat. 20) is painted on a more unstable panel cut tangentially close to the bark, so that it has suffered more and shows a number of splits. The small panel of *Jean de la Chevrière* (cat. 30) is similarly of tangential cut.

In Hals’s portraits of rectangular format, the wood grain usually runs vertically. However, two portraits on panel, *Man holding a Skull* and *Portrait of a Woman* (cat. 2, 3) show opposed diagonal slants of their characteristic curving wood grain. It would appear that the two panels were cut radially from a back-to-back position in the same bent tree trunk. This is visible in raking light, and very clear from the X-ray due to the lead white content of the ground layer (figs. 1, 2). This suggests that the panels were supplied together, thus supporting their attribution as pendants.

In his genre pieces, which are occasionally on differently shaped panels, the grain runs diagonally. Furthermore, in the pendant tondos *Drinking Boy* and *Boy playing a Flute* (cat. 27, 28) or in the lozenge-shaped pendants of *Singing Girl* and *Boy playing a Violin* (cat. 25, 26), it is noticeable that the grain slants in the opposite direction in each panel. Given these observations, one wonders whether Hals was aware of the potential visibility of the grain of these panels.

In keeping with most Netherlandish panel paintings of the period, the species of wood used for the majority of Hals’s panels is oak shipped from the Baltic region. Dendrochronology of the near-radially cut oak planks of *Zaffius* (cat. 1) suggests that they originated from a tree felled between c.1602 and c.1608 in that region. This information provides added support for accepting the date for this work to be 1611, the date found in the inscription on the painting itself, which has been confirmed to be original. The planks used for the panel of *Cornelis Vooght* were examined by dendrochronology as well. They originated from one or more trees felled between 1621 and 1627 in the Baltic. Some of the small portraits which we examined did show that Hals used other types of wood. The small panel of *Petrus Scrieverius* (316, see cat. 20) for example, is of a dense tropical wood, while its pendant *Anna van der Aar* (cat. 20) is of a wood from a fruit tree (pear or apple). Finally again, Hals’s small panels appear to conform to early seventeenth-century Netherlandish patterns.

**Canvas**

In the Netherlands in the seventeenth century, canvas was not yet specifically woven for artists. They were thus obliged to use fabric made for other purposes, notably for sails and for bed linen. Painters would normally use canvas strips whose width was related to the Flemish ‘ell’, approximately 69 cm. In the late *Portrait of a Man* at the Fitzwilliam Museum (fig. 83b; 8128), the width of the canvas measures 69.5–70.5 cm, which corresponds to this basic unit of ‘ell’. We know that the entire width of the strip is present since, unusually, there are remains of the original selvages which run parallel to the warp along the right and left sides.

Canvas of considerable dimension were used for Hals’s commissioned group portraits, for example 207.3 x 427.3 cm in the case of the *Meagre Company* (cat. 43). The possibility of rolling up these large paintings in order to transport them must have been an important consideration in the choice of canvas as a support. X-rays show that the canvas of this painting, as well as the *Regents, Regentsesses, Regents of the St. Elizabeth Hospital* (cat. 85, 86, 54) and all five militia pieces commissioned in Haarlem between 1616 and 1619 (57, 845, 846, 879, 8144) were woven in a single strip, its width corresponding to the vertical dimension of the paintings (fig. 3). Where the original top and bottom edges of the canvas remain, we know that the entire strip width is present. In the *Regents and Regentsesses* the strip width measures 312.5 cm, or 4½ ells. The last of the militia pieces (8144) measures 207.3 cm in height, which corresponds to a strip width of 3 ells. This compares with the widest single-strip canvases observed in seventeenth-century Netherlandish paintings.

The use of such wide canvases woven in a single strip was probably more expensive than the alternative of seaming together more than one strip, where the visibility of the seams could become disturbing. This study found that two canvases made up of more than one piece resulted from alterations made at a later date. Despite differences in provenance and size, the *Portrait of a Woman* (Jowell, fig. 21, 8185) has been considered a pendant to the *Portrait of a Man at Vienna* (8184). Examination of the original canvas revealed that a strip 3.5 cm wide had been cut from the bottom of the
The support consists of a single strip of canvas, 2½ cm wide. A length of coarser canvas had been added below to fill out the picture’s vertical dimension on the lefthand side and the whole overpainted. The edges of the original dimensions are reconstructed. They can be proved to more or less match those of the Portrait of a Man, and thus support the supposition that the two portraits are pendants. Such mutilations may have been made in order to fit the painting into an existing frame or to match another portrait.

In another male portrait (cat. 70), examination shows that a c.3.5 cm wide strip of unprimed canvas had been sewn onto the original canvas edge on the left side. Presumably someone subsequently considered the composition more complete if the elbow were not cut at the left edge (fig. 4).

Examination suggests that all the canvasses were of a simple weave linen fabric. Investigation of the weave density of the canvasses, that is the number of warp and weft threads per square centimetre, was possible for 19 works. Since the original canvas is usually obscured by paint layers on the front side and a lining canvas on the reverse, a thread count can mostly only be taken from an X-ray of the paintings. In some cases it is not possible to distinguish warp from weft.

The weave densities measured ranged from a rather coarse 11 threads per cm along the warp (vertical) and weft directions in Lucas de Clercq (cat. 46), and 10 to 12 threads per cm along the warp and weft (no distinction made) in Man in a Slouch Hat (cat. 83), to one almost double in fineness of 18-21 threads per cm along the warp and weft (no distinction made) in Tielman Roosterman (Biesboer, fig. 10; 89).

There appears to be no correlation between the weave density of the canvas and its size. For example, whereas the canvasses of the Regents and Regentesses (cat. 85, 86) show a relatively fine weave of 14 threads per cm along the warp and weft directions, a coarser canvas with a thread count of 12 threads per cm along the warp and 14 threads per cm along the weft was used for the 1½-wide canvas of the Fitzwilliam Man (fig. 85b; 8216) from the same period. In these group portraits the use of such a large piece of fine and hence probably more costly canvas could be explained by the importance of the commission.

The identical thread counts of the canvasses of the Regents and Regentesses (cat. 85, 86) suggests that they were acquired at the same time. One might expect to find this with other attributed companion pieces, especially where these have been found to possess identical primings (see below). However, it was found that Fevraje van Steenkiste (cat. 47) had been painted on a finer canvas, 16 threads per cm along the warp and weft, than that of her attributed pendant, Lucas de Clercq.
FRANS HALS: A TECHNICAL EXAMINATION

This initial survey also revealed that Hals appears to have used a range of canvasses of different coarsenesses, even for paintings close in date, implying that he stocked or acquired different grades of canvas at any one time. However, the different properties of the canvas used do not seem to have been exploited in the texture of the final paint layers. In paintings which are well preserved it can be seen that the smooth application of the priming layer conceals the canvas weave. The smooth preparation of the painting support was emphasized as of great importance in contemporary notes on painting technique.

For application of size and ground layers, the canvas would be stretched by a system of lacing into an oversize wooden frame or stretcher. An X-ray detail of the original canvas edges of the militia piece of c.1619 (Fig. 5), which are usually intact, shows this procedure (Fig. 1). The edges of the canvas are rolled round a cord and hemmed with oblique stitches. This is to prevent the stretching cord, laced through the canvas at intervals, from pulling through. Remains of this stretching cord are visible. At the points of stretching, the canvas is drawn into a peak and the resulting scalloped deformation is termed 'primary' cusping. The ground layer is applied, forming a ridge along the seam, and this fixes the cusping deformation. Usually these original stretching edges of the canvas were cut off during later lining treatment, or are concealed by wax lining material. However, we were able to find remains of original stretching edges in a number of paintings: Jacob Olycan (cat. 18), Aletta Hanemans (cat. 19), Feyntje van Steenwijk (cat. 47), Lucas de Clercq (cat. 46), the Regents and Regentesses (cat. 85, 86), and Portrait of a Man (cat. 70). In most cases the edges have been unrolled to form a margin of canvas without priming. The fact that the right edge of the canvas in Feyntje van Steenwijk (cat. 47) is a selvedge must account for the fact that it was considered sufficient to reinforce this with simple running stitches within the edge, rather than the usual stretching cord sewn into a hem.

It has been suggested that, as one moves through the seventeenth century, there is a general tendency for Netherlandish painters to use increasingly coarse canvases. This cannot be confirmed in the case of Hals, due to the small sample of canvas weaves available for measurement. More thread counts are needed to establish whether there is any chronological pattern in Hals’s preference for canvasses of coarser or finer weave over a given period.

However, it has been noted that several canvases could be cut from a single piece of primed canvas. Examination of the canvasses of the proposed pendants, Lucas de Clercq and Feyntje van Steenwijk (cat. 46, 47), suggests that they were cut from the left and right sides respectively of a wider strip of primed canvas. The canvas of Lucas de Clercq shows a selvedge on the left side. Only the top, left and bottom edges show remains of the original stretching edges and primary cusping deformations. This suggests that it was cut from the left side of a wider strip of primed canvas. The structure of the canvas of Feyntje van Steenwijk is exactly reversed, suggesting that it has been cut from the opposite side of a wider strip of primed canvas. However, they were not cut from the same strip, since examination has proved that they have different weave densities. Given that they also have different primings (see below), their supports cannot be used as evidence that they were necessarily designed as pendants.

Fig. 4 Radiograph of the Portrait of a Man (cat. 70)
A ridge of ground layer defines the original edge of the canvas on the left. The other three edges have been cut off. An unprimed strip of canvas was later added on the left.
It appears that a canvas was sometimes restretched, possibly several times, after application of the first ground layer. When this ground layer was not yet dry, re-stretching would produce a less marked 'secondary' cusping deformation. The Fitzwilliam Man (fig. 85b; 824) permits a reconstruction of the procedure of preparing a painting support from a piece of canvas. The support seems to have been cut from a longer length of canvas, primed with an initial layer of ground (see below). This is suggested by the presence of primary cusping along the right and left selvedges, and the continuation of the red priming right up to the edges. This piece of red primed canvas was then restretched by lacing it onto a shorter strainer for application of the second, coarse grey priming. Three observations suggest this: secondary cusping is present around all the sides, the second grey ground covers the edges of the canvas more loosely and, being messily applied, splashes around the reverse (viiiC), and finally, two sets of lacing holes correspond to the peaks of primary and secondary cusping resulting from two subsequent stretchings.

The primed canvas then seems to have been re-stretched again before painting, by folding the edges around a correctly sized stretcher and securing them with pegs, or tacks as is still common practice. This is suggested both by 0.1 cm wide unpainted tacking margins, and by paint strokes which stop short of or skirt the edges of the stretcher (viiD). Alternatively, the primed canvas could remain laced onto an oversize stretcher, in which case paint layers would extend up to the laced edges. This was the method used in painting the 1639 militia piece (824d; see fig. 5).

**GROUND LAYERS OR PRIMING**

Seventeenth-century sources suggest that the beauty and vivacity of a painting's colour depended upon good priming. In this study, the ground layers of thirty-five paintings by Hals were analysed, and a general survey was then made to determine whether they possess the qualities of good priming and play a significant role in the appearance of the paintings.

The ground colour is usually concealed by overlying paint layers, except where these do not quite meet or cover the edges of the support. However, in the Young Man with a Skull (cat. 29) and the Fitzwilliam Man (fig. 85b; 824) sizeable areas of ground have been left visible through openings in the upper paint layers. In these paintings, the ground colour serves as the mid-tones of the background, draperies and even flesh. In other pictures, the ground shows through thin or translucent paint, as in the areas which depict white collars and cuffs. For example, the light brown ground shows through the ruff of the Chatsworth Man painted on canvas (cat. 13). In Nicolaes van der Meer (cat. 41), painted on panel, a brown imprimatura (a thin layer of oil paint applied to seal the absorbent ground) over the white ground shows through the collar to provide a similar effect (viiiB).
Examination of paint samples shows that the ground is usually off-white, varying from light pinkish to ochreous. This can reach a darker cool grey or brownish tone. These slightly differing ground colours are achieved using a small number of pigments. In most cases they comprise lead white mixed with umber, sometimes with a small addition of red ochre, bone black, charcoal, fine lamp black or chalk. Occasionally chalk bound in animal glue is used in the ground and a toned imprimatura laid on top. This was the traditional priming for panels favoured in the Netherlands in the fifteenth and sixteenth centuries, but can be found on some of Hals's canvasses as well as his panels. On the other hand, oil-bound grounds, which rapidly superseded chalk grounds on canvas, appear on some of Hals's panels as well as on canvasses, and in no apparent chronological sequence.

Oil-bound grounds are found on Hals's earliest known panels. For Zaffius (cat. 1) lead white, a little red ochre and fine black were used. Portrait of a Man (cat. 2) and Portrait of a Woman (cat. 3) were both prepared with a lead white paint, mixed with a little red ochre, umber and coarsely ground charcoal black. On the small panel of the Laughing Boy (cat. 16) the ground consists of lead white with a little umber and very little fine black, again apparently bound in oil. The pair of small portraits of Petrus Scriberras (s36; see cat. 20) and Anna van der Aar (cat. 20) are painted on similar ground layers, containing lead white, a little red ochre and very little umber.

By contrast, in the panels by Hals of the 1630s which were examined, the traditional chalk ground was found. Small paint samples from three paintings on panel in this period were available for analysis (Nicolaes van der Meer, Cornelia van Vooght and Jean de la Chambre [cat. 41, 42, 50]). All three have a priming of chalk bound by glue with an imprimatura laid on top. The imprimatura contains lead white, a little umber and yellow ochre, and very little fine black, which gives the ground a slightly yellwhish appearance. Hals's chalk primings seem unusually thick when compared to those on other contemporary Netherlandish panel paintings, thus resembling the earlier manner of priming.

Perhaps more surprising than the use of oil-bound grounds on some of Hals's panels is the use of chalk grounds on some of his canvasses. This is all the more peculiar, since, again, the chalk priming is thickly applied, while painters knew at the time that such grounds, when used on canvas, were prone to cracking and flaking. Van Mander, for instance, recounts how a painter who had primed a large canvas painting in this way, found the paint on his picture flaking off, since the painting had to be rolled up several times. Hals applied a chalk ground to the relatively large canvas of Paulus Verschuyver (cat. 56), painted in 1643 (viii). Another example of chalk ground on canvas is the Portrait of a Woman (s113) from the late 1630s, where the chalk is mixed with a little lead white, umber, red ochre and fine charcoal black, and has a greyish-brown imprimatura (lead white, chalk, umber, very little fine charcoal black). The Portrait of a Woman holding a Fan (cat. 33) also has a thick layer of chalk on the canvas, with the addition of very little red and black. Naturally the possibility exists that the pictures were transferred from panel to canvas, but neither the paintings themselves nor the paint samples suggest that this was done. Maria Larp (s112), which has an oil ground, does show traces of this treatment.

The main component in twenty-seven of the thirty-five oil-bound grounds which could be analysed is lead white, presumably oil-bound. Seven of these oil grounds are on panel. umber is also nearly always present. This brown earth colour, an iron oxide which contains manganese dioxide, dries quickly due to its ability to act as a catalyst in the drying of oil.

Over a third of these grounds were 'double' grounds, that is to say, there are two paint layers covering the canvas (the oil ground on the panels consists of only one layer). Very often the difference between these two layers is not very striking. Lead white and umber are present in both layers, which often show no clear division, since one layer is applied over the other whilst it is still wet. The second layer is sometimes deeper in tone because of a greater quantity of umber present (Officers and Sergeants of the St. Hadrian Civic Guard [579], c.1633), and sometimes lighter, as in the Man (cat. 70). Also, the first layer can be made to look more greyish by the addition of a little lamp black (Banquet of the Officers of the St. Hadrian Civic Guard [547], c.1637). For the first layer in Claes Doorn van Voorhout (cat. 52), the cheap alternative for lead white was used, namely lead white diluted with chalk (vtrg). In the militia piece of c.1639 (s124), the proportion of chalk in the first ground is very high. Only in two instances did the two layers of ground have distinctly different hues, in the Fitzwilliam Man (s218) and in the Man in a Slouch Hat (cat. 83), both from the 1660s. On top of the first layer, which consists of a cheap, bright red earth, there is a cool grey, made with lead white, charcoal black and umber (viii, viii). In the Fitzwilliam Man (fig. 81b; s218) it was apparent, after the removal of the old relining canvas, that the red ground had served the purpose of filling the interstices of the canvas weave. The reverse of the original canvas was found to be virtually untouched by later hands, and one could see
that the first ground had been pushed through the interstices, presumably with a priming knife. From some other samples of ground it is clear that to this end the canvas was first treated with glue, either as a coat or by dipping the entire canvas in a liquid glue as de Mayerne suggests, before the oil ground was applied.  

Although in many of the grounds lead white and umber are the main constituents, comparison of admixtures in different pictures, supposedly executed in the same period, reveal differences. For instance, the grounds of the two group portraits of militiamen painted in c.1627 (s44, s46) and the Young Man with a Skull (cat. 29) from 1626-8 all have different compositions. These often result from either simply varying the amount of coloured pigment added, or by choosing a different pigment, or by adding black.

In some of the companion, or pendant, pieces, the grounds are identical, in so far as they possess pigments with the same chemical composition, colour and particle size mixed in the same relative amounts. This is the case in the Chatsworth Woman and the Birmingham Man (cat. 3, 2), where the typical particles of coarse charcoal black are found in both pictures. In Nicolaes van der Meer and Cornelia Vougt (cat. 41, 42) the pigment compositions of the imprimatura over a chalk ground are identical. In the Vienna Man (s184) and Woman (Jowell, fig. 2: s185), one layer of priming was applied over another which was still wet, with chalk added to the first layer and a little finely ground red ochre to the second. The concentration of umber, present in both layers, is the same in both pictures. Given the limited number of pigments present in Hals's paintings, it is all too easy to conclude that his grounds, even when examined under a microscope, appear to be similar. It is only when viewed under a very powerful microscope that it is possible to assert an absolute affinity between any two grounds.

It has been shown above that some pendant portraits painted both on canvas and panel can possess identical grounds, indicating that they have been primed together. Additionally, the panel supports themselves can be made from planks cut from the same tree. One might also expect pendants painted on canvas to show identical prepared supports. However, we cannot know until a broader survey of thread counts has been made. In the case of the two supposed companions, Lucas de Clercq and Feyntje van Steenkiste (cat. 46, 47), not only is the canvas support different, but their primings are also at odds. Lucas de Clercq's consists of two layers and contains more umber than Feyntje van Steenkiste. Feyntje's has three ground layers with red ochre added in the top layer, which makes the painting ground slightly more pinkish. It has been suggested earlier that supports could be cut from a single strip of canvas, which was pre-stretched and primed. If these canvasses also have identical grounds, the supposition is reinforced. Apart from pendants, nearly all the grounds examined differ slightly in composition, even when the pictures are close in date. This, together with the fact that many different grades of canvas were used, would suggest that Hals did not keep a large roll of canvas in his studio, but rather that he acquired his canvasses and panels with the ground applied from a supplier in small batches. It is even possible that the patron supplied his own primed support for his portrait. It has been pointed out earlier that preparing canvasses and panels was a separate profession. In 1631, the St. Luke Guild in Haarlem, which Hals joined in 1660 (Hals doc. 9), clarified the profession of the primmuurder as an identifiable craft within the guild.  

So can any significance be attached to the type of ground used? The effects of the two types of ground, chalk with a tinted imprimatura and the oil ground made chiefly with lead white and umber, are only slightly different. The first one appears slightly more yellowish with a granular texture, while the second seems in general very light and smooth. There is no consistent correlation between ground and support. One is lead to conclude that Hals views his ground primarily as a smooth painting surface. However, he does appear to have exploited slight variation in the colour of the grounds, usually light pink to ochre, to provide warm mid-tones showing through white collars and cuffs in portraits on both panel and canvas. With the exception of the Fitzwilliam Man (fig. 8b; s218) and the Man in a Slouch Hat (cat. 83), this use of a flesh-coloured priming when canvas is not in Haarlem. A possible explanation for the two notably different grounds of the Fitzwilliam Man (fig. 8b; s218) and the Man in a Slouch Hat (cat. 83) is that the primed supports were acquired from somewhere else.

PAINT LAYERS

Hals seems to have first sketched his forms using blackish or brownish lines applied thinly with a brush, directly onto the primed painting support. Where areas of
light paint have become more translucent, these underpainted lines are sometimes left visible where they draw the folds of ruffs or indicate the end of a sleeve or cuff. In the lower left corner of the Married Couple in a Garden (cat. 12) for example, where an early stage in the painting process seems to be revealed, these lines can be clearly seen just beyond the left side of the man. Lines of drawing are also visible around the right side of the head of the Oxford Woman (cat. 79) where the placement of her whole figure has been changed, and they seem to relate to the fixing of an earlier position for the head (vrij). The fluent appearance of these underdrawing lines suggests a swift sketch of the composition, which was often modified in the finished painting. Recent examination of Hals’s large group portraits in Haarlem and Amsterdam has revealed frequent revision occurring at various stages in the process of their painting (Levy-van Halm & Abraham, p. 97ff). These observations suggest a flexible working process, and may explain the apparent absence of any preparatory studies for Hals’s group portraits. However, we cannot discount his possible use of even a most rudimentary compositional sketch which was subsequently discarded.

Following the stage in which forms are set down using painted lines, the next stage appears to involve the laying in of the main areas of colour. Examination of the paintings suggests the use of a variety of coloured underpaints. Black clothing often appears to have been underpainted in thin washes of brownish to greyish paint. Like the underdrawing, this paint is visible in only a few places through upper paint layers, for example, where the white layers of the left glove and cuff against the black drapery do not quite meet in the Edinburgh Woman (vrijl, from cat. 8). Thin brownish paint, for example, shows through the thinly painted black costumes of all five guard pieces (57, 545, 546, 579, 5124), and locally through the black cap of Zaffins (cat. 1). Unusually, in the dresses of the Regentesses (cat. 86) large areas have been left open in upper paint layers to provide warm mid-tones. The dark underpaint can be recognised in paint cross-sections as a thin (c.5-10 μm) layer with a mixture of pigments differing slightly from those used in overlying paint. In the Portrait of a Man (cat. 70) at the Metropolitan Museum of Art, lead white, a carbon black and a little yellow ochre and umber were used. In the Regents (cat. 85), where the layer is thicker (c.22 μm) bone black was used in addition to the pigments used for the top layers, which include smalt (a glass coloured blue by cobalt oxide) and green verditer (an artificial copper pigment manufactured in the seventeenth century). Due to the catalytic action of the umber, small or green verditer pigments added, these thin paint layers would dry quickly, allowing the following stage in the painting process to be resumed quickly.

Sometimes strokes of light paint also underlie black clothing. For example, in Feyntje van Steenkiste (cat. 47), evidence of whitish strokes sketching the axis and form of her left sleeve is revealed by abrasion of the overlying black paint layer. In the black costumes of the Portrait of a Man and of the Regents and the Regentesses (cat. 70, 83, 86), thick underlining impasto strokes, which only sometimes relate to the highlights and forms finally painted, are visible as ridges in raking light. Paint samples show that these are grey in colour, containing lamp black mixed with lead white. Due to their thickness and lead white content, they provide a clear, positive image in the X-ray. Perhaps it was necessary to apply these light strokes to regain clarity where the dark underpainting had covered too much of the light priming. Light collars and cuffs are often first sketched using strokes of whitish paint which suggest the limits and main forms of the folds. These lead white containing underpaint can be clearly seen on the X-ray when the final collar or cuff departs in size or shape, as in the Regents (see fig. 3).

Flesh paint is underpainted using colours which vary from white to pinkish to reddish. Paint samples show that whilst the hand of the Bearded Man with a Ruff (534) is underpainted using a light red (containing vermilion mixed with lead white and a little ultramarine), the right hand of Paulus Verhoeven (cat. 56) is underpainted with white (lead white mixed with chalk). A pinkish underpainting appears to be most common, as locally visible around the edges of the hands of the Regentesses (cat. 86).

A number of paint samples taken from the sashes of the five militia pieces in the Frans Halsmuseum, Haarlem (57, 545, 546, 579, 5124) show their variously coloured underpaints, which are more subdued than the final colour. Grey paint (white mixed with fine lamp black) underlies the blue and sometimes the red sashes. Red and yellow sashes are underpainted with yellow mixtures (containing yellow ochre or an organic yellow). Blue sashes are also underpainted using pale blue mixtures containing indigo (also used for the final paint layer).

This preliminary laying in of areas using various colours could be associated with the stage of painting termed 'dead colouring' in sixteenth and seventeenth-century documents and treatises. An article in the 's-Hertogenbosch charter of 1546, issued by the Guild of St. Luke...
in Haarlem, stipulates that on panel each colour must first be 'dead coloured' and in this way come to lay on a double ground. According to Miedema, this prescription was made as a method of achieving quality control, and, though differing in concept, Hals's practice of dead colouring stems from this requirement. Writers have defined dead colouring in different ways, so the term remains rather elusive. However, van Mander must have had a painter such as Hals in mind when he wrote:

These fellow-artists go to it, without taking great pains, working direct with brush and paint with a free approach and thus set down their paintings defy in the dead colour; they 're-dead colour' too sometimes, soon after, so as to achieve a better composition. Thus those who are abundantly inventive go audaciously to work, thereafter making an improvement here and there.

This statement suggests that a dead colour stage could be used as a way of producing a more or less final design. Paint samples did sometimes show several thin superimposed layers of underpaint which indicate that, in their dead-coloured state, the paintings did not just consist of flat patches of colour. Often it is hard to distinguish where these dead colour layers end and the following stage of paint application begins, especially when the composition of paint layers applied in both stages is similar. A break in the work process is sometimes suggested by the presence of a thin layer of medium in between paint layers. This medium seems to have been used for oiling out, i.e. wetting the surface in order to saturate the colours for better visibility when painting was resumed. The documents relating to the Meagre Company (cat. 43; Hals docs. 73-5, 78) also suggest that the partially dead-coloured state in which Hals left it was considered as a provisionally completed stage of the painting, which could be taken further by another painter. A revision in the head of the regentess seated to the left behind the table in the Regentesse (cat. 86), provides another piece of evidence that dead colouring could possess rather refined modelling (fig. 6). Microscopic examination of the earlier underlying head (to the right of that now visible) which seems to have been left in its dead-coloured state, through the craquelure of the overlying background paint, suggests that it has been modelled, varying in local colour from white to light pink and grey.

From these observations we can gain an idea of the general appearance and use of the dead colour stage in paintings by Hals. The dead-coloured stage of painting seems to have been used for the first lay-in of coloured areas. This differs from the monochrome dead colouring found in early works by Rembrandt, which establishes the basic tones of the composition on the light priming. Hals's dead colours are usually more subdued than the colour of final paint layers, and often show a different combination of the same pigments. The painting can be taken far in a dead-coloured stage. Dead colouring is sometimes absent from areas or even whole paintings which are painted using a direct and open manner (Young Man with a Skull (cat. 29) and Man (fig. 85b; 218)), proving that it was not a rigid procedure.

The opmaakken or working-up of the painting would follow. In Hals's portraits this seems to involve achieving nuances of colour, detailing the elements and fixing the final contours. Sometimes the period between dead colouring and working-up must have been short, since paint samples show that the dead colour was still wet when painting continued, causing the underlying paint layer to be pulled up and mixed.

For the execution of his portraits, Hals's procedure must have depended on his sitter's time and commitment as illustrated in the documents on The Meagre Company (cat. 43). Here Hals first suggests working up the clothing and then executing the heads of the incomplete figures (Hals doc. 78). Constantijn Huygens recounts how the painter Jan Lievens first painted Huygens's clothing and bare hands and postponed the
painting of his face until spring, since the days were short. In early paintings by Rembrandt, figures appear to have been painted in after the background had been laid down. On the other hand, an unfinished picture by Van Dyck shows that some painters would start with the head. A study of the areas of overlapping paint, on the surface of the picture itself and in sample cross-sections, make it possible to reconstruct Hals's normal sequence of working up the various parts. The figures appear to have been worked up against the painted background, though overlap of the figure on the background is by no means as great as in the early paintings of Rembrandt. The close junction at the Point of contact between the background and the figure is often obscured by final contours and touches added to draw them together. In rapidly executed portraits, such as Tielerman Roosterman (Riesboer, fig. 10, 193), the background and figure have been worked up more or less simultaneously. A paint sample taken near the edge of the black drapery shows that the latter overlaps the thinly painted greenish-grey background, whereas the background paint is clearly swept over the top of the hair.

Draperies are usually painted first, the hands being left in reserve to be filled in later. Sometimes the hands are painted entirely over the finished drapery (vrrrr, from cat. 4z). Most likely the hands were usually painted together with the face. In painting the face, the lips are added last, either into an area blocked out in the ground layer or over the flesh or moustache. The hair is detailed, often bringing strands of hair or flesh-coloured strokes across the sudden transition where hair meets flesh (vrrrr). The hair is also worked into background paint which is still wet (vrrrr, from cat. 24). Collars and cuffs are completed, overlapping the paint of flesh and draperies around their edges (fig. 3, from cat. 8y). Cuffs are sometimes painted entirely over a finished sleeve (see cat. 4z) or blocked out (vrrrr). Ends of hair locks, which can appear dissociated from the rest of the hair (vrrrr, vrrrr), are sometimes added over the collar to integrate it (vrrrr, from cat. 8y). Jewellery is added over the flesh. Final contours and touches are then applied, sometimes into wet paint.

These observations accord with van Dantzig's conclusion that the sequence of the build-up progresses from the background to foreground features. However, as with other aspects of Hals's technical procedures, exceptions to this general observation should be noted. The peripheral hand of the Fitzwilliam Man (4210), for example, overlapping the cuff, was the last element to be added, as if almost forgotten. Such idiosyncrasies occur most frequently in Hals's group portraits, where his procedure must have depended especially on the availability of his sitters.

From the 1630s onwards, Hals was largely confined to painting the sombre regent fashion of black garments. Examination in raking light of these black draperies in a number of paintings reveals relieved brushstrokes which enliven the surface. Where they underly the black paint layer, they often bear no connection with the forms and modelling of the garments at the surface, and have to do with an earlier painting stage. In other cases, distinct relieved strokes lie at the paint surface (Jean de la Chambre, Feyntje aan Steenkiste, cat. 5o, 47). Typically they appear fluid with rounded edges which have been pushed up. This property has to do with the consistency of the paint applied, and can also be found in white and coloured strokes. Such a white stroke, on the left cuff of Lucas de Clercq (cat. 46) has been used as one of the few accents which enliven his sombre costume.

Paint samples show that the typical build-up of the black draperies is first a layer containing lamp black, either pure or mixed with lead white or bone black. Bone black, sometimes with umber added, was then used for the deepest tones, and lamp black mixed with lead white for the cool greyish highlights. Sometimes small quantities of ochres and umber were used. Copper verdigris was found in many of these blacks, although only in a few cases could green pigment particles be distinguished under the microscope, indicating that a soluble copper compound had been added to speed up the drying process. This corresponds closely to de Mayerne's described method for painting black draperies, that is first to use lamp black mixed with lead white and umber, and then to deepen the colour using ivory black mixed with verdigris.

Green verditer was identified in a few places in draperies which did not appear green (Laughing Boy, Regents, Regentesses, cat. 16, 85, 86). In the front panel of the dress of the Woman (Jowell, fig. 2; 818g), the green was not used as a drier, but was combined with red glazes for its colour to suggest the shot-silk material (vrrrr). The grey, watered satin costume of Claes Dwyst van Voorhout (cat. 5z) was rendered by adding azurite, an organic red pigment, and black to the lead white in the top layer, which overlies the lead white/lamp black mixture. Highlights were blended in with different proportions of these mixtures, for instance in the arched stroke circumscribing his left elbow, or thinly scumbled over the grey.
In some of Hals’s most direct paintings the draperies seem to have been chiefly laid down in one layer, straight onto the ground (Young Man with a Skull, [cat. 29]. Fitzwilliam Man [fig. 85b; 8218], Man in his thirties, [s81]). In the Young Man with a Skull (cat. 29), large areas of light reddish ground have been left visible through openings in the paint layer to provide warm mid-tones. Adjacent areas have been swept into each other whilst still wet, using hatched strokes (viii). A swift technique is also apparent in the painting of the red sash, from which a sample shows application of the red over brown whilst still wet. In the Fitzwilliam Man (fig. 85b; 8218), the swiftness of painting the draperies is almost sloppy. Arbitrary splashes of vermilion appear scattered around the yellow impasto on his right cuff and on the grey drapery below. About a century ago, observation of such displaced drops of paint on another late portrait were attributed by Bode and Moes to a trembling hand and short-sightedness, which Silve called patent nonsense.61 In these draperies, splashes of solvent have even been allowed to run down the painting and dissolve paint layers (viii). This can also be seen in the draperies of the Merry Drinker (cat. 30) and (less obviously) in the Edinburgh Man (cat. 17). In the Fitzwilliam Man (8218) and the Merry Drinker (cat. 30), Hals’s rapid technique is also evident from the way he draws a few hairs by scratching through the wet paint. Similarly the contour of the nose of Young Man with a Skull (cat. 29) is scratched in. This short-cut device can be associated with Hals’s more swiftly executed paintings, though he never uses it to the same extent as Rembrandt.62

In Hals’s rendering of cuffs, as with collars, we can trace a development in his technique which corresponds to their changed material and structure in keeping with fashion. In the Man holding a Skull (cat. 3) the stiff ruffles are sculpted by pushing through turning strokes of white impasto, which more or less reveal the underlying black sleeve (viii). The different densities of white in the strokes suggest various transparencies of the linen, whilst the relieved edges to strokes draw the edges of the ruffles. The pattern of the open lace edging to the cuffs of Cornelia Vooght (cat. 42) has been rendered using thinly applied white lines over the black sleeve (viii). Only a few black accents have been added on top, when they are too small to leave in reserve in the underlying black. The lace edging to the cuffs of Maria Larp (s112) shows a different approach. The reserves in the lacework have taken on a more imminent identity, being painted with separate black touches, either under or over the white (viii). In the lace edging of the cuffs of Tieleman Roosterman (Biesboer, fig. 10; 193) this change in technique goes a step further. The more closed structure of the white lace has been painted as a homogeneous layer. The openings in the lace which reveal the underlying black sleeve have become the figurative element, and are suggested by touches of black and grey on top. Comparison with Cornelia Vooght (cat. 42) reveals how the procedure of rendering patterned lace has been reversed, reflecting its changed structure.63

Hals’s portraits are consistently lit from the left, causing a shadow to be cast on the right.64 At its simplest, the background was painted using a single, thin paint layer, as in Tieleman Roosterman (893; viii). In places, the greenish grey paint has been brushed on very thinly using bold zigzag strokes, which reveal the underlying pinkish ground. Paint samples show that this paint contains lead white, lamp black and ochres. Different coloured ochres and the addition of bone black model the background layer. Painted two decades later, the greenish grey background of the Vienna Man (8184) is also a single paint layer containing these same pigments, modelled and applied in the same streaky way. The olive green background of Lucas de Clercq (cat. 46) is also one paint layer, simplified even further by the use of only one black pigment for modelling, possibly bone black. Only in the greyish green backgrounds of two small paintings on panel, Petrus Scribuerus (536; see cat. 20) and Anna van der Aar (cat. 20), was a finely-ground charcoal black pigment found. In addition to the pigments mentioned so far, umber is often encountered in background paint mixtures. Despite the simple character and build-up of the backgrounds in Hals’s single portraits, and the limited range of pigments used, they do show a wide variety of colouring. An exceptionally elaborate modelling is apparent in the olive green background of Feyntje van Stenkiste (cat. 47). The colour has been adjusted toward a lighter colour in a build-up of three paint layers, perhaps to coordinate with the lighter background of her husband’s portrait (cat. 46). The first paint layer was dry before it was adjusted by subsequent layers, which overlap the black drapery in places and have been applied as touches over the left side of her cap, suggesting that the adjustments were made at a late stage of painting. The thicker build-up of the background paint layer compared to that of her husband, which is abraded, can be seen clearly on the painting.

From the examination, it is clear that the landscape backgrounds of the 1639 and especially the 1633 militia pieces, as well as the backgrounds in the Regents and Regentesses (cat. 85, 86) have changed considerably in the course of time, due to the effects of natural ageing. The curtains, tablecloths and cushions in the Regents and Regentesses would have been a crimson colour,
more vivid than they are now, and with more modelling. The paint mixtures used in these areas are responsible for the broad drying cracks. Darkening of the paint medium in the two guard pieces has changed the balance of light and dark in these paintings. We can only recover some idea of the depth and detail which the background in the Regents would originally have possessed from a watercolour copy executed by Wybrand Hendricks, probably in the nineteenth century (fig. 8). There is also a Wybrand Hendricks watercolour copy of the 1633 militia piece which possibly indicates the earlier appearance of the background landscape.66

Many of the portraits display a coat of arms. It has been suggested that those on Nicolaes van der Meer and its pendant Cornelis Vrooijt (cat. 41, 42) are both inaccurately rendered.67 Paint samples have shown that they are later additions over the varnished background paint. Analysis identified the blue pigment in the emblems as Prussian blue, which only became available to artists around 1720. The coat of arms must have been added after this date, most likely in the eighteenth century, when attempts were first made to identify and reunite companion portraits. Prussian blue was also found in the coats of arms in Tieleman Roosterman (193; vlu), Jacob Obcon (cat. 18) and Aletta Hanemans (cat. 19), confirming that these too must be later additions.

Though there can be no talk of discovering any standard procedure in the creation of Hals's portraits, this essay attempts to describe characteristics which recur in the rendering of their various elements. When drawing conclusions from the results obtained in this investigation, one has to bear in mind that the forty paintings examined represent a small proportion of the two hundred and twenty-two attributed to Hals. Also, it was possible to investigate some pictures more thoroughly than others, largely because they were undergoing restoration and hence available for examination over a much longer period. Despite these reservations, certain conclusions can be drawn from this first attempt to analyse the materials and techniques used by Hals.

First, although his handling of paint sets him apart from his contemporaries, the supports for his paintings are in keeping with seventeenth-century practice in the Netherlands. There is some chronological pattern in Hals's increased use of canvas in place of panel, which agrees with seventeenth-century practice. Second, a specific chronological pattern is nearly absent in his primings, the later ones being only slightly darker. Hals's pictures are inconsistent in the materials used for their primings. In this respect, his procedures differ from Rembrandt's. For Hals, the main objective of his primings seems to have been to obtain a flesh-coloured painting ground through whatever materials seemed appropriate. This flesh-coloured priming in both his canvases and panel paintings stems from a tradition in Netherlandish painting on panel. Third, where he used rich glazes in the early Chatsworth Woman (cat. 3), he was still employing this technique in the late Regents and Regentesses (cat. 85, 86), although this is not so obvious now to the naked eye due to ageing of the paint film. Hals's use of particular pigments for rendering draperies, and his use of stuccowork for the slow-drying blacks, agrees fully with recipes of the period. Lastly, one can say that as one moves through Hals's career there is an increase in the looseness of paint application in his portraits, which already appears in his genre paintings, of which the 1656-8 Young Man with a Skull (cat. 29) is an example. Hals works spontaneously with the brush, from the first sketching-in of the composition up to the final touches, hereby contradicting what, according to Houbraken, he himself said about only the finishing touches being the hallmark of the master.68

Notes
1. For an account of their restoration see Middelkoop & van Grevenstein 1988.
3. Van Dantzig 1957.
4. Most of the paintings were examined and photographed in situ. The paint surface was examined with an operation microscope, using magnifications up to 400, and selected areas photographed. After obtaining permission from the owners of the paintings, paint samples (generally 0.5 mm in area) could sometimes be removed for cross-sectioning and micro-chemical tests. The cross-sections were made by embedding each sample in a block of polyester resin. The block was ground down and polished until the side of the sample was exposed to the surface of the block. The cross-sections were then examined under a Leica Ortholux microscope in normal and long wavelengths of incident light. Remains of the sample material were used for microscopic examination in polarized light, and for micro-chemical tests. Further identification of the elements present was done with the electron microscope in the Department of Earth Sciences, University of Cambridge. This technique enables chemical analysis on very small samples, and therefore on individual paint layers in the cross-section. The presence of varnish, for instance, was confirmed by the occurrence of peaks for both manganese and iron in the X-ray spectrum collected by this technique.
5. The samples were too small for analysis of the paint medium by gas chromatography. From observation during micro-chemical testing, the medium seemed to be mostly a drying oil.
6. Radiographs of the Chatsworth and Birmingham pictures were made in situ by Chris Hurst, using a Gilardoni portable X-ray machine. Radiographs of the five militia pieces and three regent group portraits in the Frans Hals museum were made by G. van de Vooorde, of the Koninklijk Instituut voor het Kunstpatrimonium in Brussels, using special large format X-ray equipment.
crosssectional film. Radiographs were also kindly provided for examination by the Rijksmuseum in Amsterdam, the National Gallery, London, the Iveagh Bequest in Kenwood House, the Metropolitan Museum in New York, and the National Gallery of Art in Washington.

5. We are very grateful to the following institutions which have kindly allowed us to examine their paintings by Hals: Amsterdam, Rijksmuseum and Jan Six Collection; Birmingham, Barber Institute of Fine Arts; Cambridge, Fitzwilliam Museum; Chatsworth, Duke of Devonshire's Settlement; Edinburgh, National Gallery of Scotland; The Hague, Mauritshuis; London, National Gallery, Iveagh Bequest in Kenwood House, and the Royal Collection in the Queen's Gallery, Buckingham Palace; New York, Metropolitan Museum of Art; Oxford University, Christ Church College; Venice, Kunsthistorisches Museum; and other private collections.


8. In addition, A. van Dorssen, unpublished report on pigments and other technical information on paintings by Hals, 1998, lists some changes made in the paintings, as found on these two paintings by Hals, namely Portrait of a Man (c. 1648), Berlin-Dahlem, Staatliche Kunstsammlungen.

9. Van Dantzig 1937 incorrectly states that the panel of Cornelia Vooght comprises five vertical strips matched that of the original painting. Before intervention, the size of the canvas, which now measures 600 x 80.8 cm, can be reconstructed to have been 619.7 x 77.3 cm.

10. In the last-named painting the evidence was obtained from the X-ray.

11. Van de Graaf, 1958, p. 141, no. 18: ‘De Imprentier van de toille seche que l'Imprimeur ne peint pas a truite.


13. In the last-named painting the evidence was obtained from the X-ray.


15. Ibid., pp. 75-8.

16. Van de Graaf 1958, p. 141, no. 18: ‘De Imprentier van de toille seche que l'Imprimeur ne peint pas a truite.


18. Ibid., pp. 75-8.

19. Ibid., pp. 75-8.


23. Technical information on this painting came to light during its restoration by Ian McClaire, Director of the Hamilton Kerr Institute, University of Cambridge, who is preparing a separate report for publication.

24. Neumann 1875, p. 319, points out an advantage of some pigments in the paintings: large paintings and, when well primed, easiest to transport (‘bequemst voor groote stukken, en wel gepriemt nuikt liederen te worden’). Van der Meer, 1957, p. 216, mentions that canvas is of little weight and is easily transported when rolled up.

25. Two other paintings in the Frans Halsmuseum, De Greber's military piece of 1619 (slightly reduced in size) and Pieter Soumat's military piece of 1623, both painted on a canvas, are still extant.

26. For discussion of this point see Bruyn et al. 1982, vol. 2, pp. 49-52.

27. Paint samples confirm that the build-up and composition of paint layers on the transferred strip matched that of the original paint. Before intervention, the size of the canvas, which now measures 600 x 80.8 cm, can be reconstructed to have been 619.7 x 77.3 cm.

28. Due to inconsistent records of the painting's earlier size, it is not possible to say when this mutilation took place.

29. A ridge of priming along the original rolled stretching edge, which has been opened out, is visible in the X-ray.

30. We are grateful to Mr. H. Brummer and his colleagues of the Staatliche Kunsthalle, Kassel, for providing information about their painting.

31. Houbraken 1729-31, pp. 90-2, relates how, when Van Dyck visited Hals's studio unrecognised, Hals 'took up the first canvas that came to hand' to paint his portrait ('zoek goed en zoo kwaad, als by (een man naan de hand had)'). Although the visit was most probably spurious, it is worth noting. See Houbraken's life of Hals in this catalogue, pp. 17-8.

32. Van de Graaf 1958, p. 141, note 6-20. De Mayerne mentions several recipes which suggest smoothing the priming layer using a curved priming knife or pumice stone. Exceptionally, the texture of the Regentenraads canvas does seem to have been exploited. In places of thinness paint application has left strokes catch on the high points of canvas weave, reflecting its characteristic structure. Though exaggerated by past lining treatment this effect does seem intentional.

33. In the last-named painting the evidence was obtained from the X-ray.


35. Ibid., pp. 77-8.

36. Ibid., pp. 77-8.

37. Van de Graaf 1958, p. 141, note 18: ‘De Imprentier de la toille seche que l'Imprimeur ne peint pas a truite.'
to an earlier stage in the painting process and were applied in order to indicate the position of collars, cuffs and hands. A similar procedure was observed on examining the Portrait of a Woman (1631) under the operation microscope.

Miedema 1987, p.141: '... op goed droge eyckenboert of fangeschoot, zijnde elke verve tient gedooverwer ene slooe op eene dobben len groot.'

The 's-Hertogenbosch charter of 1546 refers to the dead-colouring technique of the early Flemish masters, whereby thin and transparent glazes are built up over the pure dead colour. An alternative description of dead colour is given in a Dutch text cited in the English manuscript of Thomas Marshall's 'Commonplace-book' of c.1640-50, which describes areas of even colour which approximate the final colours in their flat tints. See Vey 1960. Neither of these conceptions of dead colour conform to what we have observed in paintings by Hals.

Miedema 1973, ch.12, 5: 'En vullender van strack, zonder veel quelen! Met pinceel en verwa, in sinnen vrymoedich! En dus schilde rende deze ware-pletenen, Fran dungien weerdigh in door-verwen stelten! Herdenover-wen oock te somtijden spoedigh! Om stellen beter: dus die overvloedich! In th' inverteren zijn, dunt ale de stoutes! En verbeteren later on dree een foote.'

This is suggested by the thinnest of the paint layers (apparent in raking light) and its low-density image on the X-ray, which indicates little modelling using lead white pigment: unpublished report by Michaela Burek, 1985, Frans Halsmuseum.


Huygens 1879, p.98. Constantijn Huygens (1596-1687) wrote about his meeting with Lievens in an autobiographical sketch of his youth around 1629. The full, original Latin text is in Woop 1897.


<table>
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<tr>
<th>No.</th>
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<td>I. Zaffius</td>
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<td>p.</td>
<td>white</td>
<td>lead white, a little red ochre and fine black, yellowish medium</td>
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<td>Man with skull</td>
<td>c. 1610</td>
<td>p.</td>
<td>whitish</td>
<td>lead white, a little red ochre, umber and coarse charcoal black</td>
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<td>3</td>
<td>Woman</td>
<td>c. 1610</td>
<td>p.</td>
<td>whitish</td>
<td>lead white, a little red ochre, umber and coarse charcoal black</td>
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<td>Militiamen</td>
<td>1616</td>
<td>c.</td>
<td>flesh</td>
<td>lead white, umber, a little bright red ochre and black (2 layers, maybe a little chalk in the top one)</td>
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<td>Man</td>
<td>1622</td>
<td>c.</td>
<td>light brown</td>
<td>lead white, a little chalk, umber, finely ground bone black</td>
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<td>c. 1620-3</td>
<td>p.</td>
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<td>1625</td>
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<td>grey</td>
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<td>1625</td>
<td>c.</td>
<td>grey</td>
<td>lead white, red ochre, umber and charcoal black (2 layers, maybe a little chalk in the top one)</td>
</tr>
<tr>
<td>9</td>
<td>Bearded man with ruff</td>
<td>1629</td>
<td>c.</td>
<td>light yellowish</td>
<td>lead white, very little red ochre and fine black (a little red lead?)</td>
</tr>
<tr>
<td>10</td>
<td>Scribeius</td>
<td>1629</td>
<td>c.</td>
<td>light greyish-ochreous</td>
<td>lead white, a little red ochre</td>
</tr>
<tr>
<td>11</td>
<td>Anna van der Aar</td>
<td>1646</td>
<td>p.</td>
<td>yellowish</td>
<td>lead white, very little red ochre, very little fine black (layers, the bottom one more greyish)</td>
</tr>
<tr>
<td>12</td>
<td>Militiamen</td>
<td>c. 1627</td>
<td>c.</td>
<td>light pinkish</td>
<td>lead white, little red ochre, very little fine black and very little organic red</td>
</tr>
<tr>
<td>13</td>
<td>Militiamen</td>
<td>c. 1627</td>
<td>c.</td>
<td>flesh</td>
<td>lead white, a little red ochre, very little fine black (layers)</td>
</tr>
<tr>
<td>14</td>
<td>Verdonck</td>
<td>c. 1627</td>
<td>ocher</td>
<td>lead white, chalk, a little red lead (7)</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Young man with skull</td>
<td>c. 1626-8</td>
<td>cold pink</td>
<td>lead white, a little red ochre and fine black; and lead white, umber, a little red ochre and very little organic red and black</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>N. van der Meer</td>
<td>1631</td>
<td>p.</td>
<td>white</td>
<td>sable/glue with imprimatura: lead white, chalk, ochre, umber, very little fine black</td>
</tr>
<tr>
<td>17</td>
<td>C. Vooight</td>
<td>1631</td>
<td>p.</td>
<td>white</td>
<td>sable/glue with imprimatura: lead white, chalk, ochre, umber, very little fine black</td>
</tr>
<tr>
<td>18</td>
<td>Militiamen</td>
<td>c. 1633</td>
<td>c.</td>
<td>light flesh colour</td>
<td>lead white, umber (2 layers, and ground darker)</td>
</tr>
<tr>
<td>19</td>
<td>Man in his 30's</td>
<td>1633</td>
<td>c.</td>
<td>light yellowish</td>
<td>lead white, a little umber</td>
</tr>
<tr>
<td>20</td>
<td>P. van der Broecke</td>
<td>c. 1633</td>
<td>c.</td>
<td>light ochreous</td>
<td>lead white, umber, very little red ochre, very little fine charcoal black (2 layers)</td>
</tr>
<tr>
<td>21</td>
<td>T. Hoosterman</td>
<td>1634</td>
<td>c.</td>
<td>light pinkish</td>
<td>lead white, umber, very little red ochre and black (2 layers)</td>
</tr>
<tr>
<td>22</td>
<td>L. de Clercq</td>
<td>c. 1635</td>
<td>c.</td>
<td>pink-ochre</td>
<td>three layers wet-in-wet: lead white, umber, very little red ochre added in 3rd ground</td>
</tr>
<tr>
<td>23</td>
<td>F. van Steenkiste</td>
<td>1635</td>
<td>c.</td>
<td>light pinkish</td>
<td>Only little umber in the 3rd ground and ground darkest (umber)</td>
</tr>
<tr>
<td>S no.</td>
<td>Picture</td>
<td>Date</td>
<td>Panel colour</td>
<td>Canvas colour</td>
<td>Composition</td>
</tr>
<tr>
<td>-------</td>
<td>---------</td>
<td>------</td>
<td>--------------</td>
<td>---------------</td>
<td>-------------</td>
</tr>
<tr>
<td>118</td>
<td>M. Laurens</td>
<td>c. 1638-40</td>
<td>Light</td>
<td>Yellowish-brown</td>
<td>Lead white, black, umber, very little red ochre; Medium-rich at the top. Imprimatura: lead white, chalk, umber, very little fine charcoal black and red ochre.</td>
</tr>
<tr>
<td>119</td>
<td>C. Duft van Voorhout</td>
<td>c. 1638</td>
<td>Light</td>
<td>Yellowish</td>
<td>Red lead white, chalk, very little black.</td>
</tr>
<tr>
<td>122</td>
<td>J. De la Chambre</td>
<td>c. 1639-40</td>
<td>Light</td>
<td>Yellowish</td>
<td>Lead white, very little red ochre.</td>
</tr>
<tr>
<td>124</td>
<td>Militia men</td>
<td>c. 1640</td>
<td>Light</td>
<td>Yellowish</td>
<td>Lead white, very little red ochre.</td>
</tr>
<tr>
<td>121</td>
<td>Woman</td>
<td>c. 1640-42</td>
<td>Light</td>
<td>Yellowish</td>
<td>Lead white, black, umber, very little red ochre.</td>
</tr>
<tr>
<td>123</td>
<td>Woman with Pan</td>
<td>c. 1640-42</td>
<td>Light</td>
<td>Yellowish</td>
<td>Lead white, black, umber, very little red ochre.</td>
</tr>
<tr>
<td>124</td>
<td>Paulus Verschuur</td>
<td>c. 1640-54</td>
<td>Light</td>
<td>Yellowish</td>
<td>Lead white, black, umber, very little red ochre.</td>
</tr>
<tr>
<td>156</td>
<td>Man</td>
<td>c. 1641-43</td>
<td>Light</td>
<td>Yellowish</td>
<td>Lead white, black, umber, very little red ochre.</td>
</tr>
<tr>
<td>157</td>
<td>Woman</td>
<td>c. 1641-43</td>
<td>Light</td>
<td>Yellowish</td>
<td>Lead white, black, umber, very little red ochre.</td>
</tr>
<tr>
<td>158</td>
<td>Man</td>
<td>c. 1641-43</td>
<td>Light</td>
<td>Yellowish</td>
<td>Lead white, black, umber, very little red ochre.</td>
</tr>
<tr>
<td>159</td>
<td>Woman</td>
<td>c. 1641-43</td>
<td>Light</td>
<td>Yellowish</td>
<td>Lead white, black, umber, very little red ochre.</td>
</tr>
<tr>
<td>160</td>
<td>Man</td>
<td>c. 1641-43</td>
<td>Light</td>
<td>Yellowish</td>
<td>Lead white, black, umber, very little red ochre.</td>
</tr>
<tr>
<td>161</td>
<td>Seated Woman</td>
<td>c. 1641-43</td>
<td>Light</td>
<td>Yellowish</td>
<td>Lead white, black, umber, very little red ochre.</td>
</tr>
<tr>
<td>162</td>
<td>Man</td>
<td>c. 1641-43</td>
<td>Light</td>
<td>Yellowish</td>
<td>Lead white, black, umber, very little red ochre.</td>
</tr>
<tr>
<td>163</td>
<td>Man</td>
<td>c. 1641-43</td>
<td>Light</td>
<td>Yellowish</td>
<td>Lead white, black, umber, very little red ochre.</td>
</tr>
<tr>
<td>164</td>
<td>Regents</td>
<td>c. 1641-43</td>
<td>Light</td>
<td>Yellowish</td>
<td>Lead white, black, umber, very little red ochre.</td>
</tr>
<tr>
<td>165</td>
<td>Regents</td>
<td>c. 1641-43</td>
<td>Light</td>
<td>Yellowish</td>
<td>Lead white, black, umber, very little red ochre.</td>
</tr>
</tbody>
</table>

(1) Colour as observed with the naked eye.
(2) Colour as observed through the stereo-microscope.
(3) Pigments identified using microscopy, micro-chemical tests and electron microprobe analysis.
a) Paint cross-section of a sample taken along the edge of the Zaffius panel (cat. 6), showing ground and paint layers extending over the edge of the panel (magn. x200).

b) The reverse of the Zaffius panel (cat. 1), which retains its original beveling on all four sides.

c) Detail along a reverse edge of the Fitzwilliam Man (cat. 8). The masterly applied, second, grey ground, has splashed around onto the back of the painting. The first, red ground is seen to have been pushed through the interstices in the canvas.

d) Detail along the bottom edge of the Fitzwilliam Man (cat. 8). The light-coloured, impasto paint stops short of the edge, which, after priming, was folded around a stretcher.

e) Detail of the collar of Nicolaes van der Meer (cat. 44). The brown underpainting over the white ground shows through the thin, translucent paint of the collar.

f) Paint cross-section of a grey highlight in the black drapery of Paulus Voorhout (cat. 56). This painting on canvas has a chalk ground with a yellowish underpainting on top (the even grey oval right of centre is an air bubble caught in the embedding material (magn. x200).

g) Cross-section through the scumbled white paint in the drapery in Claus II Depuyt van Voorhout (cat. 52). The cheap alternative for lead white, namely lead white diluted with chalk, was used for the bottom ground layer (magn. x200).

h) Cross-section through the deepest black in the drapery of the Fitzwilliam Man (cat. 8), showing the double ground. On top of a bright red earth there is a cool grey composed of lead white, charcoal black and umber (magn. x200).

i) Cross-section of the Man in a Slouch Hat (cat. 83), showing a double ground similar in color and composition to the Fitzwilliam Man (cat. 8) (magn. x200).

j) Macro-photograph of the Portrait of a Seated Woman (cat. 9), to the right of her head, with a black line of underdrawing showing through the thin background paint.

k) Macro-photograph of the Portrait of a Standing Woman (cat. 14), macro-photograph showing the greenish-grey background paint swept over the hair.

l) Tieleman Roosvluem (93), macro-photograph showing the greenish-grey background paint swept over the hair.

m) Detail of Cornelis Vrooht (cat. 42). The hand is painted entirely over the finished drapery.

n) Portrait of a Man in his Thirties (813), macro-photograph of the junction of forehead and hair, showing the abrupt transition with strands of hair brought across.

o) Macro-photograph of the hair of Verdonck (cat. 24). The curls are swept into the wet paint of the background.

p) Portrait of a Man (818a), macro-photograph of his collar, which is blocked out in the painting of the drapery. A final white contour of the collar overlaps the black drapery. This procedure contrasts with that in a painting like Cornelis Vrooht (cat. 42), where the cuff is not blocked out, but painted entirely over the finished sleeve.

q) Detail of the Portrait of a Standing Woman (cat. 18), locks of hair added over the collar to integrate it.

r) Macro-photograph of the Vienna Portrait of a Woman (1085), front panel of her dress. Green verditer was identified in the dark green of the shot-silk material (the same green pigment was identified in the strip added along the left-hand side; see the section on 'Canvas').

s) Macro-photograph of the drapery of the Young Man with a Skull (cat. 39). Rough, wet-in-wet sweetening or hatching of dark into light areas of the drapery. The light, pink-ochre ground is still visible through the hatching.

r) Macro-photograph of the drapery of the Fitzwilliam Man (953), showing Hals's sloppiness in some of his paintings. Splashes of solvent have been allowed to run down the painting, dissolving paint layers.

u) Macro-photograph of the Man holding a Skull (cat. 2). The stiff ruffles of the cuff are sculpted by pushing through turning strokes of white impasto, locally revealing the underlying black sleeve.

v) Macro-photograph of Cornelis Vrooht (cat. 42), showing that the cuff is rendered with thinly applied white lines over the black sleeve.

w) For Maria Larp (8113), macro-photograph, the reserved in the lacework take on an independent identity, being painted with separate black touches either under or over the white.

x) Macro-photograph of the background in Tieleman Roosvluem (93), painted on thinly with zigzag strokes which reveal the underlying pinkish ground.

y) Cross-section of the blue in the coat of arms of Tieleman Roosvluem (93), where Prussian blue was again identified (magn. x200).