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# The Techniques of Dieric Bouts: Two Paintings Contrasted

David Bomford, Ashok Roy and Alistair Smith

## Introduction

Alistair Smith

Four paintings by Dieric Bouts are owned by the National Gallery [1]. Three are painted on panel and one on linen. In 1985, one of the former (*The Virgin and Child*, No.2595; Fig.1 and Plate 7, p.55) was cleaned thus providing the opportunity for a detailed technical examination. The interest of this study is increased because of the Gallery's good fortune in possessing also the linen painting (*The Entombment*, No.664; Fig.5 and Plate 5, p.55), since it exemplifies the work of the same artist on a different support and in a different medium. This article is able, therefore, to describe something of the range of Bouts's techniques.

This introductory note aims to parallel the revelation of the technical contrast between the two works below with a brief exposition of their different functions and contexts.

*The Virgin and Child* measures only 37 cm. (14 $\frac{3}{8}$  ins.) from top to bottom. The figures are, therefore, considerably less than life size. Both the size of the painting and the scale of the figures are directly comparable to Bouts's *Portrait of a Man* (No.943) and other Netherlandish portraits of the time (for example, Rogier van der Weyden's *Portrait of a Lady* (No.1433), Memlinc's *A Young Man at Prayer* (No.2594). Since it is accepted that these portraits were painted for domestic interiors, it follows that *The Virgin and Child* was probably also planned for such a location and intended for private devotion. Scholars have considered the possibility of the painting having been part of a diptych or triptych, in which case it would have been flanked by similar portraits. But the centralized composition and self-sufficient narrative makes it more probable that it was an independent unit.

Since *The Virgin and Child* and *The Entombment* are not very different in size and scale of figures, one might easily suppose that the latter was designed for a similar function and location. This is not the case. In the fifteenth century, *Entombments* were invariably made as part of a complex, generally as part of an altarpiece made up of several paintings. As one might expect, Bouts's *Entombment* is known to have been associated with other paintings as late as the mid-nineteenth century. It was seen in Milan by Sir Charles Eastlake who described the series thus [2].

Four drawings or pictures in tempera by Rogier van der Weyden — one under glass only offered for sale — The Deposition from the Cross (for about £200) — other subjects — The Adoration of the Kings — Presentation — Annunciation — those drawings originally in the possession of the Foscarini family found their way to Vienna where Guizzardi, envoy from Milan, purchased them early in the present century — Poldi was (in 1858) in treaty for the drawing in question (called, as usual Lucas Van Leyden) — Q? are/will the other three be hereafter saleable?



Figure 1 Bouts, *The Virgin and Child* (No.2595), panel, 37.1 × 27.6 cm., after cleaning and restoration.

The National Gallery *Entombment* is the painting which Eastlake describes as the *Deposition from the Cross* by Rogier van der Weyden. From his note, it would appear that he may not have seen the other pictures, which were not offered for sale. His concern about their being possibly available for acquisition doubtless resulted from his natural desire to acquire the whole complex rather than one isolated example.

Some details were clarified when he visited Milan again in 1860 when he saw at the 'Casa Guiccardi' [3].

No.366 — The drawing or tempera painting by Rogier V. der Weyde (called as usual 'Luca di Leida') — 2.10 $\frac{1}{4}$  h. 2.4 w. cloth — under glass. Entombment — C. supported by Jos. of Arim. female more in front supporting feet with Nicod. behind the tomb three Maries + St. John — landscape (the landscape being in tempera wants tone in the green).

I saw the pendant (in another house) Adoration of the Kings not so good (not so well preserved) — the other two are said to be the Crucifixion and the Annunciation. There is a Crucifixion possibly by the same hand in the Castel Barco collection but it is smaller and not in good state.

This makes it clear that Eastlake actually saw both *The Entombment* and *The Adoration of the Kings*. Indeed, *The Entombment* was promptly acquired for the National Gallery. In his notes he mentions the *Adoration* twice, an *Annunciation* (twice), a *Presentation* (once) and makes refer-



**Figure 2** (far left)  
Bouts,  
*The Annunciation*,  
canvas,  
90.2 × 74.3  
cm.  
The J. Paul  
Getty  
Museum,  
Malibu.



**Figure 3** (left)  
After Bouts,  
*The Adoration*,  
pen and ink,  
34.5 × 28.0  
cm.  
Uffizi,  
Florence.



**Figure 4**  
Bouts,  
*The Crucifixion*,  
canvas,  
179 × 152 cm.  
Musées  
Royaux des  
Beaux-Arts,  
Brussels.



**Figure 5** Bouts, *The Entombment* (No.664), canvas, 90.2 × 74.3 cm. National Gallery, London.



**Figure 6** Bouts, *The Resurrection*, canvas, 90.0 × 74.3 cm. The Norton Simon Foundation, Pasadena.

ence to either one or two *Crucifixions*. His assumption throughout is that there were several related scenes.

Thus we should be aware that *The Entombment* was not, like *The Virgin and Child*, an independent unit or integral work of art. As Eastlake's note suggests, it was part of a complex and the related works are now identified with *The Annunciation* (Fig.2; J. Paul Getty Museum, Malibu), *The Adoration of the Magi* (whereabouts unknown [4]; see Fig.3), *The Crucifixion* (Fig.4; Musées Royaux des Beaux-Arts, Brussels) and *The Resurrection* (Fig.6; Norton Simon Foundation, Pasadena).

*The Crucifixion* measures 179 × 152 cm. and is thus almost exactly twice the height and width of the other paintings. It is assumed, therefore, that it may have acted as a centre-piece. Nevertheless, it is hard to be certain how the series would have been arranged. Also it is difficult to account for its being painted on linen rather than on a wooden support. (Paintings on linen were extremely rare in the Netherlands at the time.)

These, therefore, are the two questions to which art historians should now address themselves.

While having as yet no evidence I would like to posit the following: firstly, that the series was painted on linen to make transport (to a client in Italy?) more feasible, and secondly, that the paintings might well have been transported as separate units, their eventual arrangement being left to the client.

Whatever the arrangement of the linen paintings, *The Entombment* was probably displayed in a chapel, as one part of a sizeable complex, and not in a domestic interior. Its function should be seen to be as different from that of *The Virgin and Child* as its technical make-up.

### Acknowledgement

I am grateful for the help given me by Mr Derek Johns in the preparation of this article.

### Notes and references

1. DAVIES, M., *The Early Netherlandish School*, National Gallery Catalogues, 3rd edition (London 1968), pp.14–19.
2. Notebook of Sir Charles Eastlake, MSS. in the National Gallery, Part 1, Milan, 1858.
3. Eastlake Notebook, Part 3, Milan, 1860.
4. Although this painting is now lost, it is possible that its design is recorded as the drawing reproduced here as Fig.3 (Uffizi, Florence). See SCHÖNE, W., *Dieric Bouts und seine Schule* (Berlin/Leipzig 1938), p.186 and fig.87c. The proportions of the scene seem to accord well with the others in the series, making a connection likely.

## The technique of two paintings by Dieric Bouts

David Bomford and Ashok Roy

The two paintings examined here, both firmly attributed to Bouts [1], demonstrate the significance of using different painting materials in achieving particular effects in a work of art. The fifteenth century was a period of great change in painting throughout Europe. In Italy the technical changes were mainly concerned with the transition from

egg to oil as a painting medium and, later, from panel to canvas. In Northern Europe, oil media were in general use somewhat earlier: they were not suddenly invented by van Eyck as Vasari would have us believe, but had been known and in use for a long time. Van Eyck's mastery of the oil medium, however, virtually amounted to a discovery of its potential and established fundamental techniques that were to continue in the Netherlands for centuries.

One of the paintings under consideration here, *The Virgin and Child* (No.2595; Fig.7 and Plate 7, p.55) lies firmly in that tradition. A small, richly coloured painting



**Figure 7**  
Bouts,  
*The Virgin and  
Child*  
(No.2595),  
after cleaning  
and  
restoration.

on panel, it exploits to the full the possibilities of the oil medium. Other oil paintings by Bouts have been the subjects of major technical studies in the past — indeed, probably the first reliable account of Early Netherlandish painting techniques (by Coremans *et al.* [2]) was a study of Bouts's altarpiece of *The Last Supper* in S. Peter's, Louvain, one of three works that can with certainty be attributed to him. In that study, the use of a drying oil medium was unambiguously identified for the first time.

Later, one of the other key works by Bouts, the pair of *Justice of Otto* panels was also studied [3]. The reason for the particular interest in Early Netherlandish painting in the 1950s was the 'Primitifs Flamands' projects, which included technical as well as art-historical investigation. One result of the project was a remarkable account of van Eyck's Ghent altarpiece [4] which is one of the most

extensive studies of a work of art ever undertaken and which remains a standard reference for all subsequent work on painting techniques of that period.

The other painting in the present study is *The Entombment* (No.664; Fig.8 and Plate 5, p.55) a so-called *Tüchlein* painted in glue tempera on fine linen. *Tüchleins* are very rare, a small diversion in European painting technique, explored by only a very few painters: apart from Bouts, the group includes Bruegel [5], Dürer, Hugo van der Goes, Quinten Massys (an example is in the National Gallery, London, No.3664) and, working in a related method, Mantegna. The technique enjoyed considerable popularity in Cologne around 1500, but always remained rare in the Netherlands.

Other *Tüchleins* attributed to Bouts have been associated with *The Entombment*. Two, now in the United States, are



**Figure 8**  
Bouts,  
*The*  
*Entombment*  
(No.664).

clearly related in dimensions, subject matter and technique (see above) and may well have been those seen by Eastlake when he was negotiating to buy *The Entombment* in 1860 (see above). Another larger painting, now in Brussels, which may also have been part of the same work, was the subject of a most skilful cleaning and examination in the 1970s [6].

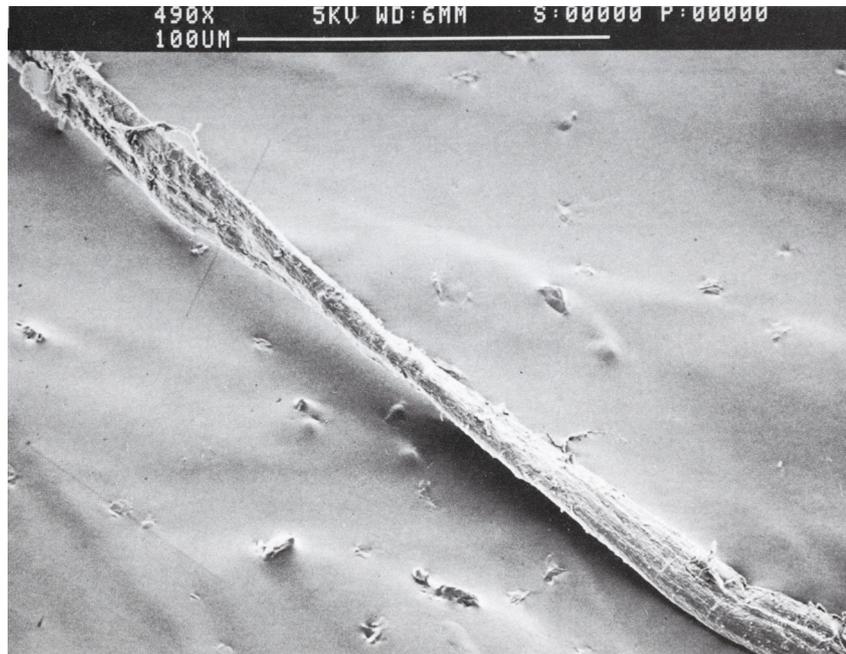
The small *Virgin and Child* panel was cleaned in 1985 and a limited number of samples taken for analysis. *The Entombment* will not be cleaned, for reasons outlined below, but again a few samples were taken from the edges of the picture and from some damages. An account of their materials and layer structure follows. Comparison of two such different techniques from the same hand gives a valuable insight into the sophisticated control over their materials exercised by the master painters of the fifteenth century.

## The Entombment

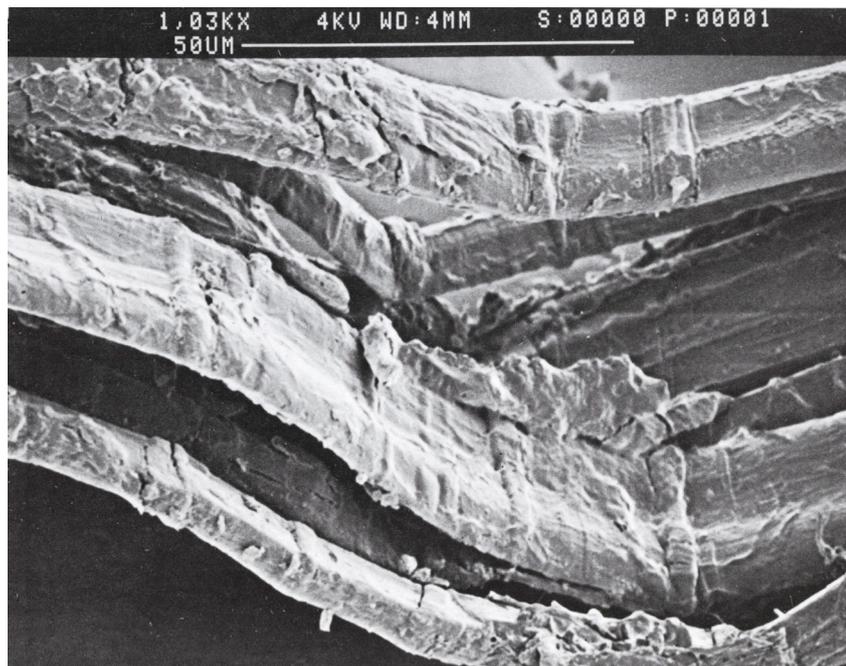
### Support

*The Entombment* is painted on a very fine linen of simple tabby weave (picks and ends passing alternately under and over each other, see Plate 6a, p.55). The threads are tightly Z-spun and the fibres have been identified as flax. When examined in the scanning electron microscope (SEM) the individual fibres are seen to have a spiral twist and a flattened, ribbon-like appearance (Fig.9a) more commonly associated with cotton, while at the same time having the characteristic 'bamboo'-like structure of flax (Fig.9b). The use of cotton would be highly unusual in a picture of this period and further examination confirms that the fibres are indeed flax; the uncharacteristic flattening and spiral twist seem to be phenomena of ageing and have been observed

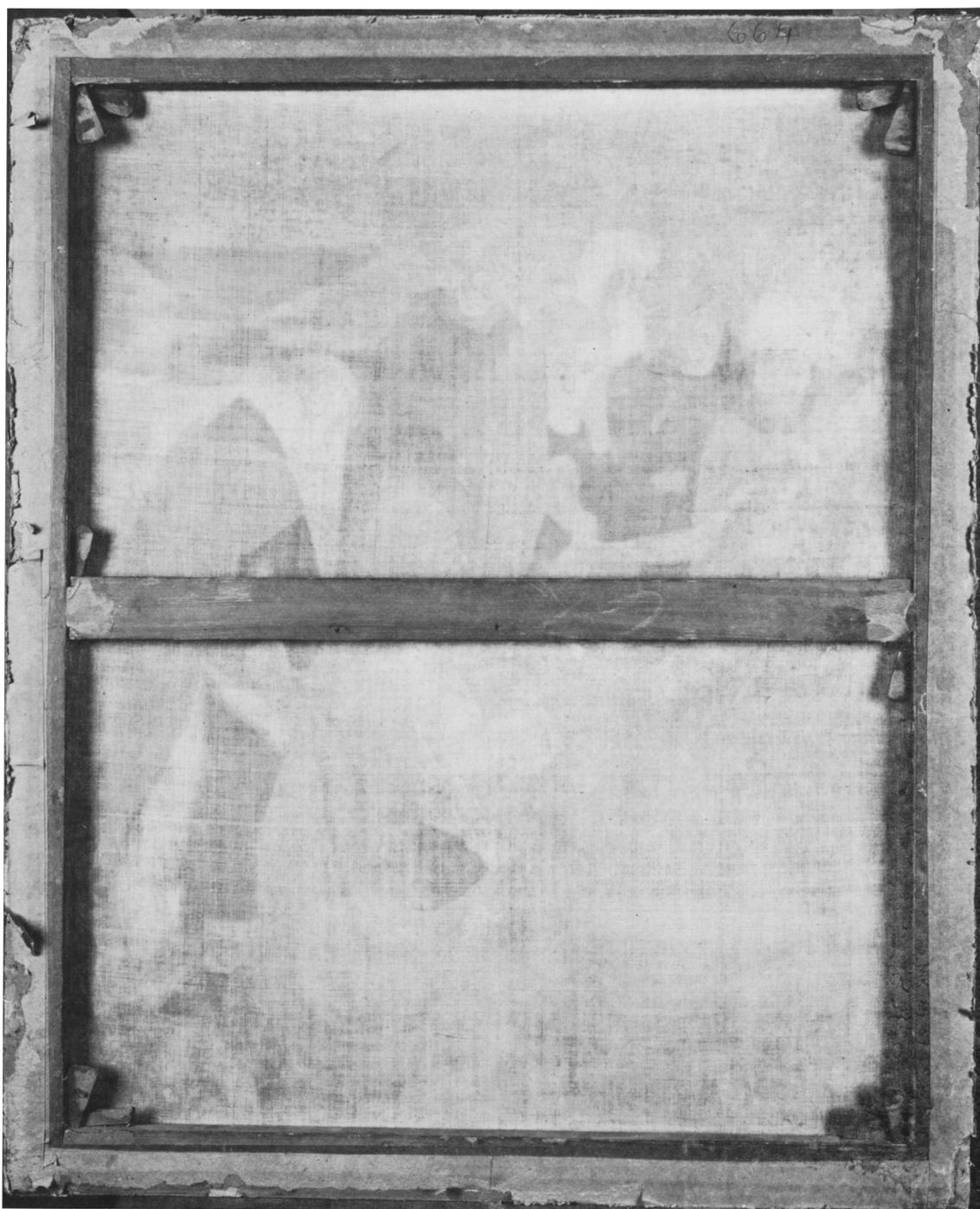
**Figure 9a**  
SEM micrograph of a single fibre from the linen canvas of Bouts's *The Entombment* showing the twisted conformation of the fibres. Gold-coated, 490 ×.



**Figure 9b**  
SEM micrograph of part of a thread from *The Entombment*. The characteristic 'bamboo-jointed' structure of the fibres of flax may be seen, but they are also unusually flattened and ribbon-like. The layer of glue size is evident. Gold-coated, 1030 ×.



**Figure 10**  
Bouts,  
*The*  
*Entombment*,  
back of the  
lining canvas.



in other cases. There is some variation in thread diameter in both horizontal and vertical directions. A thread count carried out on the fabric itself is given in [7].

Despite its considerable age, the linen is in exceptionally good condition. Much of the credit for this must go to the fact that it was skilfully lined, at some time before 1860 when it entered the Collection, on to fine linen of similar weave. Fortunately, the lining adhesive chosen was a glue formulation of broadly similar refractive index to the glue medium of the paint itself (see below). Had the lining adhesive contained any waxes, oils or balsams, the result would have been a disastrous darkening of the whole structure of the painting. Even so, the lining probably caused a slight darkening in some areas: on the grey tomb, for example, there is an irregular staining which

may be partly due to penetration of adhesive into the paint layers.

Glue lining of a linen painting in which the medium is water-soluble is an extremely hazardous and difficult operation. It is inevitable that the paint layers will be disturbed by the presence of moisture. A notable feature of *Tüchleins* is that the paint layers on the front often soaked through to the back where the composition can be seen quite distinctly in reverse. In the case of *The Entombment*, this process has been accentuated further by lining, and the coloured staining has been driven right through to the reverse of the lining canvas (Fig.10).

It should be noted here that exactly the same phenomenon of the coloured reversed image appearing on the back of the lining canvas is seen on *The Resurrection* (see Fig.6)

[8]. In addition, the lining fabric, stretcher and old tack holes (see below) would also appear to be identical.

The presence of rust-stained tack holes, usually a helpful indication of the original dimensions of a canvas painting, is somewhat confusing on *The Entombment*. In common with other early canvas paintings, there is here a painted border around the limits of the fabric, partly turned over the sides of the present stretcher. On *The Entombment* the border is light orange-brown in colour, but in other examples it is a darker brown, or black [5]. Whether these borders are supposed to form only the tacking margin on the canvas, or whether they were intended to show partly on the front of the picture as a painted framing, is not always clear. Certainly one would expect any surviving tack holes to be only in the border and, at the bottom edge of *The Entombment*, this is indeed the case. However, those along the top edge are inside the border, in a strip of unfaded blue sky. This pattern is repeated on *The Resurrection* and, apparently, on *The Annunciation*. It is not likely that these tack holes can be original, but they are of interest in indicating that before the present lining the paintings were on smaller stretchers, and in providing a further clue to the common history of the three paintings.

#### Ground or priming

There is no conventional ground present, but the canvas has apparently been sized with glue which, under high magnification can be seen quite clearly coating the fibres (Fig.9b). It has a slightly brownish appearance and the presence of iron and manganese [9] indicates that it may contain small quantities of umber pigment.

#### Underdrawing

Infra-red photography and reflectography reveal little in the way of preparatory drawing. This does not necessarily imply that there is none, only that there are not significant amounts of carbon black present in those areas which can be penetrated by infra-red radiation. The apparent caution of this interpretation is in fact justified, because a small sample taken from the green shawl of the weeping woman

has a considerable quantity of charcoal particles (see Fig.11) clinging to its underside, which can only be part of a preparatory drawing, perhaps where some shading has been used. Presumably there must be charcoal under other parts too, and it is surprising that so little shows in the infra-red photograph.

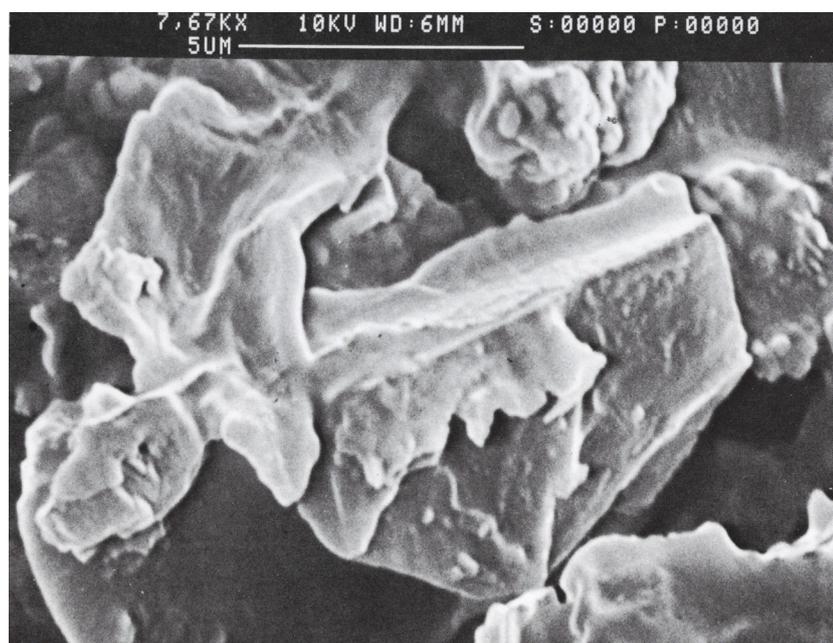
Passages of something else resembling underdrawing are revealed, rather unexpectedly, in ultra-violet light. A UV-fluorescence photograph (Fig.12) shows lines and *pentimenti* (in the region of Christ's and the Virgin's linked hands, in the shadow of Christ's upper leg and in the region of the Magdalen's left shoulder and left hand) which, in an infra-red photograph, would certainly be interpreted as carbon-black drawing: but, as we have seen, infra-red shows very little.

What, then, are they? Under high magnification, they simply appear to be lines of partly abraded paint, but on close examination the canvas fibres underneath do appear slightly darker than those elsewhere, as if stained or coloured by some sort of underdrawing. It is not yet possible to identify what material is present here, but it may be supposed that the paint did not adhere very well to it in these areas and flaked off, causing the lines of apparent abrasion. This would explain, too, why it shows in a UV-fluorescence photograph: normally only surface effects would be seen, but here the underlayer is exposed or only thinly covered.

It has been suggested that lead- or silver-point may have been used. This would be most unusual and seems unlikely on practical grounds alone: for drawing on a fabric painting, a soft or fluid material such as charcoal or ink would seem more likely than a hard metal point. But it is clear that Bouts did employ some sort of unusual material for his underdrawing — which can be detected in UV-light, but which is more or less transparent to infra-red radiation — possibly in combination with passages of more conventional charcoal drawing or shading.

Certainly Bouts was still working out his composition even at the painting stage; the prominent alteration to the back of Nicodemus is a case in point.

**Figure 11**  
Bouts, *The Entombment*. SEM micrograph of the drawing/shading layer beneath the weeping woman's robe showing a single particle of the black pigment, probably wood charcoal. Gold-coated, 7670X.





**Figure 12**  
Bouts,  
*The*  
*Entombment*,  
detail of  
UV-photograph.

*Paint layers: the medium*

The component of the paint which gives *The Entombment* and other *Tüchlein* paintings their characteristic appearance is the binding medium. For *The Entombment*, solubility tests and gas-chromatographic (GC) analysis have specifically ruled out oil and egg-yolk: the medium is almost certainly animal glue [10], and as well as giving the whole painting its delicate, pale gouache-like look this had a direct bearing on Bouts's choice of pigments.

Although the optical effects are complex, it is essentially the difference in refractive index (RI) between pigment and medium which determines the opacity of a particular paint film. For pigments of high RI such as lead white, vermilion and lead-tin yellow, it does not much matter what medium they are dispersed in: the difference in RI is large enough in each case that they will always form opaque films.

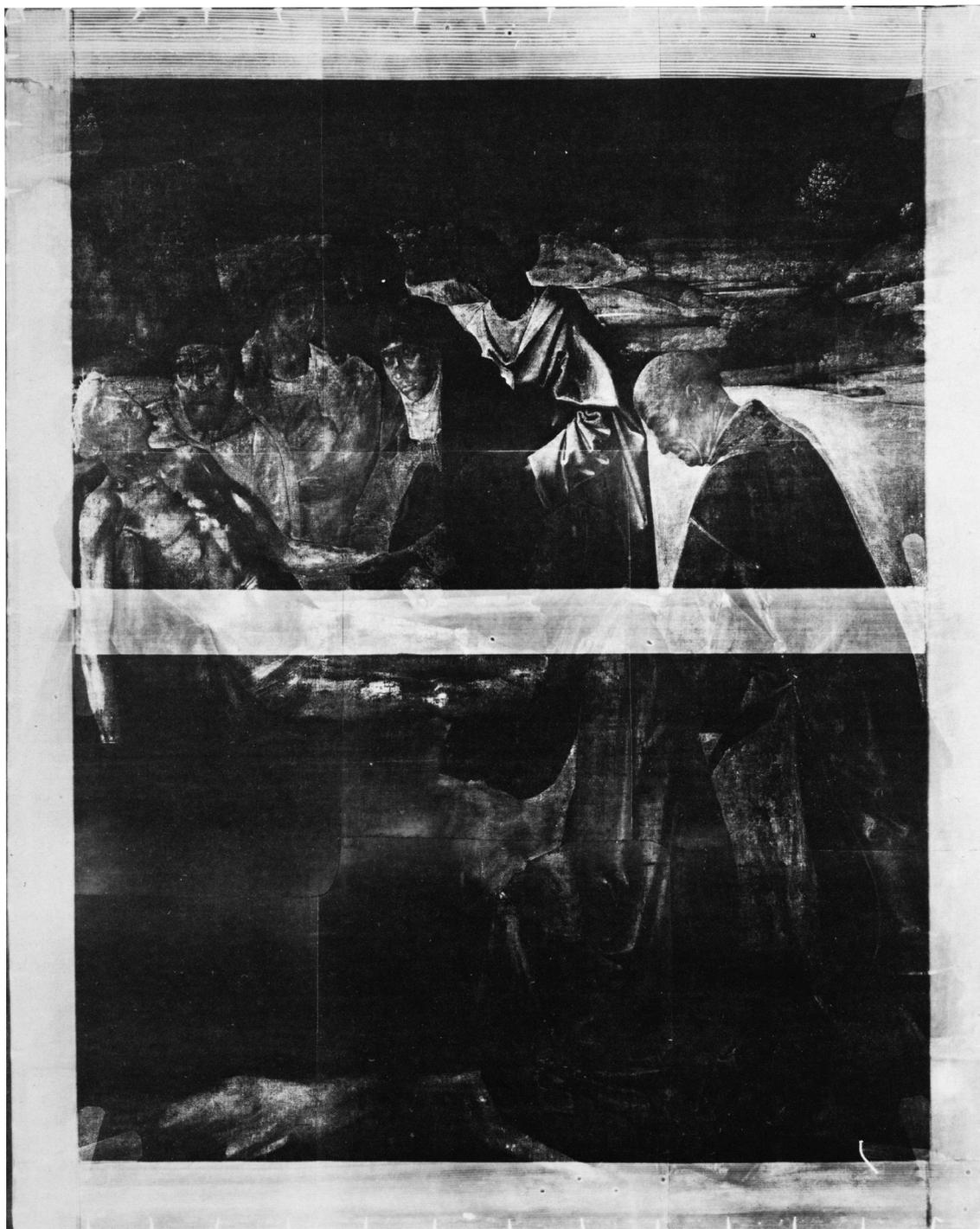
Of the three types of media mentioned above, drying oils have the highest RI (approaching that of some pigments), egg rather lower and animal glue the lowest. For pigments of low RI dispersed in oil, therefore, the difference in RI may be very small and the paint film consequently quite transparent. The same pigments in egg would be more opaque and in animal glue more opaque still.

The significance of this becomes clear when it is found the Bouts used *chalk* extensively as a white pigment on *The Entombment* (see below). This is an unusual occurrence, because only in a medium of animal glue or gum is chalk

sufficiently opaque to form a satisfactory pigment. In egg, and even more so in oil, chalk is quite useless because it is rendered more or less transparent. Similarly, the red lake pigment identified on *The Entombment* here forms a rather opaque paint, whereas in oil it would be altogether richer, more transparent and the colour more saturated.

The glue medium does not form a particularly coherent film. The pigment particles are not suspended within a continuous layer as they might be in an oil painting, but rather loosely bound to each other and to the linen. (In many places they are only left in the hollows of the weave and the tops of the thread are almost bare, see Plate 6a, p.55.) It is probable too that the glue medium coats each particle somewhat imperfectly and so the significant surrounding refractive index for the upper surface of some particles may not even be that of glue, but simply air.

All these factors make the paint layers and the linen, where it is exposed, particularly vulnerable to treatment with materials of higher RI, whether by varnishing, over-painting or impregnation with a lining adhesive. The result of such treatments would be a drastic darkening of the whole painting caused by a combination of increased transparency of the paint layers and the irreversible 'wetting' of the pale linen fabric. Miraculously, *The Entombment* has escaped any treatments of this kind, except for the lining with a glue formulation not dissimilar to the paint medium itself. As mentioned above, this may have stained some areas slightly, but quite insignificantly compared with the darkening that would occur with oils, waxes and so on.



**Figure 13a**  
Bouts,  
*The*  
*Entombment*,  
composite  
X-radiograph.

Other *Tüchleins* have not been so fortunate. Presumably many have not survived at all: of those that have, some are almost unrecognizable under layers of varnish and repaint. It has been possible in some cases to reclaim the original to some degree by using solvents which will not attack the glue medium [6]. But in general, cleaning of such paintings is a high-risk operation which, in any case, cannot be expected to reverse substantially any darkening of the fabric layer.

On *The Entombment*, there is simply a layer of surface dirt on the paint, imparting a warm greyish tone to the whole picture (except for the strip of blue sky at the top edge which was once the tacking margin and therefore protected by a frame). No attempt at cleaning is envisaged,

because the aqueous agents needed to remove dirt are precisely those that will attack the glue medium. Neither is it thought possible to remove the dirt by dry methods such as fine powdered rubber: the paint is in places insufficiently well-bound to resist such treatment and could simply be rubbed away along with the dirt.

All these considerations arise from the nature of the glue medium. Such paintings are regarded as exceptionally vulnerable and should always be kept behind glass.

#### *Paint layers: the pigments*

A small number of samples were taken from the edges of the composition and from the edges of existing lacunae. In addition, the composite X-radiograph (Fig. 13a) is valuable

**Figure 13b**  
X-radiograph  
detail of the  
Virgin's head.



in interpreting some of the passages of the painting and in assigning pigments to those areas which could not be sampled. The layer structure of the various parts is described below in a broad classification by pigment colour.

*White pigments:* Both *chalk* and *lead white* are used in many areas. It has been noted above that the use of chalk as a white pigment is only possible by virtue of the low refractive index of the glue medium and elsewhere in painting it is found rather rarely, except as a constituent of grounds for paintings both on panel (see p.51) and canvas.

To the naked eye, the two pigments look quite similar on *The Entombment*, but are readily distinguished micro-chemically, by X-ray diffraction (XRD) [11] and by referring to the X-radiographs, on which lead white gives a dense white image and those areas which contain mainly chalk appear quite dark. In general, wherever chalk has been used as the principal pigment a small amount of lead white is incorporated, with some of the highlights painted in pure lead white.

The most striking contrast in the use of the two pigments is seen in the X-radiograph of the white cloth around the Virgin's head (Fig.13b). The part below her chin gives a dense white image indicating a good deal of lead white, while the part on top of her head gives a black image indicating the use of almost pure chalk; and yet, to the unaided eye, the two passages appear the same.

Other areas of white — the mantle of S. Mary Magdalene, her head-cloth and that of the weeping woman, and Christ's shroud — appear intermediate in density, indicating a chalk and lead white mixture with lead white highlights in places.

Similar comparisons may be made for other light areas, for example, the flesh paints. The faces of Christ, the man supporting him (Joseph of Arimathea?), the Virgin and that of Nicodemus have dense white X-ray images with pronounced highlights, indicating a high proportion of lead white. The X-radiographs show the faces of S. John and S. Mary Magdalene, on the other hand, to be much darker, suggesting the use of chalk with just a little lead white reinforcement here and there.

In some places a layer of chalk is used as an underpaint, which has on occasion been misinterpreted as a thin chalk ground. It is, however, confined to certain light areas such as the sky, the red sleeve of S. Mary Magdalene and the similar red headgear of Joseph of Arimathea and the furthest woman. That there is little lead white present in this underlayer is immediately apparent from the X-ray images which are quite dark.

*Blue pigments:* Over its chalk underlayer, the sky consists of natural *azurite* and chalk with just a trace of lead white. The bright blue strip along the top of the picture presumably gives a reasonable idea of the original colour of the whole sky, although even here the paint is somewhat

worn. The discoloration of the remainder is due mainly to surface dirt, partly to abrasion allowing the fabric colour to show through, and perhaps also to a slight degradation of the azurite seen more clearly elsewhere.

Pure azurite is used for the top layer of Joseph of Arimathea's collar. There seems to be a brownish black, almost bronze-coloured, discoloration coating the top surface of the azurite crystals which may be a corrosion product of the azurite mentioned above. Laser microspectral analysis (LMA) indicates the presence in a sample of copper alone, implying that no other pigments can be responsible for the discoloration. It is possible that the basic copper carbonate of the pigment has been partly converted to cupric oxide, a process which may lead through a brownish stage to a black product, perhaps by exposure to alkaline conditions during an attempted past cleaning. Under the pure azurite layer of the collar appears to be a dense modelling containing lead white.

The Virgin's robe, Nicodemus's collar and his under-robe all appear superficially similar to Joseph's collar, but are remarkably different. They are more thickly painted than any other part of the picture, although the medium is the same animal glue as elsewhere. There are two distinct layers present and the upper layer has flaked away partly to reveal the lower. The underlayer is a fairly light blue, composed of azurite and lead white and giving a dense modelled image in the X-radiograph. The incomplete upper layer is much darker and is composed of azurite (again partly degraded into the brownish black corrosion product), *natural ultramarine* and *smalt* [12] (see Plate 6b, p.55); there is no white pigment present in this layer.

The use of three blue pigments in a single paint mixture is most unusual, and the occurrence of smalt in a painting of this early date is notable. The early history of smalt (a manufactured potassium glass whose blue colour is due to the presence of cobalt, added as cobalt oxide during preparation) is somewhat obscure. However, the once traditional view that smalt was first made in the mid-sixteenth century in Europe is now known to be untrue. It has been identified on wall paintings from the Near East dating from several centuries before that, and on an altar-

piece by Michael Pacher of c.1483 [13]. Its occurrence on *The Entombment*, of the mid-fifteenth century, although unusually early for an easel painting, is by no means impossible, and of course the technique of the picture is remarkable in a number of respects. Clearly it is important to be sure that the sample has not been contaminated with pigments applied by a later hand. There are some obvious repairs to Nicodemus's collar and under-robe, which show as dark holes in the X-radiograph because the losses penetrate to the underlayer containing lead white: however, the surviving parts of the dark top layer in which the three blue pigments are found appear to be wholly authentic.

Nicodemus's pale greenish blue cloak is probably meant to be a rather purer pale blue as it is composed simply of azurite and a little lead white; the other two blue pigments are absent here. The greenish tone seems to be mainly due to wearing allowing the light brown fabric colour to show through.

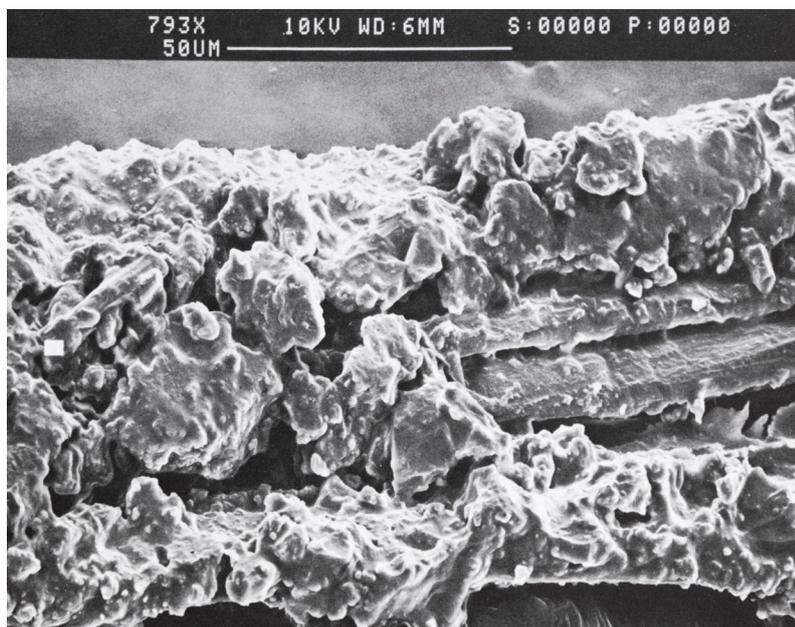
There is yet another blue pigment found on *The Entombment*, principally in the landscape. All the various shades of blue-green in the near and distant landscape are composed of lead-tin yellow (see below) and *indigo* (a blue dyestuff extracted from plants of the genus *Indigofera*) mixed in various proportions. The tiny particles of indigo were detected microscopically [14], whilst laser microspectral analysis showed the presence only of lead and tin (from the lead-tin yellow) indicating that no inorganic blue is present and that the pigment is indeed organic.

Indigo is a relatively impermanent colouring material and can fade rapidly when exposed to light. That the blue of the landscape on *The Entombment* has faded considerably, and that the lead-tin yellow component has become relatively more prominent, is evident from a bright turquoise strip at either side where the paint has been protected from light by a frame or by a paper edging. The fading clearly occurred a long time ago, since the edge of the unfaded paint does not correspond precisely with the edge of the gummed paper now on the picture; this gummed paper seems to have been in place since the picture was acquired in 1860.

It is clear that *The Entombment* is much less colourful

**Figure 14**

Bouts, *The Entombment*. SEM micrograph of the dark brown pigment making up the paint layer of the shadow beneath Nicodemus's foot to the right-hand edge of the picture. The pigment particles are partly obscured by glue, but are clearly not wood charcoal (see Fig.11). The particle morphology seems to correspond to bone black. Gold-coated, 793X.



than it was originally, due to a combination of factors described above: the fading of the indigo in the landscape, the degradation of the azurite, the thinness and wearing of the paint layers and finally the overall dull grey dirt film have each contributed to a substantial lowering in tone of the picture surface.

*Yellow pigments:* The pale lemon-coloured *lead-tin yellow* is the only yellow pigment used in significant amounts on *The Entombment* [15]. Its influence can be seen on the X-radiographs since it gives a dense image comparable to that for lead white. Thus it is clearly seen to form a major component of the landscape, of Christ's crown of thorns and of the highlights on the trees at the right.

*Yellow ochre* has also been found, but only in trace amounts. It seems to form a minor component of the green dress of the weeping woman.

*Green pigments:* As we have seen, much of the green paint on the picture is composed of blue and yellow mixtures. However, the true green pigment *malachite* as the natural mineral form has been identified in the dress of the weeping woman.

As with the blue draperies described above, the paint of the green dress is substantially thicker than the surrounding paints of the landscape, flesh and white drapery. In fact, there is an unexpected layer structure here: beneath the green malachite-containing layer is a blue layer composed of indigo and white. Since it plays no part in the final colouring, this is presumably a complete (but original) alteration, perhaps thought necessary because of the close proximity of another blue robe, that of the Virgin.

*Red pigments:* The main area of red in the picture is S. John's robe and the principal pigment here is *vermilion* (mercuric sulphide) [16]. This explains its dense X-ray image, characteristic of a mercury-containing compound.

The vermilion appears rather dull — much less bright than corresponding reds on *The Resurrection* — and has a greyish appearance. This does *not* seem to be due to conversion of the vermilion to its blackened form (metacinnabar), which has been noted elsewhere [17] and which might be expected in view of the lack of protection afforded by the glue medium. Rather, it seems to be due to an overlying glaze of a *red lake* pigment (the constitution of which has not been identified [18]) containing a little black. In addition, the overall dirt film lowers the tonal values considerably. The red lake glaze is seen to be more opaque in the glue medium than it would be in oil and, instead of forming a rich translucent layer over the vermilion, it forms a slightly dull turbid one.

The red lake is also used elsewhere, in S. Mary Magdalene's sleeve and hem, the furthest woman's head-cloth and Joseph's hat. In these passages it seems to be a little more successful as a glaze because it is used over a reflecting chalk underlayer. However, these are also some of the most abraded areas of the picture, so its translucency may be somewhat unintended. In any case, it appears to be poorly bound by the glue medium.

Samples have not been taken from the flesh paints, which are largely well preserved. It is likely that a small quantity of the red lake or (less likely) vermilion is mixed with the chalk and lead white to give the pale pink tints.

*Brown and black pigments:* Various shades of *earth pigment* (*umbers* and *ochres*) have been used in several parts of the picture [19]. The brown border at the limits of the original canvas, which passes over adjacent paint and therefore seems to be one of the final parts to be painted, consists of a mixture of ochres and umbers, a little lead-tin yellow and a trace of black.

The black pigment used in the paint layers appears to be *bone black* [20]. An SEM micrograph (Fig.14) shows particles which, although somewhat obscured by the glue medium, appear to have the irregular disc-shapes consistent with bone black, rather than the more jagged morphology associated with charcoal and other vegetable blacks (Fig.11). The presence of calcium phosphate shown in an X-ray powder pattern from a sample taken from the shadow at the right edge suggests the use of an animal black [21].

Where this brownish black has been used in *The Entombment* it seems invariably to have a little red lake pigment mixed with it to give it a warm tone. The shadow under Nicodemus's foot, for example, contains bone black, chalk, and red lake.

## The Virgin and Child

### Support and ground

The picture is painted on a single thin oak panel, the grain vertical, chamfered slightly at the edges. At some time it has split in two in the direction of the grain along a line running down through the centre of the child and the fingertips of the Virgin's left hand. The split was repaired and the panel cradled in 1863 (according to an inscription in Spanish on the back). During recent treatment the cradle was removed: the back of the panel is exceptionally clean and smooth, indicating that it may have been thinned slightly during cradling, but it was probably always fairly thin.

The ground, as would be expected, is composed of chalk bound with an animal glue and it was clearly applied with the panel already fixed into a frame. This is a characteristic feature of many Netherlandish panel paintings of this period: the subsequent removal of the frame exposes a border of bare wood at the edges of the panel and the ground stands up in a ridge where it was pushed against the inner edges of the frame. Sometimes, as here on the *Virgin and Child*, there are ragged extrusions of ground on the bare wood outside this pronounced ridge where it was squeezed into gaps between frame and panel. These extrusions are usually thinner than the adjacent ground, but can actually be thicker (as here, in places) if the gaps were particularly large and the adjacent ground was smoothed down to a lower level during or after application. It is not clear whether the frame around the panel at that stage was intended to be permanent or merely temporary. The frame now on the picture is modern.

### Underdrawing

Infra-red photography (Fig.15) and reflectography reveal some underdrawing, most clearly in the legs and feet of the Child and in the Virgin's hands; a cross-section (not illustrated) from a damage in the Virgin's hand clearly shows carbon black particles lying above the ground. In

these areas it consists of a regular hatching running along and around the form. Not much is visible elsewhere: if there is more drawing — in the faces for example — it is probably in outline only and the painted lines on top follow it precisely. In addition, the major area of drapery — the Virgin's blue robe — is so thickly painted (mainly in azurite) that infra-red radiation cannot penetrate it, although underdrawing is evident in samples (see Plate 8a, p.55).

There appears to be no particular consistency in the amount of underdrawing on panel paintings attributed to Bouts. In the *Justice of Otto* (now in Brussels), there is a detailed drawing with extensive hatching and cross-hatching in the shadows [3]. In the small *Portrait of a Man* (No.943, dated 1462), however, infra-red techniques reveal no underdrawing at all. It may well be a matter of scale: the large and complex compositions of the *Justice of Otto* panels clearly needed considerable planning and

re-planning (there are obvious *pentimenti*) whereas the smaller panels could be painted much more directly. The small amount of hatched drawing visible on the *Virgin and Child* is very similar in execution to parts of the drawing seen on the Brussels panels.

#### *Paint layers: the medium*

In the pioneering work on Bouts's painting materials in 1952 [2], the medium of the altarpiece of the *Last Supper* in S. Peter's, Louvain was found to be a drying oil in all layers of the paint samples tested, or at least to have a drying oil base. It was thought then that the oil may have been modified with a resin or other substance, although no objective evidence of the presence of modifying agents could be found. There was no evidence of egg tempera, even in the underpainting and therefore the altarpiece was firmly placed in the category of 'pure' oil painting.

**Figure 15**  
Bouts,  
*The Virgin and Child*,  
infra-red  
photograph.



Methods of identification at that time were based on relatively simple solubility and staining tests. Similar methods were applied in 1958 to the *Justice of Otto* panels [3] and here, too, with one exception, the samples were all found to have a base of drying oil. The one exception was in an area of ultramarine where an unidentified aqueous binder was suggested. This is occasionally reported [22] on Early Netherlandish paintings: the use of an aqueous medium such as animal glue allows the lapis lazuli to form a much more opaque and brilliant paint layer than the

higher refracting oil medium would do. Unfortunately the effect has often been irreversibly lost by saturation with later oils and varnishes, or damaged by cleaning with aqueous reagents.

In the *Virgin and Child*, under examination here, three samples were taken for medium analysis by gas-chromatography; the results were reported in an earlier volume of this *Bulletin* [23].

The red damask background was found to contain only linseed oil. The Virgin's blue robe and the green cushion



**Figure 16**  
Bouts,  
*The Virgin and  
Child*,  
composite  
X-radiograph.

contained linseed oil together with a distinct indication of egg, perhaps in the underlayers. Staining of sections with amido black 10B from the background and the green cushion gave a weak indication of protein in the underlayers but the results are not conclusive. Staining tests for media should be treated with some caution, however, since one sample from the edge of a flake loss in the background gave a strong reaction for protein in parts of its top layer which is almost certainly the result of past blister treatment using animal glue.

It does in any case seem certain that the medium here is principally linseed oil, including the Virgin's blue robe. The use of mixed oil and egg tempera techniques in Early Netherlandish painting has been reported elsewhere [24]. It cannot be ruled out that Bouts used a mixed medium technique and pure oil techniques simultaneously on different pictures, as later Italian painters (for example, Cima) were to do.

#### Layer structure and pigments

Samples were taken from the edge of existing lacunae for cross-section examination and pigment identification. In addition the composite X-radiograph (Fig.16) and infra-red photograph (Fig.15) are helpful in elucidating features of the layer structure and in indicating the pigments that have been used.

The slight general opacity of the X-ray image, and the fact that the vertical wood grain shows clearly, suggests that there is a thin layer of lead white paint above a thin chalk ground. It is not certain whether this is a continuous priming or an extensive underpaint, since although it is visible in many of the cross-sections, it is difficult to discern in one or two taken from the brocade background.

The X-ray image shows the way the main forms are modelled. The faces and other flesh parts are built up from the basic ground or priming colour with gradations of lead white in the highest lights, painted precisely around the dark lines representing the eyes, mouths and so on. The use of thick lead white paint for the sky and dense lead white mixtures with lead-tin yellow highlights for the brocade hanging are also clearly visible.

The richly worked colour effects of the *Virgin and Child* are achieved with a fairly straightforward palette. Whites, as we have seen, are *lead white* [25] and yellows are *lead-tin yellow* [26]. Blue pigments are *azurite* and *ultramarine* (lapis lazuli), reds are *vermilion* and an unidentified *red lake* and greens are *verdigris* and a '*copper resinate*' type glaze. There are also small amounts of *earth colours* and *bone black* present.

The infra-red photograph (Fig.15) is useful in pinpointing areas of ultramarine, since its infra-red reflectance is high (much higher than that of azurite) and it appears almost white in infra-red photographs and reflectograms. This is strikingly seen in the distant blue landscape of hills and towers which virtually disappear in the infra-red, since their reflectance is as high as that of the sky (also in ultramarine and white [27]) over which they are painted. In the Virgin's robe, too, ultramarine is seen to form the final layer in most places with the lower reflecting azurite showing through.

This basic layer structure for the Virgin's robe is confirmed by cross-sections (see for example Plate 8a, p.55), although there are variations in detail between light

#### Plate 6 Bouts, *The Entombment* (No.664).

(a) Macro detail of the linen canvas at the top edge of the picture (sky) showing the type of weave, and partly abraded paint on the surface and in the interstices of the fabric.

(b) Dispersed pigment mount of the thick blue paint from Nicodemus's collar after extraction of the glue paint medium, mounted in DPX and photographed under the microscope in transmitted light at  $700\times$ . Actual magnification on the printed page given opposite. Three separate blue pigments have been combined to make up the paint of the collar. The largest blue-green particle is azurite (top right), the smaller pure blue particle to the left is natural ultramarine, and the palest triangular particle (lower left) is the cobalt-containing blue glass pigment, smalt.

#### Plate 8 Bouts, *The Virgin and Child* (No.2595), photomicrographs of paint cross-sections, photographed in transmitted light (a at $250\times$ ), and reflected light (b and c at $350\times$ ). Actual magnifications on the printed page shown opposite.

(a) Dark blue of Virgin's robe, thin cross-section in transmitted light.

1. Chalk ground.
2. Very thin lead white priming with a thin line of underdrawing beneath.
3. Azurite undermodelling; note the discoloration of the oil medium.
4. Thick glaze of natural ultramarine.

(b) Dark green of cushion.

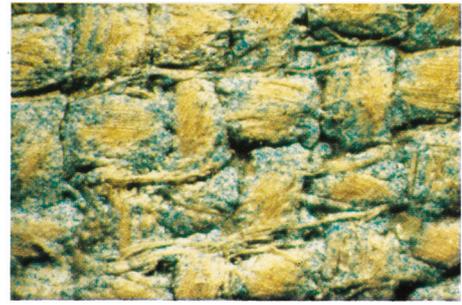
1. Chalk ground.
2. Thin lead white priming.
3. Cool yellow: lead-tin yellow, lead white + bone black.
4. Warm brown: red lake pigment, lead-tin yellow + a little black.
5. Light green underpaint for cushion: lead-tin yellow + a little verdigris.
6. Thick 'copper resinate' green glaze in good condition.

(c) Pink of brocade hanging.

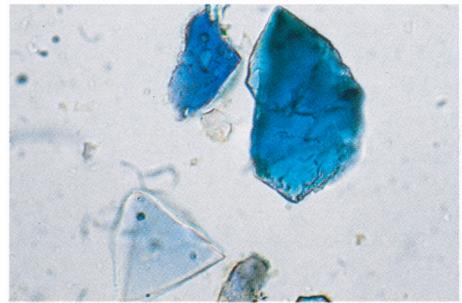
1. Chalk ground.
2. Thin lead white priming.
3. As layer 3 in (b).
4. As layer 4 in (b).
5. Two layers of pink comprising red lake pigment mixed with white. In areas of more saturated colour there is a final glaze of pure red lake pigment.



Plate 5 Bouts, *The Entombment* (No.664).



a c.25x

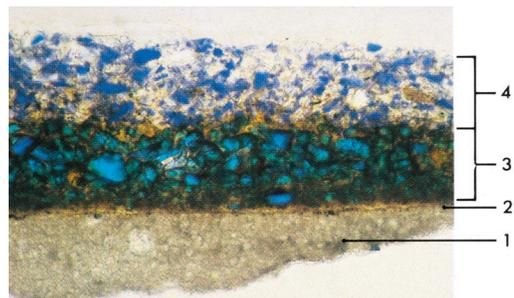


b 465x

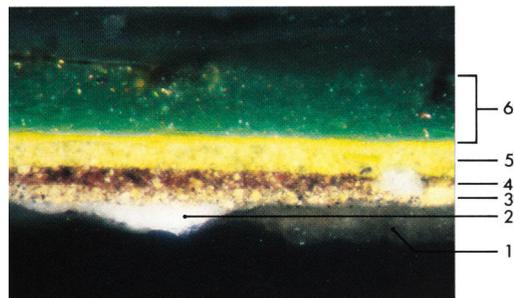
Plate 6 Bouts, *The Entombment* (No.664).  
Full caption on facing page.



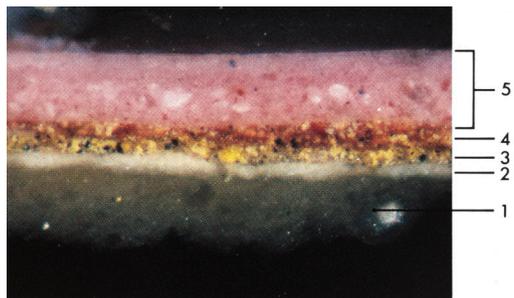
Plate 7 Bouts, *The Virgin and Child* (No.2595), after cleaning and restoration.



a 160x



b 280x



c 280x

Plate 8 Bouts, *The Virgin and Child* (No. 2595).  
See facing page for full caption.

and dark areas. In the brightest parts, there is a thick top layer of ultramarine and white, then a thinner layer of high-grade azurite and white over a layer of poorer grade azurite and white; below these are the lead white priming and chalk ground. Bouts is seen here to be laying-in the broad features of the blue drapery with cheaper pigments and only applying the better grade azurite and expensive ultramarine as the final layers.

In the dark shadows of the robe the structure is slightly different and the optical effects more complex. Over the white lead priming is a thin layer of azurite mixed with white, then a thick layer of pure azurite, and finally a glaze of pure ultramarine. The dominant feature of this passage occurs in the thick azurite layer in which the pigment seems to have reacted with the oil medium causing substantial discoloration which can be seen in a thin cross-section (Plate 8a, p.55). The top layer of ultramarine with its high tinting strength and relative transparency in the oil medium gives an added intensity to the darkened azurite beneath. Although these areas appear almost black to the unaided eye, there is no black pigment present.

The brocade hanging and the cushion on which the Child sits appear to have a similar light brown underpaint and this is confirmed by cross-sections (Plates 8b and 8c, p.55). It consists of two layers, a warm brown over a cool yellow and, although slightly variable in colour and thickness, these two extend everywhere under the cushion and brocade. The brown comprises mainly red lake pigment of a fairly subdued tone, a little lead-tin yellow and a few particles of black; the lower layer is mainly lead-tin yellow, some bone black and white pigment. On top are painted the coloured design details. The dark green of the cushion, for example, has an intense dark green glaze of 'copper resinat' in good condition over a thin light green layer (lead-tin yellow, probably mixed with a little verdigris, Plate 8b, p.55) over the underpaint. The bright pink of the brocade consists of a mixture of red lake and white over the underpaint (Plate 8c, p.55), glazed with pure red lake for the richer red areas. The red edge of the cushion is vermilion with a red lake glaze. The pale hatched highlights are almost pure lead-tin yellow with vermilion and white admixed for the more orange touches. These highlights in the brocade and cushion have a strong lower-left to upper-right diagonal emphasis which seems to indicate that Bouts was right-handed, but speculation of this kind should be treated with caution!

The grey window opening to the right is a simple mixture of black and white with a little azurite lending it a greenish tinge, over a thin light greyish brown underpaint, whilst the blue-grey of the sill is similarly painted but with a thin layer of azurite and white drawn across the surface. To the left, where the edge of the window is marked by a strip of shadow, only azurite and a fine-grained black pigment have been used. The flesh areas, as might be expected, are mainly lead white, modified with trace amounts of other pigments and layered to create subtle variations in flesh tone. The Child is painted in white with traces of vermilion, black and azurite, over a cooler layer of white with a very few blue or black particles. The Virgin's neck where it passes into shadow is similar, but has a little more fine black in the upper layers.

## The paintings contrasted

The *Virgin and Child* and *The Entombment* by Bouts provide a striking demonstration of the effect of varying painting materials on the appearance of a finished picture. Using a broadly similar range of pigments, but varying almost everything else, Bouts showed here (and in other similar works) how different end results could be perfectly synthesized by exploiting the combined properties of particular materials.

The *Virgin and Child* might be described as a 'classic' Early Netherlandish panel painting, in the direct but relatively new tradition of van Eyck and Rogier van der Weyden. Painted on an ivory-smooth white ground on oak, its colours owe their rich, glowing appearance to the glossy, high-refracting oil medium. The oil made possible, as none of the other media then available could, the use of glazes — transparent warm-coloured paint layers over lighter opaque underpaints. Only oil had a high enough refractive index to make those glazing pigments transparent. Also, importantly, oil formed a coherent film surrounding and wetting each pigment particle and continued to do so after drying. The slow drying properties of the oil medium also allowed great subtlety in the blending of tones. Transitions from light to shade could be made gradual or dramatically sharp with equal ease. Brushstrokes could be left showing for emphasis and texture, or completely effaced for smoothness and transparency.

Bouts and his contemporaries, although not defining them in today's scientific terms, would have been perfectly aware of the optical and drying properties of linseed and other oils. They would have tested the appearance of various pigments in oil, would have noted that some were more difficult to wet and grind and required more or less oil than others, and would probably have found empirically that lead pigments, for example, acted as driers, speeding up the drying of a paint film. There is evidence too, in other paintings of the period, that they knew that walnut oil yellowed less than linseed oil as it aged, and so should be reserved for the lighter parts of a picture.

Bouts was also clearly aware of the very different properties of the materials used in *Tüchlein* painting. The technical tradition which led to paintings of this type, the use of a glue medium and fabric, presumably derived from the painting of banners, both secular and religious and, less directly, from manuscript illumination. The use of fabrics in other contexts and pigments dispersed in glue and egg was already centuries old.

The most obvious difference between *The Entombment* and the *Virgin and Child* is in the texture of the painting surface. The regular weave of the linen fabric, although now more prominent through wearing, always gave the paint a minute chequered grain, all the more pronounced for the absence of a conventional ground.

The dry, gouache-like surface appearance of the paint is, as we have seen, a direct consequence of the selection of an animal glue medium. The low refractive index and the poor film-forming properties, leading to high light scattering from the surface, both result in an opaque, chalky appearance (literally, since chalk is widely used). The absorbency of the fabric also played its part, by withdrawing medium which would otherwise remain in the paint

layers. Just how much was absorbed may be judged from the coloured reverse image visible on the back.

It is surprising how much of an uncracked layered paint structure is still intact on *The Entombment*. In some parts the fabric is almost bare, in others, paint survives only in the hollows of the weave, but over much of the picture the paint layers are more or less complete. It is, though, a changed and still vulnerable painting. The brittleness of the medium, its susceptibility to aqueous reagents and to staining, the fading of the indigo and the decomposition of the azurite, and the accumulation of surface dirt have all contributed to its ageing.

The *Virgin and Child* has aged more unobtrusively. A split in the panel, a few flake losses and a little wearing in places are the only actual damages. A more graceful sign of age is the fine network of cracks, characteristic of all Early Netherlandish panel paintings, giving to the translucent oil layers an almost ceramic look, utterly different to the woven texture of *The Entombment*.

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3. VAN MOLLE, F., *et al.*, 'La Justice d'Othon de Thierry Bouts', *Bulletin de l'Institut Royal du Patrimoine Artistique*, **1** (Brussels 1958), pp.7–69.
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6. MASSCHELEIN-KLEINER, L., GOETGHEBEUR, N., KOCKAERT, L., VYNCKIER, J. and GHYS, R., 'Examen et traitement d'une détrempe sur toile attribuée à Thierry Bouts. La Crucifixion de Bruxelles', *Bulletin de l'Institut Royal du Patrimoine Artistique*, **17** (Brussels 1978–79), pp.5–21.
7. Vertical threads (counting along a horizontal measure): 20, 21, 22, 21 threads/cm. Horizontal threads (counting along a vertical measure): 19, 20, 20, 19 threads/cm. The direction of the warp and weft cannot be deduced from the canvas, since no selvedge is visible.
8. A reversed image has also been reported on the back of 'The Annunciation'. Private communication, Andrea Rothe, Conservator of Paintings, The J. Paul Getty Museum, Malibu, California.
9. Microchemical tests and spectrographic analysis with the laser microprobe indicated some concentration of iron and manganese associated with the size layer on the canvas.
10. Two samples, of blue and white paint, were examined by J. S. Mills for medium. Both were found to break up when warmed with water. GC of the saponified material showed egg and oil to be absent. Hydroxyproline from animal protein was detected by the modified Ehrlich test.
11. A sample from the upper part of the Virgin's white headdress was shown to be almost pure chalk by XRD. See JCPDS file No.24–27.
12. After extraction of the glue medium, a dispersed mount of the mixed blue was examined by polarized light microscopy. The presence of smalt was initially suspected from its microscopical appearance, and confirmed by the detection of cobalt in a sample using LMA. Silicon, aluminium and copper were also found.
13. MÜHLETHALER, B. and THISSEN, J., 'Smalt', *Studies in Conservation*, **14**, 2 (1969), p.53.
14. Aggregate particles of a very intense blue with a slight bronze lustre when viewed dry were seen under the microscope. The pigment was found to be inert to strong aqueous sodium hydroxide, and slightly soluble in chloroform, ruling out the possibility of the presence in the sample of Prussian blue from some later retouching. Insufficient material was available for chromatographic confirmation of indigo.
15. The lead-tin yellow was shown by XRD to be of the form described by Hermann Kühn as 'type I'. See KÜHN, H., 'Lead-tin Yellow', *Studies in Conservation*, **13**, 1 (1968), pp.7–33 and JCPDS file No.11–233. Both lead and tin were detected spectrographically in several samples.
16. By microscopy and the detection of mercury with the LMA.
17. GORDON, D., BOMFORD, D., PLESTERS, J. and ROY, A., 'Nardo di Cione's "Altarpiece: Three Saints"', *National Gallery Technical Bulletin*, **9** (1985), p.32 and Plate 7c, p.35.
18. The substrate for the red lake pigment was shown to be hydrated alumina by the detection of aluminium in a sample by LMA.
19. For example, iron, silicon, aluminium and manganese were found by LMA in a sample of the greyish brown paint of the tomb.
20. A low concentration of phosphorus could be detected by LMA in a sample containing the brown-black pigment. See also Note 21 below.
21. XRD of a sample in agreement with JCPDS file No.18–303.
22. See COREMANS, P. (1953), *op. cit.*, p.70.
23. MILLS, J. S. and WHITE, R., 'Analyses of Paint Media', *National Gallery Technical Bulletin*, **9** (1985), pp.70–71.
24. BOMFORD, D. and KIRBY, J., 'Two Panels by the Master of Saint Giles', *National Gallery Technical Bulletin*, **1** (1977), p.56.
25. Lead white (basic lead carbonate) confirmed by XRD, JCPDS file No.13–131.
26. Lead-tin yellow 'type I' confirmed by XRD. See Note 15 above.
27. Natural ultramarine was confirmed microscopically in a miniscule sample from the edge of a damage in the sky.