

# Rubens' oil sketches for the Achilles Series: A focus on the imprimatura layer and drawing material

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## Introduction

In 2004 an exhibition on the Achilles Series of eight tapestries, for which Rubens made the designs, was held in the Museum Boijmans van Beuningen in Rotterdam and the Museo Nacional Del Prado in Madrid. The fascinating story of the creative process, starting with Rubens' skilful oil sketches and the transition via *modello* to tapestry, is carefully described in the accompanying catalogue.<sup>1</sup> The seven sketches of the Achilles series in the collection of the Museum Boijmans van Beuningen were restored prior to the exhibition, which provided an opportunity for research.<sup>2</sup> During treatment, samples were taken from four panels (figs. 1-4) to examine the layer build-up and analyse the pigments and drawing material. Scrapings were taken to analyse the binding medium.<sup>3</sup>

The results of this research, which focussed on Rubens' use of a streaky imprimatura as a preparatory layer, as well as his choice of drawing material, will be discussed and illustrated in this article.

Recently, interest was raised in Rubens' painting technique and the streaky imprimatura in particular.<sup>4</sup> We hope that this article, though limited to the findings on the Achilles series, will contribute to the already existing technical information on this subject.<sup>5</sup>

## Rubens' streaky imprimatura

Looking closely at Rubens' oil sketches for the Achilles series, one can often detect areas where the streaky imprimatura is visible with the naked eye. Rubens applied this imprimatura first before drawing or painting the composition. The colour of the imprimatura can vary from a grey-black to brown-black and ochre-brown. Often Rubens applied this layer with a wide, rough brush, which resulted in parallel running dark paint lines where the black particles have been separated and lined up by the hairs of the brush. However, in some of the sketches a dense, less streaky and more even layer was used.

The imprimatura functions as an isolation layer on top of the chalk ground, to prevent absorption of the oil from subsequent paint layers. However, Rubens seems also to have used this type of streaky imprimatura as a third

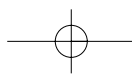
dimension, a grey-beige middle tone in his compositions. The streaky appearance gives the colour vibration and therefore adds a certain liveliness to his compositions.<sup>6</sup> Other painters such as Jan Brueghel I, who worked closely together with Rubens, sometimes applied a tinted and streaky imprimatura on their panels, but they do not seem to have used it for pictorial purposes.<sup>7</sup>

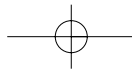
In the Achilles series, the imprimatura shows a grey-black coloured layer, which is very thin and transparent (fig. 5). There are some slight colour variations within the series, as well as differences in the proportion of exposure of the imprimatura. In *Thetis Receiving Arms for Achilles*, for example, the imprimatura is almost totally covered by the paint layer. In the colourful sketch *Achilles Among the Daughters of Lycomedes* the streaky imprimatura plays only a minor role, while in *Achilles Slays Hector* it is very dominant and the composition mainly consists of painted outlines with some touches of colour in the figures and in the background (fig. 6).

## Drawing

In the Achilles sketches, the drawing is visible in many areas.<sup>8</sup> From the eight Achilles sketches, the four sketches examined for this study expose extensive underdrawing.<sup>9</sup> Rubens outlined the composition and, while searching for the right forms, made many changes, which remained visible. The drawings were applied in a fast and free style way. The lines are dark and sometimes rather thick, and are well preserved (fig. 7). The architectural elements in these four panels, like the herms on both sides of the compositions, show excessive underdrawing (fig. 8). If not exposed, the dark black lines of the drawing can often still be seen through the transparent paint layers. For example, in *Achilles Slays Hector* (fig. 6), Rubens loosely sketched the composition in a black drawing material over the grey imprimatura, allowing the lines to show through a thin layer of transparent paint.

Three sketches of the series show no black underdrawing and presumably Rubens applied the design directly in paint. In *The Wrath of Achilles* he laid out the composition in transparent reddish-brown paint. He then traced over





some of the contours to add more definition. He used opaque flesh tones for skin and other light sections, and more transparent paint, or a combination of the two, for shading.

Looking at the paint handling in all seven sketches, swift and spontaneous brushwork can be detected.<sup>10</sup> Rubens' variety of lines, colours and brush strokes are combined with effective contrasts between light and dark, smooth and rough, to achieve a pleasing harmony. There is no explanation why he left some compositions so open structured, and why the level of finish of the seven paintings here discussed, varies so greatly.<sup>11</sup>

#### Examination and analysis of the cross-sections

From the beginning of the research, it was questioned how it is possible that the drawing material used in the Achilles sketches remained so well bound to the surface. Some cross-sections were taken to examine the build-up of the paint and the components of the imprimatura and drawing material.

The first cross-section was taken from an area with only the ground and imprimatura (fig. 9). The ground consists of a thick white chalk layer (up to 150 µm) with a thin, more yellow-coloured translucent imprimatura layer (5 to 10 µm), containing some black particles, on top. The black particles are charcoal black, recognised as horizontally oriented pieces that protrude from the surface of the imprimatura layer and are longitudinally lined up, indicating that no movement of a brush disturbed their position. It appears that the binding medium has been partially absorbed by the chalk ground. An old varnish is present on top.

The mineral content of the imprimatura consists mostly of chalk with an occasional lead white and red ochre particle (Inv. no. 1760e). The SEM-EDX results of the imprimatura layer indicated a high content of calcium and some lead dispersed over the layer with a few more concentrated areas. There seems, however, to be some variation in the composition of the imprimatura between the different panels. The cross-section taken from another panel (Inv. no. 1760d) does not show any red ochre particles. Furthermore, the amount of lead dispersed over the layer seems less and there are no concentrations of lead that could point to the presence of lead white.

The underdrawing appears to be executed in a dry medium. Possibilities of dry drawing media common in the seventeenth century, such as charcoal, metal point and graphite,

were considered.<sup>12</sup> The distinctive microscopic appearance of charcoal, however, could not be recognised. Also the use of metal point could not be confirmed by EDX. Natural graphite was widely used from the end of the sixteenth century.<sup>13</sup> It shows a typical metallic shine in light reflection microscopy, which however, was not observed here. SEM-EDX of the drawing material revealed, besides carbon, the presence of silicon and traces of aluminium, potassium and iron, which corresponds with the mineral composition of black chalk (fig. 13). It is very hard to measure the black particles as many are lying below the surface, but a few particles could be recognized in the SEM backscatter image.

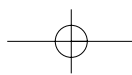
Black chalk is a dense material, and is often used because of the handling properties: lines can be created that are thicker, thinner, darker or lighter. Black chalk is made from carbonaceous clay stone that was found in the Piemont in Italy, Spain, Germany and even Holland, and was used by Botticelli, Dürer, Lucas van Leyden a.o.<sup>14</sup>

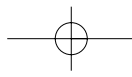
Whereas the charcoal particles in the imprimatura layer are smaller and therefore more difficult to detect, the black chalk drawing material has a more dense character. Cross-sections taken from the drawing material on top of the imprimatura layer (figs. 10-11, A-B) shows how the black chalk particles are pressed into the possibly still soft imprimatura layer. Here, the black charcoal particles present in the imprimatura itself appear to be pushed down; shifted into a less organised structure. It seems that the imprimatura was not completely dry when the drawing (and paint) were applied on top. This can also be illustrated by a cross-section taken of the paint where no underdrawing is present (fig. 12). Here too, the charcoal particles in the imprimatura appear rearranged, possibly by the movement and pressure of a paint-loaded brush.<sup>15</sup>

#### Analysis of the binding media

The discovery that Rubens used an aqueous binding medium in the imprimatura has been mentioned and studied before.<sup>16</sup> We used Fourier Transform Infrared Spectroscopy (FTIR) and Direct Temperature resolved Mass Spectrometry (DTMS) to analyse the binding media of the Achilles sketches.<sup>17</sup>

FTIR usually gives information on chemical groups, for example the amide bonds in proteins, acid groups in fatty acids or the presence of long alkyl chains from fatty acids. FTIR is also sensitive to metal carboxylates that often stabilize traditional oil paint. DTMS as a supporting technique, shows chemical features as molecular signatures appearing in the mass spectrometric data. It is very sensitive for the





**Fig. 1** Peter Paul Rubens, *Thetis Dipping Achilles in the Styx*, oil on panel, 44.1 x 38.4 cm Museum Boijmans van Beuningen, Rotterdam, (Inv. no. 1760)



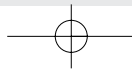
**Fig. 2** Peter Paul Rubens, *The Education of Achilles*, oil on panel, 44.7 x 38.4 cm Museum Boijmans van Beuningen, Rotterdam (Inv. no. 1760a)



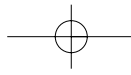
**Fig. 3** Peter Paul Rubens, *Achilles Slays Hector*, oil on panel, 44.4 x 53 cm Museum Boijmans van Beuningen, Rotterdam (Inv. no. 1760d)



**Fig. 4** Peter Paul Rubens, *The Death of Achilles*, oil on panel, 45.3 x 46 cm Museum Boijmans van Beuningen, Rotterdam (Inv. no. 1760e)







**Fig. 5** Detail, Macro photograph of the surface of the imprimatura of panel 1760 (black particles in lined form are visible)



**Fig. 6** Detail of *Achilles Slays Hector* showing the striped imprimatura. Lines of drawing are visible through the transparent paint layers

analysis of resins, waxes, fatty substances, polysaccharides and proteins. It can resolve these compound groups very well as pure or slightly aged materials, but the interpretation is more tentative when ageing has progressed strongly. In order to be sure that the chemical composition is correlated to specific layers, samples were subdivided under the microscope before analysis, using micro knives and needles. Such samples are homogenized in alcohol using a micro mortar and pestle before being transferred to an analysis probe that is inserted into the mass spectrometer and then heated. The temperature is linearly increased from room temperature to approximately 800 °C in two minutes. The compounds released from the probe are ionised under electron ionisation (EI) conditions and subsequently mass analysed.

Samples were taken from the ground, imprimatura layer, drawing material, and paint. Very little sample material was taken and while interpreting the results one has to be aware of the possibility that materials from different layers may have interfered.

The ground (from Inv. no. 1760e) was found to consist of white chalk and animal glue. Animal glue could be established with DTMS; it gives a characteristic pattern with main mass peaks at  $m/z$  70 and 154. This pattern matches that of standard reference materials. Light microscopy suggests that some fatty substances had penetrated the ground and indeed evidence for palmitic (C16 FA) and stearic acids (C18 FA) was found. A P/S ratio of about 1.4 was calculated (fig. 14).

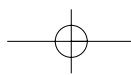
DTMS of the exposed imprimatura layer (from Inv. no. 1760e) showed fatty acids (C14, C16, C18), diacids, a protein pattern, calcium carbonate and lead. A mass peak pattern typical for drying oil was not observed. The mass peaks at  $m/z$  94, 117 and 186 are characteristic of certain amino acids in protein, but the MS pattern does not point to animal



**Fig. 7** Detail of Paris right foot in *The Death of Achilles*. The dark drawing lines are visible on the surface



**Fig. 8** Detail of the left herm in *The Death of Achilles* showing excessive underdrawing



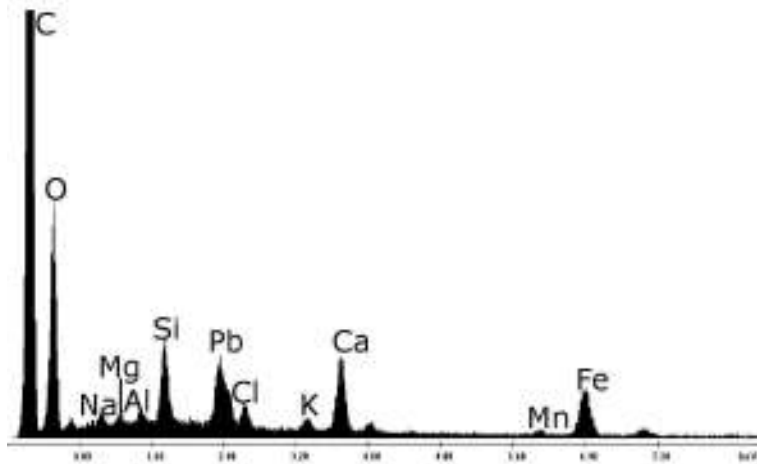
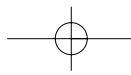


Fig. 13 SEM-EDX spectrum of the drawing material

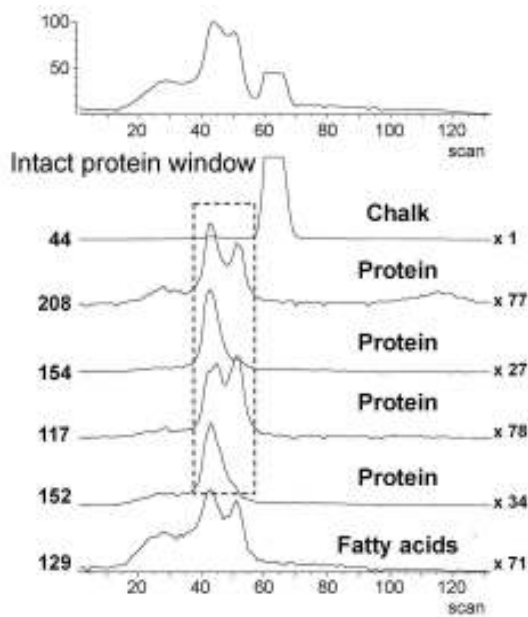


Fig. 14 DTMS data on the ground from panel 1760 e showing the total ion current trace and mass chromatograms of ions from chalk (m/z 44), intact proteins (m/z 152, 117, 154, 208) and a general marker for saturated fatty acids (m/z 129)

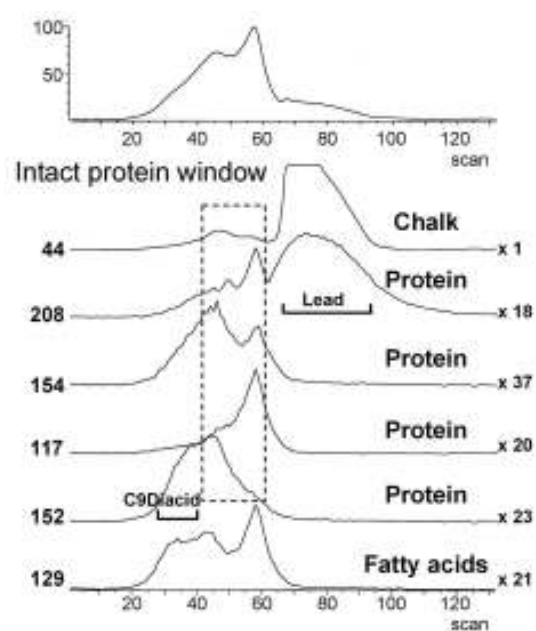


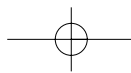
Fig. 15 DTMS data on the imprimatura from panel 13 showing the total ion current trace and mass chromatograms of ions from chalk (m/z 44), intact proteins (m/z 152, 117, 154, 208) and a general marker for saturated fatty acids (m/z 129). Note the appearance of lead (m/z 208) in scan window 60-100. The degraded proteins appear in a higher temperature window compared to the ground. M/z 152 appears as a broad peak and includes the marker for azelaic acid (C9 diacid) between scan 20-40

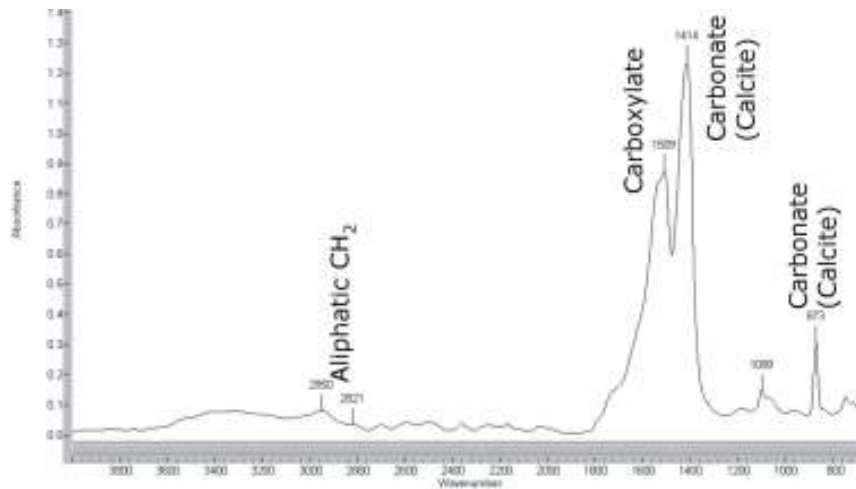
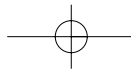
glue. The information is interpreted as a proteineous medium of egg, with a possible small addition of oil (fig. 15). This interpretation can be confirmed by amino acid analysis.

The combined presence of fatty substances and protein seems to indicate that an emulsion paint was used for the imprimatura. This combination first dries physically (evaporation of water) creating a surface that is quickly ready for painting, while still not completely dry, which would

explain our findings on the black chalk particles pressed into the imprimatura. Further oxidative cross-linking of fatty materials and proteins would yield a chemically stable layer.

FTIR of the imprimatura (Inv. no. 1760b and e) shows the presence of chalk, lead (and/or calcium) carboxylates and the absence of lead white (fig. 16). The concentration of lead white is probably too low compared to the high amount of





**Fig. 16**  
FTIR transmission spectrum of the imprimatura layer from 1760 e showing chalk (calcite), lead carboxylate, and the absence of lead white (no peak at 680 cm<sup>-1</sup>)

chalk present in this layer. The presence of lead carboxylates can be interpreted as dissolved lead mineral matter that has reacted with the fatty acids from the medium. The FTIR spectrum of the imprimatura from another sketch (Inv. no. 1760d) only revealed the presence of chalk and no lead carboxylates, which corresponds to the much lower lead content detected in this imprimatura using SEM-EDX. This confirms the slight variations in composition of the imprimatura layers in the different panels of the sketch series as was mentioned in the previous section.<sup>18</sup>

The drawing material was analysed separately with FTIR and DTMS, but these data point to the same composition as the imprimatura sample and clearly include chalk, which means the sampling of the pure drawing material may not have been accomplished (fig. 16).

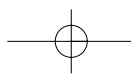
No varnish could be traced in the samples of the drawing material, which implies that neither resins nor varnishes were used to fix the black chalk drawing. During previous and recent varnish removals the drawing material has remained in place.

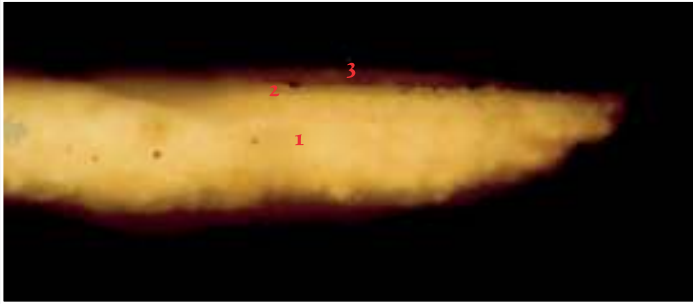
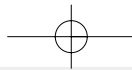
The analytical results of the binding medium of the lead white paint show that a linseed oil was used.

Because of the complexity of the materials and the close positioning of the layers, it is very difficult to draw any firmer conclusions without further analyses, which would have required renewed sampling.<sup>19</sup> In addition, the execution and study of reconstructions of the characteristic build up could be helpful in supporting our theory.<sup>20</sup>

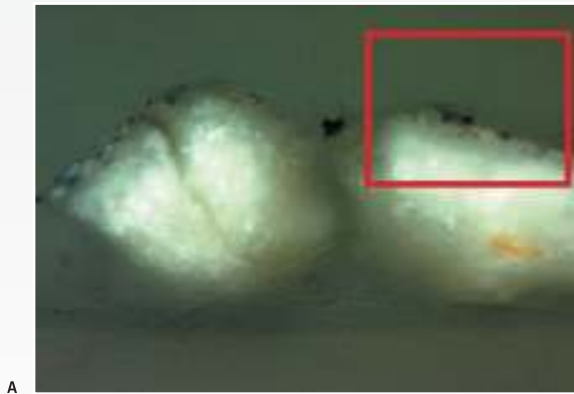
### Conclusion

An emulsion as medium for the grey imprimatura layer might have been very suitable for Rubens to draw and paint on. This fast drying material gave him the opportunity to speed up the painting process. It became hard and resistant over time and provided the right preparation for oil paint on top. During the drawing process the black chalk must have been pushed into the emulsion material when the latter was still slightly soft. It seems that the black chalk particles were 'embedded' in the imprimatura and the combination turned into a hard film.<sup>21</sup>

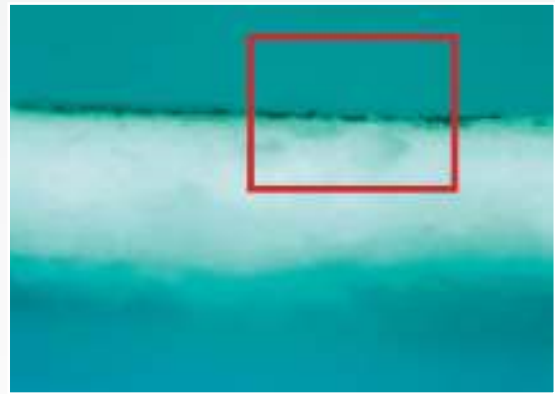




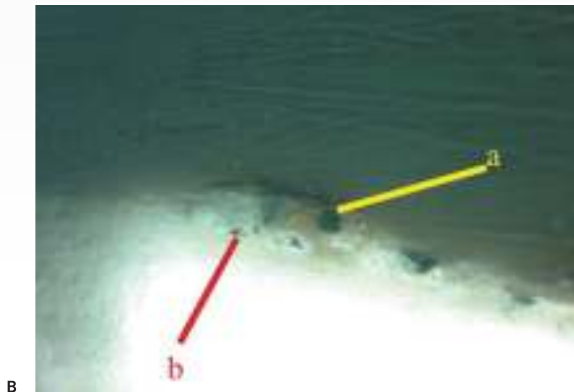
**Fig. 9** Cross-section of ground and imprimatura of *The Death of Achilles* (without drawing and paint) normal light dark field, taken at 200x magnification .  
 Layer 3: Old varnish  
 Layer 2: Imprimatura with black charcoal particles  
 Layer 1: Chalk/glue ground



A



A



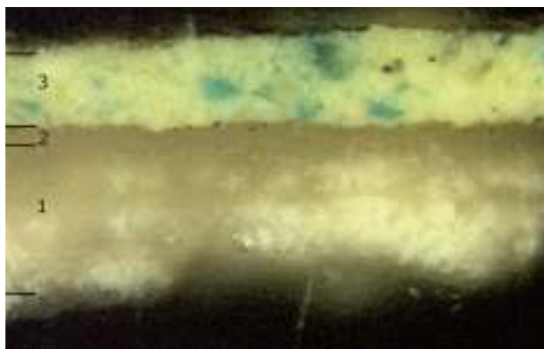
B



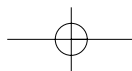
B

**Fig. 10** Cross-section from panel 1760 e showing drawing material, imprimatura layer and chalk ground (bright field, taken at 200x magnification). Lower detail (taken at 500x magnification): **A** black chalk particle (in yellow), **B** charcoal particle (in red)

**Fig. 11** Cross-section from 1760 d Showing drawing material, imprimatura layer and chalk ground (ultraviolet light, taken at 200x magnification). Lower detail (taken at 500x magnification): **A** black chalk particle (in yellow), **B** charcoal particle (in red)



**Fig. 12** Cross-section taken from the green colored background in *The Education of Achilles* (bright field, taken at 200x magnification ).  
 Layer 3: Pale green paint containing blue copper pigment and lead tin yellow  
 Layer 2: The imprimatura layer , with black charcoal particles at the surface  
 Layer 1: chalk/glue ground; the ground has absorbed the binding medium of the imprimatura





### Acknowledgements

We would like to thank Jeroen Giltaij and Friso Lammertse, curators of the Museum Boijmans van Beuningen for giving the opportunity for realizing this project. Also thanks to Jerre van der Horst, FOM Institute AMOLF, for kind assistance with DTMS analysis, and to Barbara Schoonhoven for her contribution to the discussions on the topic.

### Notes

**1** F. Lammertse and A. Vergara, Peter Paul Rubens, *The Life of Achilles*, [exh. cat., Museum Boijmans van Beuningen, Rotterdam, 2003/ Museo Nacional de Prado, Madrid, 2003-2004], 59. J. Giltaij, 'Peter Paul Rubens. Het leven van Achilles', in: N. de Poorter, G. Jansen, J. Giltaij, Rubens en zijn tijd. Museum Boijmans van Beuningen. Eigen Collectie, (Rotterdam, 1990), 96-113. The seven panels were probably painted between 1630 and 1635. Inv. nos. 1760, 1760a, 2310, 1760b, 1760c, 1760d, and 1760e.

**2** Rotterdam/Madrid 2003-2004, 18-20. Technical information on the sketches (in the same catalogue) by A. Boersma, 68-69, 78-79, 88, 100, 120, 130-131, 140-141.

**3** Samples were taken from panels 1760, 1760 a, 1760 d and 1760e. Scrapings were taken from panel 1760 e.

**4** N. van Hout, 'The oil sketch as a vehicle for Rubens' creativity', in *Drawn by the Brush: Oil Sketches by Peter Paul Rubens*, [exh. cat., Bruce Museum, Greenwich, Connecticut / Berkeley Art Museum / Cincinnati Art Museum] (New Haven and London, 2004), and N. van Hout, 'Reconsidering Rubens' Flesh Colour', *Boletín del Museo del Prado*, 37 (2001), 7-20.

**5** In the past, many Rubens' specialists have mentioned the streaky imprimatura on oil sketches and tried to explain its use. One of the first articles on Rubens Painting Technique: H. von Sonnenburg, F. Preusser, 'Rubens, Gesammelte Aufsätze zur Technik', (Bayerische Staatsgemäldesammlungen, München), Sonderdruck aus *Maltechnik-Restaur.*, 2-3 (1979); J. Kirby, 'The Painter's Trade in the Seventeenth Century: Theory and Practice', *National Gallery Technical Bulletin*, 20 (1999), 5-49; J. S. Held, *The Oil Sketches of Peter Paul Rubens. A Critical Catalogue*, 2 vols, (Princeton, New Jersey, 1980), 10; N. van Hout, 'Meaning and Development of the

Ground-layer in Seventeenth Century Painting', in E. Hermens ed., *Looking through Paintings*, *Leids Kunsthistorisch Jaarboek*, XI, (Baarn and Londen, 1998), 199-225. M. Doerner, *Malmaterial und seine Verwendung im Bild*, (Stuttgart, 1949), 307.

**6** Held 1980, 8-11; Van Hout 1998; Lammertse in Rotterdam 2003: 'We do think that he received the planks in long pieces glued together already before sewing them in sizes he preferred to use for painting. Concerning the different characters of the layer and fastness of the brush he might have demanded to apply the imprimatura in his own studio together with his specific wishes.'

**7** E.g. Jan Breughel, *Flowers in a Basket*, Museum Boijmans van Beuningen, shows a streaky imprimatura layer. Also painters from an earlier period used a streaky imprimatura e.g. Cornelis Ketel 1548/1616.

**8** Rotterdam 2003, 68, 69.

**9** Rotterdam 2003, 19, cat. nos. IA, 2A, 7A, 8A.

**10** See for an extensive description of the painting technique: Rotterdam 2003, 68-69.

**11** Rotterdam, 2003, 68-69. Van Hout 2004, 77-78. Van Hout suggests that Rubens might have left the sketch *The Death of Hector* in a dead colouring and unfinished state. He also suggests that the degree of making a design with black chalk first might have to do with the capability of his pupils to be able to paint certain details. This could be the case here as the eight Modello's of the Achilles series are painted by Rubens pupils and sometimes worked up or improved by the master. Rotterdam 2003, 10-32.

**12** D. Bomford, *Art in the Making: Underdrawings in Renaissance Paintings*, (New Haven and London, 2003), 26-37.

**13** A. Siejek, 'Identifikation und Rekonstruktion graphischer Mittel auf dem Mahlgrund', in A. Siejek, Kathrin Kirsch, *Die Unterzeichnung auf dem Malgrund, Graphische Mittel und Übertragungsverfahren im 15.-17. Jahrhundert*, *Kölner Beiträge zur Restaurierung und Konservierung von Kunst- und Kulturgut*, ed. Ingo Sandner, University of Applied Sciences Cologne, (Munich, 2004), 71-75. Van Hout 2005, 75-77. On paper Rubens used also graphite and pen but on paintings mostly black chalk.

**14** Scientific analysis has confirmed the use of black chalk by these artists. Siejek 2004, 60-65.

**15** Van Hout 2004, 79. In contrast with Van Hout's findings in general, paint surface of *The Achilles* oil sketches seems relatively untouched. The imprimatura drawing material and paint layer are in an extremely good condition.

**16** Von Sonnenburg 1979; J. Wouters, 'La Conversion de Saint Bavon de Pierre Paul Rubens. Les liants au laboratoire. Analyse de liants protéiniques' / *De Beking van Sint-Bavo door Pieter Paul Rubens. Laboratoriumanalysen van bindmiddelen. Analysen van proteïnehoudende bindmiddelen*, *Bulletin of the Royal Institute for Art Patrimony*, 28 (Brussels, 1999/2000), 183-89. Von Sonnenburg 1979, 89-92; M. Doerner, *Malmaterial und seine Verwendung im Bilde*, (Stuttgart, 1949), 307.

M. Van Bos, J. Wouters, 'Materials and Technique Peter Paul Rubens' *Elevation of the Cross*, Study, examination and treatment, *Institut Royal du Patrimoine Artistique*, 24 (1992), 63-81, 178.

Van Hout 1998, 205-210; De Graaf 1958, 23. Kirby 1999, 27-28.

**17** FTIR and DTMS analysis were carried out at FOM-Institute AMOLF, using a Biorad FTS Stingray 6000 system, and a JEOL JMS-SX/SX 102A 4 sector double focusing mass spectrometer.

**18** Differences in compositions of the imprimatura could also have lead to differences in colour. De layer might have become more transparent and/or darker in time. Rotterdam 2003, 64.

Dendrochronology by Peter Klein showed that the lower board was cut from the same tree as the upper board of *The Education of Achilles* (cat. no. 2A) and the lower board of *Thetis Receiving Arms for Achilles*. It explains the slight differences in the preparation and therefore the components of the imprimatura on the different boards.

**19** These results are preliminary and would require further confirmation by direct analysis of the painted surface using ATR-FTIR, which is possible in this case because the drawing and imprimatura are rather exposed. Further study with a molecular imaging technique such as imaging SIMS (Secondary Ion Mass Spectrometry) may also cast more light on the composition of the upper layers.

**20** Reconstruction project at ICN

and the Getty Institute by Maartje Witlox and Tiarna Doherty:

'Reconstructions and analysis of 17th-century preparation layers used on panel paintings.' Started in 2005, still ongoing.

**21** The use of black chalk dipped in oil could be another explanation for its durability and good adhesion. Discussion with Nico van Hout.