

Leonardo brought to Light: Multispectral Imaging of Drawings by Leonardo da Vinci

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INTRODUCTION

Leonardo da Vinci was the archetypal Renaissance man with an interest in painting, sculpture, architecture, anatomy, and engineering.

Many of Leonardo's manuscripts are now housed at Windsor Castle and cared for by the Royal Collection Trust, however much remains to be discovered about Leonardo and his artistic techniques.

Three drawings underwent multispectral imaging with the aim to reveal more about his artistic technique. This technology enhances features that are not visible to the naked eye.

METHOD OF MULTISPECTRAL IMAGING

Images are captured of an object illuminated in ultraviolet, visible and infrared light. As materials interact with light in a variety of ways, features that cannot usually be seen by the human eye are suddenly revealed.



Figure 1: The arm of the Virgin © Her Majesty The Queen, Moral rights retained by Cerys Jones.

ANATOMY OF A BEAR FOOT

The multispectral images of the drawing of the bear foot enabled each layer to be digitally removed, thereby providing a fascinating insight into how Leonardo built up his drawings. The visible image showed the white bodycolour, iron gall ink and metalpoint, the shorter infrared images contain the ink and metalpoint, and only the metalpoint remains in the longer infrared images.

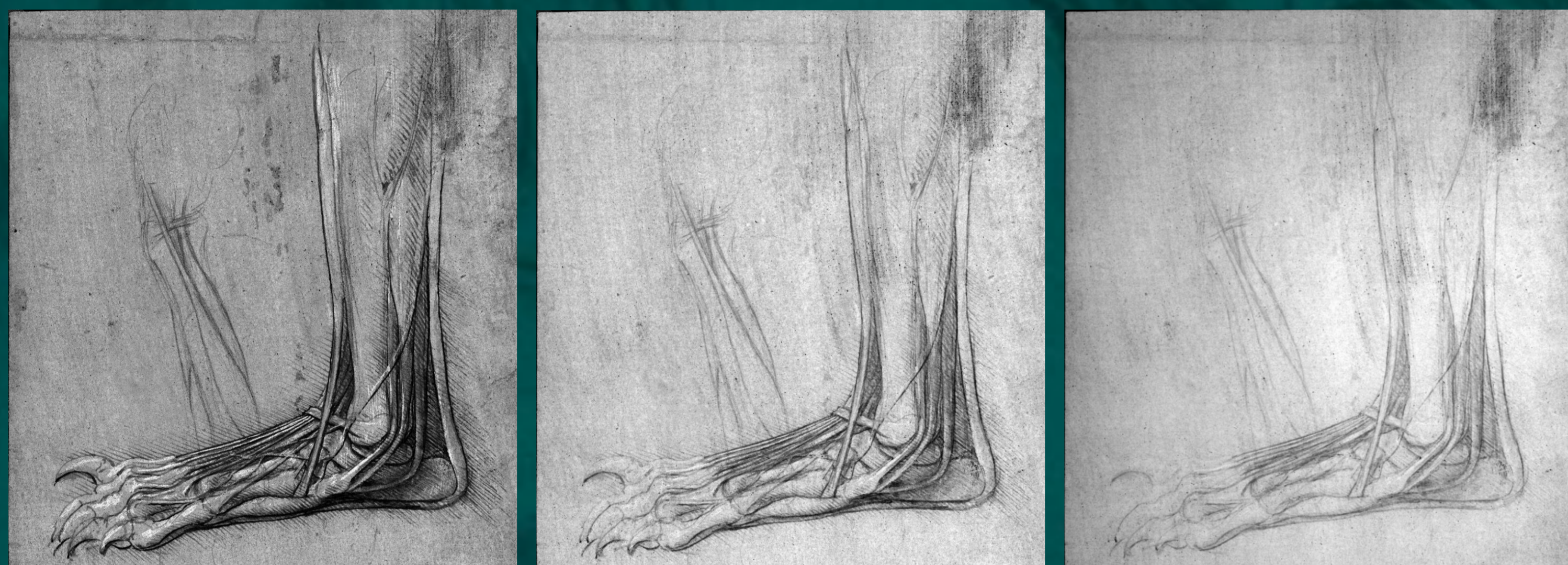


Figure 2: Images of the drawing of the anatomy of a bear foot illuminated in visible, infrared light (700 nm) and infrared light (940 nm). © 2018 Her Majesty The Queen, Moral rights retained by Cerys Jones.

STUDY FOR THE VIRGIN'S ARM

This study was for the painting *The Virgin and Child with St. Anne* held in the Louvre Museum, Paris.

The infrared image of the Virgin's arm revealed the outline of the arm beneath the sleeve. This is not visible to the human eye as it is covered in other media, such as red chalk, white bodycolour, ink and watercolour wash.

The image processing identified areas of the sleeve (in yellow) that had been drawn in black chalk but were not covered with the ink, watercolour wash or white bodycolour.



Figure 3: The image of the study for the virgin's arm taken in infrared light (940 nm) (top), and visible light (middle). Bottom shows the false colour image © 2018 Her Majesty The Queen, Moral rights retained by Cerys Jones.

STUDIES OF HORSES AND A DOG



This drawing is part of a group at Windsor Castle, in which the metalpoint has faded. The multispectral images dramatically revealed drawings of two further horses and a dog, all completely invisible to the naked eye. The horses and dog were further enhanced by a processing technique called Principal Component Analysis and then creating a false colour image. When the back of the paper was imaged under ultraviolet light, all five animals could again be seen. The reason for this has yet to be determined and requires further scientific research.