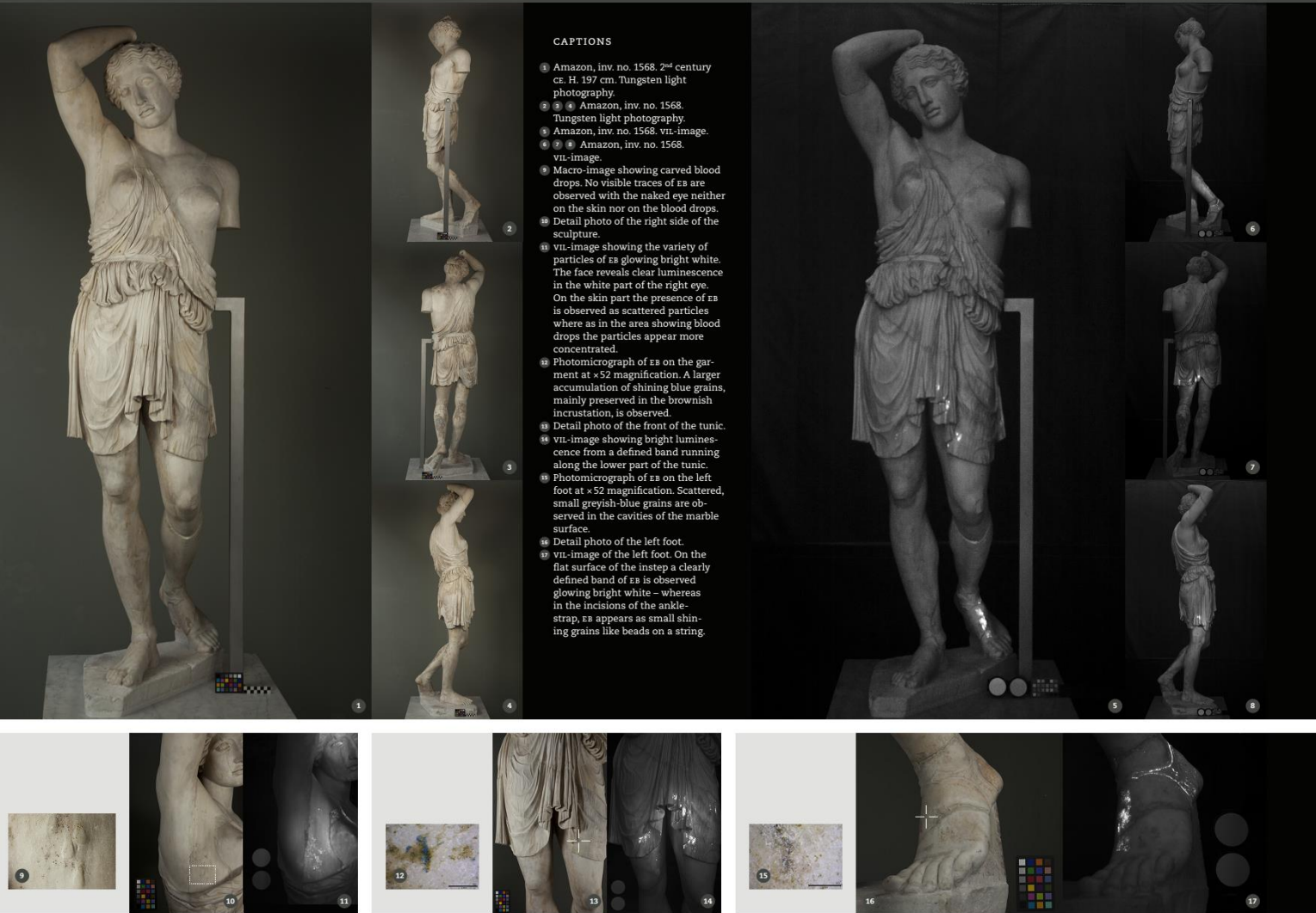


# Visible-induced Luminescence (VIL) Digital Imaging in Research on Ancient Sculptural Polychromy: A 2<sup>nd</sup> Century CE Marble Amazon in the Ny Carlsberg Glyptotek, Copenhagen

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## INTRODUCTION

The study reported on here was conducted in the spring of 2010 within the framework of a project carried out by the Ny Carlsberg Glyptotek and the Copenhagen Polychromy Network (CPN). The project investigates the polychromy of Greek and Roman stone sculpture in the Ny Carlsberg Glyptotek.<sup>1</sup> The 'Sciara Amazon' is a 2<sup>nd</sup> century CE Roman marble copy of a Greek bronze original of the mid 5<sup>th</sup> century BCE. The sculpture has been known since the 17<sup>th</sup> century and is the name piece of an Amazon type of which several other Roman copies exist. The right hand, left arm and left shoulder are missing; the left shoulder has been restored. There are a few cracks and several breaks, but the sculpture is otherwise complete. Around some joints, reworking of the surface has taken place.<sup>2</sup>



## CAPTIONS

- 1 Amazon, inv. no. 1568, 2<sup>nd</sup> century CE. H. 197 cm. Tungsten light photography.
- 2 Amazon, inv. no. 1568. Tungsten light photography.
- 3 Amazon, inv. no. 1568. VIL-image.
- 4 Amazon, inv. no. 1568. VIL-image.
- 5 Macro-image showing carved blood drops. No visible traces of EB are observed with the naked eye neither on the skin nor on the blood drops.
- 6 Detail photo of the right side of the sculpture.
- 7 VIL-image showing the variety of particles of EB glowing bright white. The face reveals clear luminescence in the white part of the right eye. On the skin part the presence of EB is observed as scattered particles where as in the area showing blood drops the particles appear more concentrated.
- 8 Photomicrograph of EB on the garment at  $\times 52$  magnification. A larger accumulation of shining blue grains, mainly preserved in the brownish incrustation, is observed.
- 9 Detail photo of the front of the tunic.
- 10 VIL-image showing bright luminescence from a defined band running along the lower part of the tunic.
- 11 Photomicrograph of EB on the left foot at  $\times 52$  magnification. Scattered, small greyish-blue grains are observed in the cavities of the marble surface.
- 12 Detail photo of the left foot.
- 13 VIL-image of the left foot. On the flat surface of the instep a clearly defined band of EB is observed glowing bright white - whereas in the incisions of the ankle-strap EB appears as small shining grains like beads on a string.
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## METHODS AND MATERIALS

The sculpture is examined to locate and document traces of Egyptian blue (EB), a synthetic pigment commonly used in antiquity. The examination is by means of the non-invasive techniques microscopy and visible-induced luminescence (VIL) imaging.

VIL-imaging is a recently developed technique to detect and map EB.<sup>3</sup> The pigment has the property of absorbing visible radiation and of re-emitting infrared radiation (IR) in the 800–1000 nm range with a peak at c. 910 nm. The technique exploits the strong emission, visualizing and detecting particles of the pigment that remain invisible to the naked eye, even when concealed by layers of discoloured organic binding media, varnishes or inorganic patina.<sup>4</sup> The methodology is thoroughly described in the above-mentioned publication and goes as follows:<sup>5</sup> the luminescence emission from the pigment is captured using a modified Canon 40D camera with a Schott BG39 filter with a cut-on (50%) at 830 nm in front of the lens and commercially-available red, green and blue (c. 470–630 nm) light-

emitting diodes (LEDs) from Exelc. Spectralon® 99% and 75% non-luminescence, reflectance standards are placed alongside the object and included in all images. The evaluation of the presence of the luminescence from EB is carried out by comparison with the standards.

Initially the stone surface of the sculpture is systematically examined with the naked eye and a video microscope, Leica VZ 75c up to  $\times 160$  magnification. The sculpture is then rotated about its axis with an interval of 90 degrees in connection with documentation using colour and VIL photography, both with four exposures (fig. 1–4 and fig. 5–8). Detail photos are taken of various selected areas of the sculpture, where the luminescence is strongest. Microscope images are captured with the video microscope.

VIL-imaging reveals extensive luminescence properties of EB. On the skin the pigment is, in the main, present on the surface as scattered particles but in some places more concentrated as observed in the white part of the right eye-ball and the area showing blood drops (fig.

## RESULTS

The visual examination and documentation of EB by means of near-infrared digital imaging gives very different results.

Microscopy of the surface shows few traces of a blue pigment which are found not only on the garments but also on the skin (fig. 9–10, 13 and 16). The majority of the grains are distributed on the lower part of the tunic in front and at the back. The examination also reveals blue grains on the front and back of the legs and on the feet. As a rare exception groups of blue grains can be observed but in most cases the pigment exists only in very minute amounts (fig. 12 and 15). The colour of the pigment varies from greyish blue to clear, shining blue. In general the blue pigment is observed where the marble surface is covered in incrustation.

VIL-imaging reveals extensive luminescence properties of EB. On the skin the pigment is, in the main, present on the surface as scattered particles but in some places more concentrated as observed in the white part of the right eye-ball and the area showing blood drops (fig.

11). A bright glowing band is observed running along the lower part of the tunic, most sharply defined in the front and on the back (fig. 14). The left foot shows a defined band glowing on the flat surface of the instep and in the incisions of the ankle strap (fig. 17).

When combined, microscopy and VIL-imaging complement each other. Microscopy elicits qualitative information on the pigments and the marble surface. The presence of microscopic particles depends on a reasonable state of preservation of the surface; areas with no or only limited amounts of microscopic particles have undoubtedly been deeply cleaned or reworked. However VIL-imaging visualizes the distribution of EB on a submicroscopic level and elicits not only invaluable information on the decorative patterns on the sculpture but also documents the practice of using blue in the skin tones and eyes. The astonishing results should have an impact on conservation practices, handling and transportation as well as for museum communication of polychromy in antiquity.

## ARCHAEOLOGICAL COMMENT

The Amazon belongs to a very large class of Roman statuary representing gods and other mythological characters. Few studies of the polychromy of such sculptures have been published and no VIL-images at all.<sup>6</sup> The results obtained from the Amazon provide important information in a number of respects. The EB in the right eye is paralleled in the eyes of a 4<sup>th</sup> century BCE marble head from the Artemision at Ephesos in the British Museum; it is also found mixed with white lead in the white of the eye of a 2<sup>nd</sup> century CE female marble head, also in the British Museum.<sup>7</sup> Though no other pigments have yet been observed, the presence of a colour in the eye ball of the Amazon strongly suggests that iris, pupil, eyelashes and eyebrows were also shown, as on the 1<sup>st</sup> century CE female marble head from Herculaneum.<sup>8</sup> EB found on the skin of the Amazon may be compared to the skin tone containing EB documented on a contemporary female marble head.<sup>9</sup> The ornamental band containing EB on the lower part of the tunic calls to mind the border seen on the lower edge of the tunic of the Amazon of Sciara

found at Ecija, Spain.<sup>10</sup> As for the EB on the instep of the left foot, it looks like a sandal thong. If this is what the painter intended, it is a misunderstanding, for the Amazon is not wearing sandals: there are no soles! She wears ankle-straps, which were not spur holders as some suggest, but meant to support the ankle when mounting and dismounting, thus characterizing the Amazon as a rider. Such straps are also seen on depictions of dancers and acrobats.<sup>11</sup>

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