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# Hidden history?: examination of two patches on John White's map of 'Virginia'

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**Summary** Technical imaging and non-invasive analysis of the areas covered by two paper patches on an Elizabethan map of the coast of North Carolina ('La Virginea Pars': P&D 1906,0509.1.3), drawn by the gentleman artist John White, has revealed a number of changes made to the original design. One patch was used to make minor alterations to the representation of the coastline. The second patch covers a large symbol, which apparently represents a fort or fortification, and bears on its surface a faint version of a similar symbol.

## INTRODUCTION

John White was an English gentleman and fine water-colour artist who made five voyages to the east coast of North America, specifically to what is now North Carolina, between 1584 and 1590, shortly after it was first visited by Europeans. He was heavily involved with attempts, sponsored by Sir Walter Raleigh among others, to establish English colonies in the region and in 1587 became governor of a failed attempt at a permanent settlement on Roanoke Island (the so-called 'Lost Colony'). White produced a remarkable series of watercolours, providing a visual record of the voyages and the plants, animals, birds and people encountered; he also made a number of maps. These drawings (now in the Department of Prints and Drawings at the British Museum, 1906,0509.1.1–73) were probably originally intended to form a presentation album to be given to Queen Elizabeth I, Walter Raleigh or another patron at court at some time after the second of his voyages in 1585 and would have been used to encourage support for the establishment of a permanent colony.

Nothing is known of the history of the drawings between their creation and 1788, when the Earl of Charlemont, a great collector and patron of the arts, bought 75 John White watercolours mounted in an album. The album remained in the Charlemont family until 1865 when it was sent for sale to Sotheby's in London. Unfortunately, prior to the sale there was a fire in the warehouse adjacent to the auction rooms. Although the album was only slightly scorched, great damage was caused by the water used to quench the flames,

as the saturated volume was left under pressure beneath other books for three weeks. This resulted in considerable 'offsetting', where pigment has transferred from drawings onto facing sheets or, in the case discussed here, between two parts of the same folded sheet. The damaged album was sold first to Henry Stevens, who rebound the drawings before selling them on in 1866 to the British Museum, where they were first housed in the Department of Printed Books before being transferred to the Department of Prints and Drawings in 1906. They were removed from the album and mounted for display in the mid-twentieth century.

These watercolours form a well-known and invaluable resource for the study of North America at the point of first contact with Europeans. One map in particular, 'La Virginea Pars' (P&D 1906,0509.1.3: Figure 1), which shows the east coast of North America from Chesapeake Bay to Cape Lookout, has been cited frequently in discussions concerning the early European settlement of this area. It has long been known that this map bears two patches of a type sometimes used to alter or correct images on paper; these patches were noted, without further comment, by a number of previous writers on the watercolours, notably in the standard reference book on the drawings, Hulton and Quinn's facsimile edition with full catalogue [1; Nos. 111 and 136]. The watercolours formed the basis of the exhibition *A New World: England's First View of America* (first shown at the British Museum in 2007 before travelling to three venues in the United States); the accompanying publication by Kim Sloan and other scholars reproduced all the drawings and related versions, including de Bry's

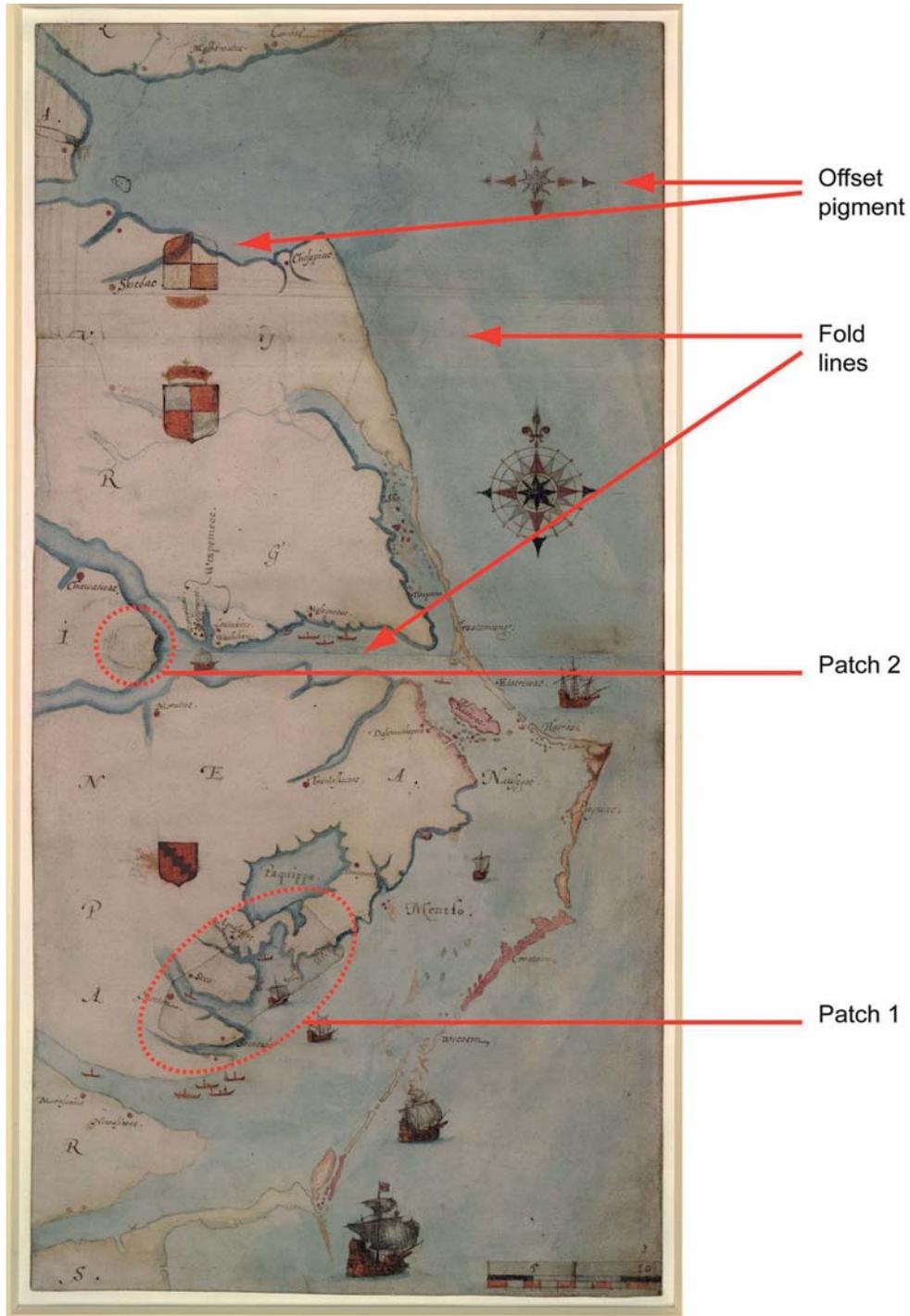


FIGURE 1. 'La Virginea Pars' by John White, P&D 1906,0509.1.3 (478 × 235 mm), showing the two paper patches and fold lines

prints after them [2]. Until preparations were made for this exhibition the drawings had been fastened on all four sides onto their mounts for display making the versos unavailable for study. For the exhibition the drawings were removed from their old mounts and hinged into new mounts, making such access possible. At the same time, a group of the drawings, although not the map 'La Virginea Pars', was subject to technical examination that helped, among other things, to establish the basic palette used by John White [3, 4].

In 2012, Brent Lane of the University of North Carolina, who was searching for the present locations of the villages marked on the coast on the lower patch, enquired whether the coastline or village locations were different under the patch. This led Kim Sloan and Alice Rugheimer to place the map on a light box, which showed some changes to the coastline in the lower patch and a large blue and red symbol under the upper patch. The scientific examination of the White watercolours was then extended through a detailed investigation of the map and its patches.

TABLE 1. Summary of pigments found on 'La Virginea Pars', John White, P&amp;D 1906,0509.1.3

Colour	Method(s) used	Identification
Blue; sea and coastline	Raman	Indigo
Blue; fort symbol protruding from under patch 2	Raman	Indigo
Blue; shield with arms of Elizabeth I	XRF	Smalt
Gold; shield with arms of Elizabeth I	Raman/XRF	Orpiment
Black; shield with arms of Raleigh	XRF	Metallic silver
Red; symbol underlying patch 2	XRF	Lead-containing pigment, probably red lead
Red; both shields	Raman/XRF	Red lead and vermilion
Red; boat east of patch 2	Raman/XRF	Hematite (red ochre)
Red; diffuse pink in chain of islands	Raman/XRF	Vermilion and ?red lake pigment
Black lines of underdrawing	Raman	Graphite

## EXAMINATION OF THE MAP

The fragility and nature of the map meant that only non-contact and non-destructive techniques could be used in its examination. After detailed observation under the microscope, a range of imaging techniques (detailed below and in the experimental appendix) was applied to help clarify the drawing on and beneath the patches. In addition, X-ray fluorescence (XRF) and Raman spectroscopy were used to investigate the pigments employed by White on this map.

### *The patches*

An initial examination of the map using optical microscopy found no evidence of any damage to the main paper sheet under the patches, suggesting that they were applied solely to alter or correct a first draft (for the purposes of this investigation the two patches were termed patch 1 and patch 2, as indicated in Figure 1). Both patches are made from paper that has edges that are torn or cut irregularly, possibly to make them less obvious once adhered. In patch 1, the coastlines of the underlying map have been continued over the surface of the applied paper using a palette that appears to be the same as that employed in the rest of the map while patch 2 bears on its surface a small section of coast and a symbol in very faint lines. The nature and significance of this symbol is discussed in more detail below.

### *The pigment palette*

As mentioned above, the pigments were analysed using the complementary techniques of XRF and Raman spectroscopy, with XRF providing evidence of the elements present and Raman giving compound-specific identifications. Unfortunately, while both methods are ideally suited

to the non-destructive analysis of works on paper and give clear results for inorganic compounds, neither is particularly effective for the analysis of most organic materials [5; pp. 13–15] (indigo being an exception to this general rule), so that it was not possible to answer all the questions raised in relation to this map. A summary of the results is given here (see Table 1) and full details can be found in [6].<sup>1</sup>

Not surprisingly, given that the map is believed to be by the same artist and drawn at the same time as the other watercolours from the album (c.1585–1587), the palette proved to be very much in accord with that found during the earlier examination of White watercolours [3, 4]. All the blues, with the exception of those used in the uppermost shield, were of indigo, the reds were provided by red lead, red ochre, a possible red lake and small amounts of vermilion, the outlines were drawn in graphite, and the blackened areas on the lower shield, that of Walter Raleigh, proved to be degraded silver, probably originally applied as shell silver to provide a bright, metallic and luxurious finish. As discussed above, the sheet was once folded. Much of the surface of the uppermost shield, which bears the arms of Queen Elizabeth I, has been offset onto the area above it and under magnification it was clear that substantial quantities of pigment, including fine detail, have been lost. The quarters that now appear mostly white were originally blue with applied gold-coloured symbols. The blue used here is smalt, which was also found on other White watercolours at the British Museum, while the gold colour is provided by orpiment, the only inorganic pigment found on this sheet that was not previously identified on other White watercolours. Although orpiment ( $\text{As}_2\text{S}_3$ ) is gold in colour and has a gold-like lustre, it is not commonly found on paintings of this period, as it is both photosensitive and unstable in combination with many other paints. Nevertheless, Harley records that it was considered suitable for heraldic devices [7; p. 93], which may explain its presence here.

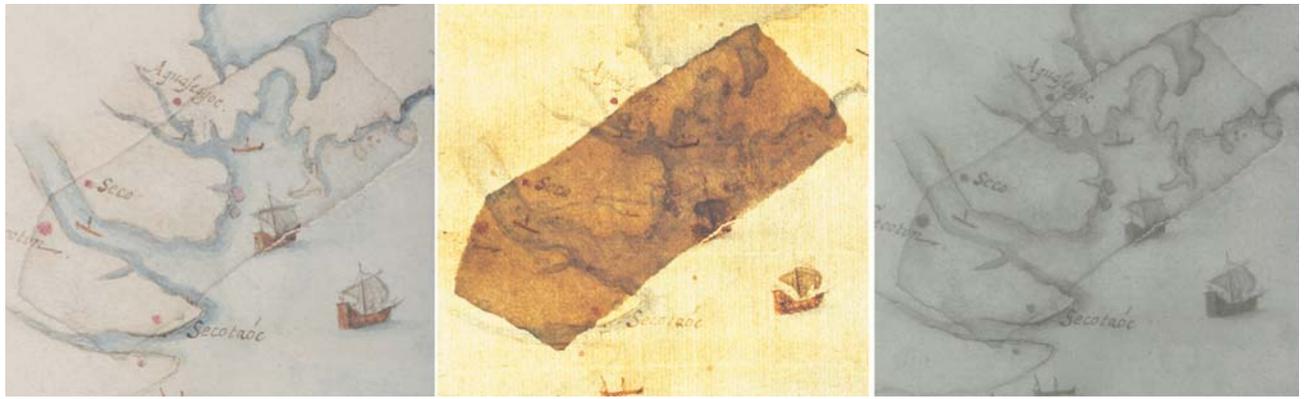


FIGURE 2. Patch 1 on P&D 1906,0509.1.3: left, reflected visible light image; centre, transmitted visible light image; and right, infrared reflectogram (contrast increased for clarity)



FIGURE 3. Patch 2 on P&D 1906,0509.1.3: left, reflected visible light image; centre, transmitted visible light image; and right, ultraviolet-reflected image

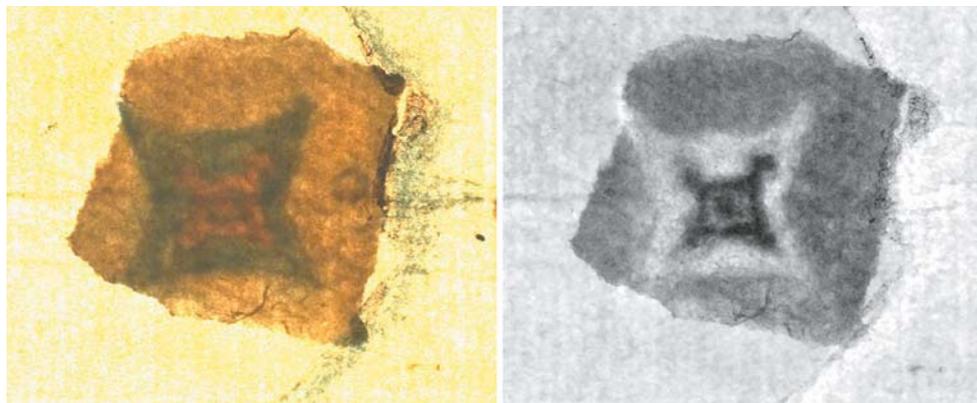


FIGURE 4. Enhanced images of the symbol underlying patch 2 on P&D 1906,0509.1.3: left, enhanced by scaling the lightness of the transmitted visible light image; and right, enhanced by converting the transmitted visible light image into the LCh system and extracting and scaling the h band



FIGURE 5. Ultraviolet-reflected image of the symbol on the surface of patch 2 on P&D 1906,0509.1.3: left, enhanced by scaling the lightness of the image; and right, enhanced by local histogram equalization of the scaled ultraviolet-reflected image



FIGURE 6. Area to the east of Lake Paquippe showing changes between the initial sketching, as shown in the infrared reflectogram (IRR; left) and the finished map, as shown in the reflected visible light image (right). Once alerted by the IRR image many of the changes can be seen by eye



FIGURE 7. Images of the ship in the inlet just to the east of Patch 2: left, underdrawing as revealed in the infrared reflectogram; and right, final painted image

## VISUALIZING THE COVERED AREAS

The main motivation for examining the patches was to investigate what lies beneath them and to assist in this process a number of imaging techniques were applied. The first method was transmitted visible imaging, accomplished by placing a light source beneath the map and positioning a camera above it (see the experimental appendix for details). This very simple method proved extremely effective in revealing previously hidden sections of the map, Figures 2 and 3. It also clarified some features of the paper used for the patches, showing that the laid and chain lines (the regular pattern of lines impressed by the wires in the mould used to make handmade paper) and the surface characteristics of this paper were similar to those of the sheet used for the main map [8].

Both patches and much of the main map sheet were then subjected to infrared examination. Infrared radiation is generally more penetrative than visible light and under some conditions it can be used to visualize areas under materials that are opaque to visible light but transparent to infrared radiation. The most common application in the study of works of art is to examine the underdrawings in paintings [9]; because infrared radiation penetrates many pigments but not carbon, preliminary sketches made in carbon-based media (such as charcoal or carbon inks) that

have been covered by paint layers become clear in infrared images. As the findings from Raman spectroscopy demonstrate, the initial outlines in this map were produced using the carbon-based material graphite and infrared imaging proved very effective in revealing the many alterations made between the initial sketches and completing the final map. Infrared images were captured in two wavelength bands, 800–1000 nm and 800–1700 nm. The 800–1700 nm range (a technique normally termed infrared reflectography) provided the most information in this case and only these images are shown here (other infrared images can be found in [6]).

Patches 1 and 2 were also examined using ultraviolet radiation. Two techniques were used: ultraviolet-induced luminescence, which records luminescence in the visible range stimulated by ultraviolet illumination, and ultraviolet-reflected imaging, which records reflected ultraviolet in the same way as a visible image records reflected visible light. Ultraviolet radiation is generally poorly penetrative and so provides information about only the very topmost layers of an object. Ultraviolet-reflected imaging gave the clearest record of the very faint lines on the surface of patch 2 (Figure 5), showing them to be a surface phenomenon. Even using these methods, the images generated were not always as informative as might be desired and a number of image processing techniques were also applied. Details of these are given in the experimental appendix and in the appropriate figure captions.

## RESULTS

### *The main map*

Comparison of the infrared reflectograms of the main map sheet with its final appearance shows that many changes were made to the initial sketched outlines, although most are fairly minor corrections of geographical detail (see for example Figure 6). Many of the ships also feature such *pentimenti*, the most apparent of which is that to the ship in the inlet just to the east of patch 2 [10]. Figure 7 shows a comparison between the final version of this vessel and the initial underdrawing seen in the infrared reflectogram. In the reflectogram the ship has two lines to the side that could be oars or anchor ropes and the sail seems to be billowing towards the land, while in the final image the lines have been covered with the brown paint used to depict the ship's hull and the sail seems to swell in the opposite direction.

### *Patch 1*

The number of alterations between the initial sketches and the final image on the main map sheet add to the complications of interpreting what may lie beneath patch 1. Comparison

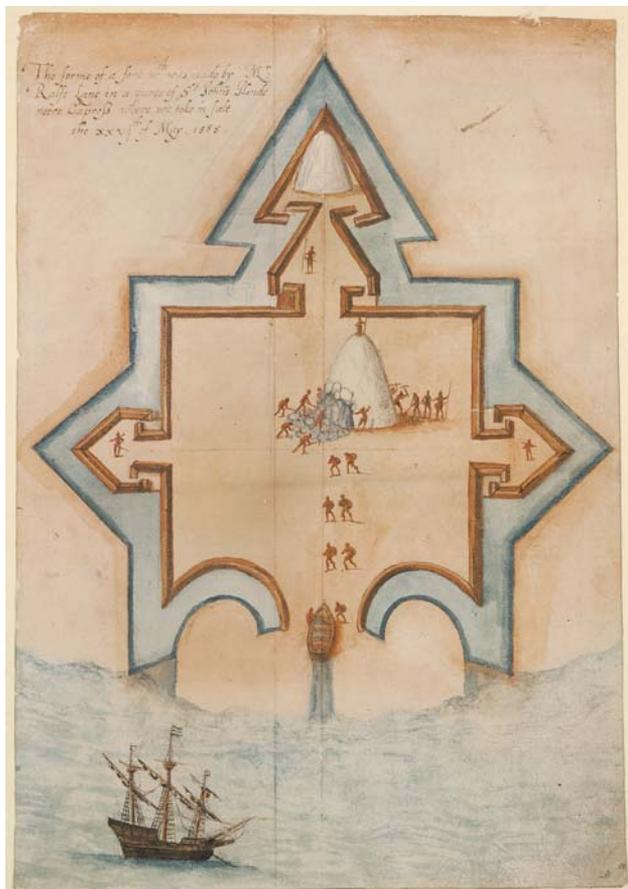


FIGURE 8. 'An entrenchment near Cape Rojo, Puerto Rico' by John White, P&D 1906,0509.1.5

of the visible reflected and transmitted images (Figure 2, left and centre) suggests it covers a fairly similar earlier version of this area of coastline. However at least two blue lines (crossing the peninsula on which the settlement of Seco sits), and possibly others, can be seen in the transmitted visible but not in the reflected visible image and must, therefore, relate to the drawing concealed by the patch. These may reflect a differently shaped coastline or the presence of additional river courses in the original version. Because it is not clear how deep the infrared radiation has penetrated, it is difficult to know if the extensive alterations seen in the infrared image (Figure 2, right) relate to changes in the preliminary sketch on top of the patch or to an earlier version beneath it. The outline of the original location marker for the settlement of Secotaóc (which was repositioned to the west in the final image) offers the most helpful clue when seeking to interpret these images. This marker is partially concealed by the patch; the portion that is not covered is clear in the infrared reflectogram, while the covered region is barely visible. On this basis it seems most likely that the majority of the lines visible in the infrared image relate to preliminary sketches on the top surface of the patch rather than to drawings concealed beneath it. It is therefore difficult to be sure what lies beneath the patch and to determine why it was applied; it may simply relate to the blue lines that clearly underlie it. The evidence of multiple changes to the initial sketches found on the main

map sheet shows that it was simple to correct mistakes in the graphite lines by painting over them. It is possible that the blue paint lines were more difficult to modify and the easiest remedy was to cover them with a patch.

### Patch 2

Investigation of patch 2 produced rather more dramatic results. The transmitted visible image (Figure 3, centre) revealed an earlier version that was very different from the current appearance of the map, featuring a symbol in the shape of a large lozenge or four-pointed star, outlined in blue and filled with red, with a small circle to the right adjacent to the coastline. When examined closely, the two leftmost points of the large symbol can just be seen on the surface of the main map protruding from under the left edge of the patch.

The symbol under the patch was greatly clarified by image processing of the transmitted visible image (Figure 4) and a square dark feature can be discerned in the centre of the symbol. From Figure 4 (right), it seems that the inner section, which appears dark in this processed image, has at least one defined sub-rectangular corner at the top. While the detailed interpretation of this symbol is beyond the scope of this study and is best left to experts in the field, it seems certain to represent a fort or fortification [11]. The use of signs on maps at this period was very much in flux [12] and it is not clear if this shape is intended as a symbolic representation or as an actual depiction of the ground plan of a fort or of an intended, but unbuilt, fort. The shape revealed seems to have parallels with another of White's drawings in the British Museum collections – the plan of an entrenchment near Cape Rojo, Puerto Rico (P&D 1906,0509.1.5: Figure 8).

The pigments used in the production of the underlying symbol were investigated with a mixture of Raman and XRF spectroscopy, Table 1. Raman investigation of the blue areas where they protrude at the edge of the patch showed them to be painted with indigo, and hence fully in accord with most of the other blue areas of the map, while XRF showed the red areas to contain a high proportion of lead, suggesting the use of red lead ( $Pb_3O_4$ ), again in agreement with other findings from this map and from other John White drawings [4].

Detailed examination of the top surface of the patch produced an equally unexpected result; a number of very faint and previously unnoticed lines are just visible with the naked eye, defining a shape that is similar to that seen under the patch, although smaller and surrounded by concentric squares (Figure 3, left). These lines can be seen most clearly in the ultraviolet-reflected image (Figure 3, right), strongly suggesting that this is very much a surface phenomenon. Further enhancement of this image (as described in the experimental appendix) increased its legibility (Figure 5), making the similarities between the central shape and the symbol found beneath the patch more apparent. The

ultraviolet-reflected images also show a central cross-shaped feature and two surrounding concentric squares, incomplete on the coastal side. A horizontal fold line that passes through the centre of both patch and symbol complicates attempted interpretation.

Attempts to identify the materials used to produce these lines met with limited success. Raking light examination showed no associated indentations, suggesting that whatever was used was applied in liquid form, either with a brush or with very light strokes of a pen. Optical microscopy of the area revealed no visible particles in the lines; overall they give the impression of being stains or areas of localized damage rather than being due to the deliberate application of a particulate pigment. Raman spectroscopy gave no results and XRF analysis was hampered by the narrowness of the lines relative to the 0.65 mm spot size of the X-ray beam and because their very faint nature made focusing difficult. However, two areas where the lines are at their most dense and where as little as possible of the underlying symbol was in the beam path were analysed by XRF. The results showed no detectable elements present at levels above those expected from the underlying paper, paper patch and concealed symbol. Taken together, these findings suggest that some form of organic compound or a material based on very light elements was used, although it cannot be pure carbon as it does not show up in the infrared reflectograms. Organic pigments are certainly present in some paintings by White; within the British Museum collections a very faded green is used in 'Sabatia' (P&D 1906,0509.1.38), with better-preserved organic pinks and purples found elsewhere in the same drawing [3]. However none of the pigments in the other John White drawings so far examined have quite the same appearance as the lines discussed here. One other possible, if rather romantic, explanation is that these lines could reflect the use of an 'invisible' ink (an ink that would only be revealed when treated in some way, usually by applying heat). Such materials are well recorded from this period, with inks based on alum, milk, citrus juice or urine being the most frequently mentioned [13].<sup>2</sup> The data so far collected would certainly be consistent with the use of any of the materials in this list, even alum; while no aluminium was recorded in the areas examined, the low sensitivity of the XRF equipment to aluminium does not allow its use to be excluded. However, such a specific hypothesis is impossible to prove and the use of an initially visible, but now much faded, substance is probably more likely.

## CONCLUSIONS

In summary, the two paper patches attached to P&D 1906,0509.1.3 use similar materials and techniques to those of the main map and appear to be contemporary or near contemporary with it. The first patch may fulfil the expected purpose of such additions, altering and correcting a flawed

initial layout. The second is more unusual, concealing a boldly coloured symbol apparently indicating a fort or signifying the intended location of one. Even more surprisingly, having once covered this sign, it was then redrawn, albeit at a smaller scale and in slightly different outline format on the surface. While the surface depiction is now barely visible, in the absence of a definitive material identification it is difficult to know just how clear it would have been originally. However, the fine lines used suggest that it could never have dominated the map in the way the first, now covered, symbol must have done. The interpretation, within a wider Elizabethan context, of the symbols that were made or covered is beyond the scope of this study, as are any connections they may have with the intended site of the 'Cittie of Raleigh' or with the 'Lost Colony', the abortive first attempt at a European settlement in North America.

## EXPERIMENTAL APPENDIX

### *Technical imaging*

The methods used to capture visible and ultraviolet-reflected images are given on page 23 of this *Bulletin*. Infrared reflectograms were captured using an Osiris Imaging System, with an InGaAs array sensitive in the c.800–1700 nm range and a six-element 150 mm focal length f/5.6–f/45 lens. A Schott RG830 glass filter was positioned in front of the lens. Two tungsten radiation sources were positioned at approximately 45° with respect to the focal axis of the camera.

### *Image processing*

Selected images were further enhanced using the image processing package VIPS/nip [14], and Adobe Photoshop C5. For patch 1 the lightness and contrast of the infrared reflectogram were increased to improve legibility and a slight edge enhancement added using the Photoshop 'unsharp mask' function (Figure 2, right). For patch 2, two enhanced versions of the transmitted visible light image of the underlying symbol were produced, the first (Figure 4, right) simply by scaling the lightness of the uncalibrated image. For the other (Figure 4, left) the image was converted to the CIE LCh (lightness, chroma and hue) colour system and the h band (hue angle) extracted and scaled. This gives very strong differentiation between the red and blue areas in the concealed symbol, particularly after scaling of the image. Two enhanced versions of the uncalibrated ultraviolet-reflected image of the faint surface lines were also produced. In one (Figure 5, left), the lightness was simply scaled to give an optimum visibility of the faint lines just visible by eye. For the second (Figure 5, right) this image was further processed by local histogram equalization.

*X-ray fluorescence spectroscopy (XRF)*

XRF analysis was carried out using a Bruker Artax spectrometer, fitted with a molybdenum X-ray tube and operated at 50 kV and 500  $\mu$ A. The analytical spot size was c.0.65 mm and spectra were collected for 300 seconds. Helium gas was introduced into the area between the object and detector in order to allow greater sensitivity in the detection of lighter elements. As the layers applied on the map are very thin compared to the depth of penetration of the X-ray beam, each analysis reflects the elements present in both applied material and support. In all cases spectra were also collected for blank areas of the support (for the patches this included the paper of both the patch and underlying map) and these results subtracted from those collected in areas of interest to give results for the applied materials.

*Raman spectroscopy*

Raman spectra were obtained using a Horiba Jobin Yvon LabRam Infinity spectrometer with green (532 nm) and near infrared (785 nm) lasers with maximum powers of 1.2 and 8.3 mW at the sample respectively (although in this case lower powers were used), a liquid nitrogen cooled CCD detector and an Olympus microscope system. This allowed tiny areas containing one or two grains of material to be targeted for analysis, with a sample spot size in the order of a few microns in diameter depending on the power of objective lens used. Spectra were collected for between 5 and 20 seconds, with at least five scans used to produce each spectrum. The resultant spectra were identified by comparison with a British Museum in-house database.

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## NOTES

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