JANE DAVIES CONSERVATION
ARCHITECTURAL PAINT RESEARCH

ARCHITECTURAL PAINT RESEARCH,
BANQUETING HOUSE, LONDON
2014 – 2018

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INTRODUCTION

The Banqueting House was designed by Inigo Jones, and was built for James I (1603–1625). It was completed by 1622 and is the only surviving complete building from the Great Palace of Whitehall. The building was the first example of classically influenced Palladian-style architecture in England. The interior of the Banqueting House is dominated by a magnificent ceiling painted by Peter Paul Rubens, for Charles I (1625–1649), which was installed in 1636. The building was a focal point in the life of the 17th-century court, and was the site of grand diplomatic ceremonies and elaborate court masques, designed and written by Inigo Jones and Ben Jonson amongst others. The interior was also the scene of symbolically important ceremonies, such as the Maundy Thursday celebrations and 'Touching for the King's Evil' during which the king cured afflicted subjects of scrofula. The building witnessed many significant historic events, including the execution of Charles I, the Restoration of Charles II, and the formal offer of the throne to William of Orange and Mary in 1689. In 1698 Sir Christopher Wren converted the Banqueting House to the Chapel Royal, and the building continued as a chapel until 1890. Over the years it has undergone restoration campaigns led by James Wyatt, Sir William Chambers, Sir John Soane and Sir Robert Smirke. The northern annexe, which contains a grand staircase and from which the building is now entered, was built by James Wyatt in the early 19th-century. From 1890 onwards, the Banqueting House functioned as a museum, until the Department of the Environment took it on in the 1960s and opened it as a setting for government functions and events. It passed into the care of Historic Royal Palaces in 1989 and is now open to the public.

FIG.1: upper image, the exterior of the Banqueting House, viewed from the north. Photograph HRP online source.
FIG.2: lower image, the Ruben's ceiling as it appeared at time of sampling. Photograph HRP online source.

This report summarises the architectural paint research (APR) undertaken in the Banqueting House by Jane Davies Conservation between 2014 and 2018. Paint research included the elaborate ceiling framework, wall frieze, pilasters, Corinthian capitals, balcony

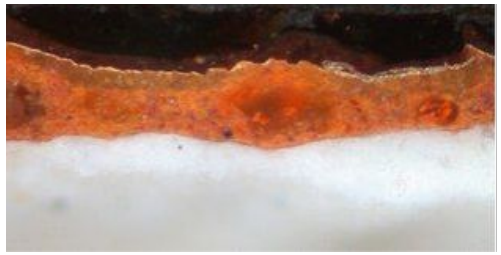

FIG. 3 ABOVE Cross-section sample from the curved planceer at the northern end of *Minerva* photographed under darkfield reflected light (2016/30). 200× magnification at capture, printed magnification not calculated. Showing Jones's first and second schemes.

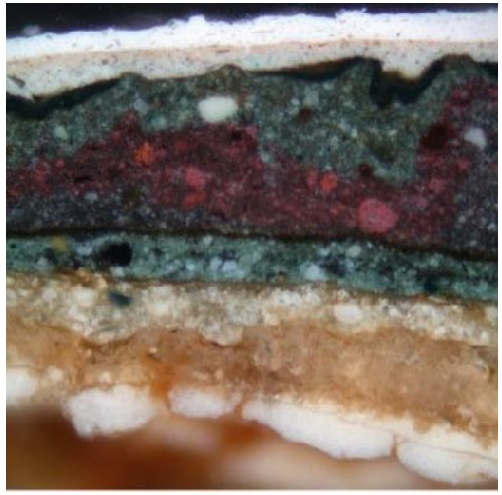

FIG. 4 ABOVE Cross-section sample from the south-east caisson spandrel of *Apotheosis* photographed under darkfield reflected light (2016/27). 200× magnification at capture; printed magnification not calculated. Showing Jones's first white and second pale blue decoration.

and lower walls. Jones's first scheme (*c*. 1622) consists of a simple finish of lead white in oil over preparatory oil, lead white and chalk layers. However, Jones' second scheme, which dates from after the installation of the paintings in 1636, comprises a more elaborate decorative scheme, with regions of walnut-tree colour graining, gilding and figurative decoration.

During the second Jones scheme the ceiling was first painted a uniform red-brown; this colour provided a base for gilding and for graining which seem to have been worked up simultaneously. In some samples we see varnish and graining overlapping the edges of the gilded design (e.g. sample 2016/30). Two samples, from the egg and dart, and cyma reversa, of the cornice provide evidence that overlying dark paint was applied wet-in-wet with Jones' brown paint (samples 2016/35 and 2014/9) and that the natural-resin varnish was part of Jones' second scheme. This graining constitutes the 'walnut-tree colour' referred to in historical documents. In the case of the planceers, the brown base coat was applied, then the gilded figurative designs were carried out. Glazes, and in some cases more opaque paint mixtures, were applied onto the gilding to create figurative designs such as the rinceau ornament, 'green man' masks and putto. Samples from plain gilded regions, such as the cyma reversa mouldings, generally show evidence of brown paint, followed by ochre-pigmented oil size and gold leaf. However, and very interestingly, the backgrounds of the spandrel caissons were painted blue with a mixture of lead white and smalt directly on top of the first white scheme with no plain brown ground having been applied. Painting blue over white would have shown the blue colour off to better effect. The gilding on the spandrel caissons was also applied directly over Jones' first white scheme; the granular nature of smalt would have been a difficult, rough surface over which to apply gilding and the blue colour might have given a greenish cast to the thin gold leaf.

In many samples, after Jones' second scheme we see evidence of a varnish which appears dark under ultraviolet illumination, possibly suggesting that it has a high oil content rather than simply being a resinous varnish. Documents record work by Streater in the 1680s and this mixture may have been applied by him as a varnish layer to improve the appearance of the paintwork. Certainly, the inclusion of at least some oil to create an oleo-resinous coating would be typical of 17th-century varnish formulations. At approximately the same point in the layer structure there is evidence of a shellac varnish which seems to have been applied only to certain regions, including the caissons and the large cyma reversa or planceer next to *Minerva*. This may be part of Streater's intervention or may be a different early treatment. A notable early intervention which might

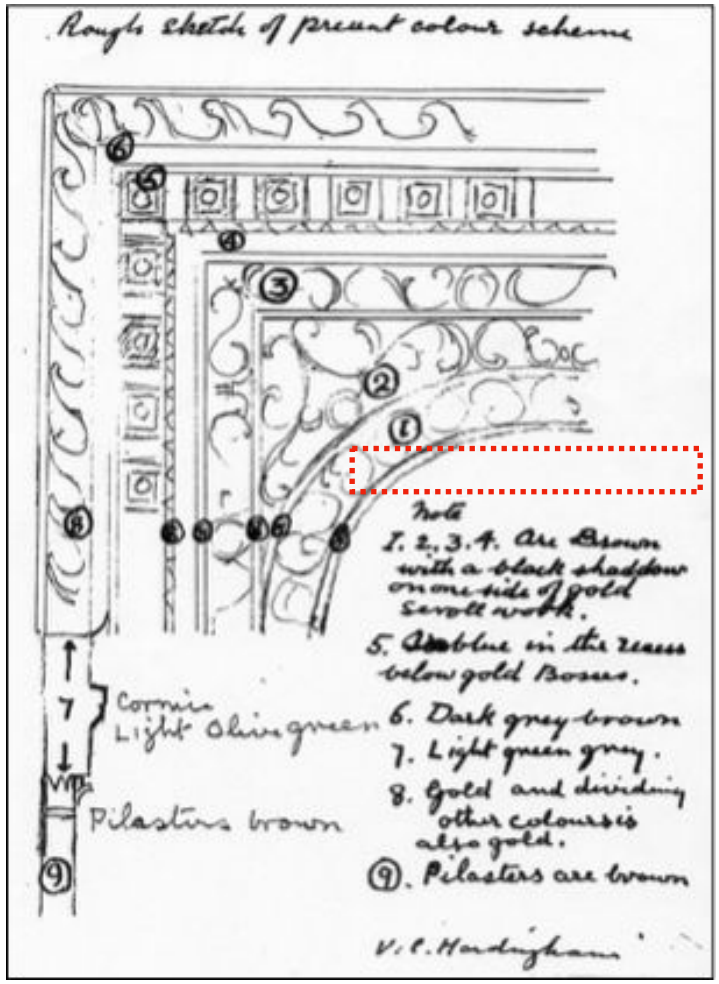

FIG. 5 ABOVE Sketch by V.C. Hardingham showing the colour scheme of the coffering in 1950. The note regarding the blue coffer soffits is highlighted with red.

also relate to Streater is the re-painting of the caisson backgrounds blue, with a second smalt- and lead-white-containing paint. This was applied over the shellac. The shellac at the intersection of the cyma reversa and planceer had developed cracks before the next layer of natural resin varnish[1] was applied suggesting some time had elapsed. This later varnish may be part of Kent's treatment, or may have been applied at some time between Streater and Kent's documented work. There is not a great deal of clear evidence of Kent's intervention although in some samples there is a brown paint layer which most probably relates to his work. Later, the caisson backgrounds were repainted blue with a paint mixture that included Prussian blue. The coffer soffits, which were originally painted with graining, were later painted with a Prussian-blue-containing paint mixture; this was still visible in the mid-20th century when it was documented by V.C. Hardingham (FIG. 5).[2] The two Prussian-blue paints are not from the same scheme, and the first on the caissons pre-dates Soane's restoration whereas the blue on the coffer soffits appears to be either co-eval with, or post-date Soane's work.

The most widespread non-original scheme dates from between 1829 and 1837, when Soane and Smirke carried out significant repairs and redecoration of the Banqueting House. At this stage many of the caissons were replaced and repairs were carried out to other parts of the woodwork and elsewhere. Originally, the background of the caissons was a blue mixture of smalt and lead white; this was altered to graining in Soane's scheme. Just like in Jones' time, the first stage of decoration once the structural repairs had been carried out was the application of graining to much of the ceiling. This re-graining is distinctive, and very different in cross-section from Jones' initial graining, in that it consists of mixture of grey, brown, black and dark red-brown paint. It is possible that the dark appearance of this graining is due to an attempt to mimic the appearance of Jones' graining with the darkened varnish

[1] The natural resin varnish is bright green-blue and the shellac is a distinct orange under ultraviolet light.

[2] Hardingham, V.C., sketch 1950, reproduced by Granville and Burbidge, *The Banqueting House, Whitehall: Condition Survey of the Carved and Polychrome Timberwork of the Ceiling - January* 2008, 2010, p.10.

FIG. 6 ABOVE Detail of an uncovering trial on the planceer at the north end of the ceiling, revealing Soane's scheme. Note the dark shadows, which offer much more contrast with the gilding than the modern, opaque, greyish shadows visible at the top of the image.

over it. It appears that parts of Soane's re-graining were selectively varnished, possibly with a slightly pigmented varnish or glaze.

Next in Soane's scheme figurative gilding, for example on the planceers, was applied over the graining, with deep green and blue glazes of Prussian-blue-based mixtures painted on to create shadows and modulation. The optical effect of the translucent blue-toned glazes over the warm red-brown graining and gilding was extremely deep and rich, and was far more striking than the crude 20th-century shadows of dark, opaque paint mixtures (FIG. 6). Some samples from gilded areas show traces of Soane's early 19th-century re-graining beneath his gilding. The Soane gilding consists of an off-white undercoat, followed by a pigmented oil size and gold leaf. A few samples from gilded regions do not show any underlying traces of the re-graining. Much of the gilding from this era consists of two of more applications of size and gold leaf, demonstrating the decorators' attention to detail and desire for a high-quality finish.

The majority of Soane's gilding remains visible to this day, while the grained and other regions were overpainted in the 20th-century first a pale biscuit colour and then the modern white that we see today. On decorative regions, such as the caissons and planceers, these modern paints were applied around the gilded decoration. In the most recent scheme drop shadows were then painted around the gilded designs with an opaque black paint which, from afar, is difficult to distinguish from the dirty 19th-century gilding with which it is supposed to contrast. The coffer soffits were treated slightly differently yet again, with a pink paint applied at the same time as the pale biscuit was applied elsewhere; in the later 20th century the coffer soffits were painted white along with much of the rest of the ceiling. Localised repairs to the gilding have been carried out at various times, including a few touches of Dutch metal gold-effect paint.

REGION-BY-REGION DISCUSSION

Caissons and planceers

Caissons

Smalt-containing paint and early gilding from Jones' 1630s scheme, has been identified in samples from the south-east and south-west spandrel caissons of *The Apotheosis of James I*. Both of these caissons have a substrate made of planks, clearly visible to the naked eye (FIG. 7). In other caisson samples, from around *Apotheosis* as well as the two oval corner paintings, *Hercules* and *Minerva*, the earliest paint is from Soane's scheme (FIG. 9) and the substrate is not made up of visible planks suggesting that entire caissons were replaced during Soane's intervention, when Turner *et al*. were paid for 'preparing the frames and making parts new for the paintings and preparing spandrils for ditto'.[3] In replaced caissons, Soane's graining sits directly on a softwood substrate.

FIG. 7 Detail of the south-east spandrel caisson of *Apotheosis*, showing the visible planks of the original timber support.

Seen in cross-section, the smalt-containing paint of the original caisson backgrounds is translucent and mixed with lead white (FIGS 4 and 8). All of the smalt-containing samples include some evidence that a shellac varnish (orange under ultraviolet illumination) was applied to the surface as part of an early intervention. In one sample (2018/17), a small flake of the earliest smalt-containing paint has detached and been re-adhered by the shellac which might suggest the shellac was applied after some time had elapsed. The original smalt may well have degraded to some extent, as it does not appear very strongly coloured in any of the cross-sections. Although it is of small particle size and therefore not the most expensive and brightest blue even when originally applied.[4] Although in an earlier phase of APR the smalt layers were interpreted as multiple layers of a single scheme, the

[3] Reference required

[4] For a discussion of the processes and factors involved in the degradation of smalt in oil see, for example, Spring, M., Higgitt, C. and Saunders, D., "Investigation of Pigment-Medium InteractionProcesses in Oil Paint containing Degraded Smalt" in *National Gallery Technical Bulletin*, Vol. 26. London: National Gallery. 2005. pp.56-70. Accessed online on 19/3/17 at [https://www.nationalgallery.org.uk/upload/pdf/spring_higgitt_saunders2005.pdf].

disruption of the layers seen in sample 2018/17 suggests that, in some places, the first smalt scheme may have been painted over slightly later with a second smalt-containing scheme, which must date from one of the early interventions – possibly Kent's. Later, a Prussian-blue-containing mixture was applied over the blue backgrounds of the caissons and, later still, it appears that the backgrounds were altered by Soane to be grained instead of blue, which is consistent with the replaced caissons from this era. Soane's distinctive grey and brown paint mixtures are evident in cross-section. Previously it was suggested that Soane echoed the Prussian blue with a grey-blue mixture, which was seen in cross-section; however, having seen more cross-sections of Soane's paint, which employs, amongst other mixtures, a mixed-grey paint as part of the graining, it seems likely that the 'blue-greys' of Soane's figurative backgrounds are simply parts of the graining. The graining was varnished – a common technique by the 19th-century to enhance the effect of lustrous, rich timber.

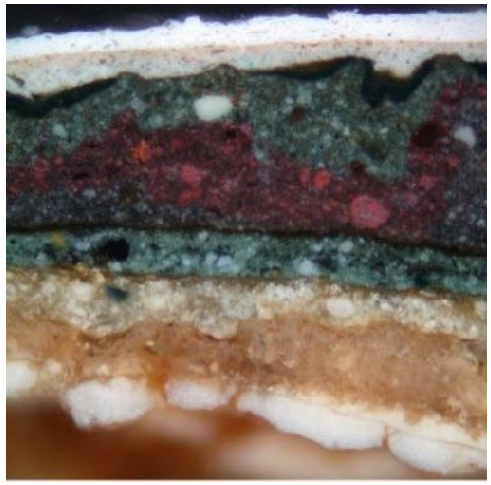

FIG. 4 **REPEAT** Cross-section sample from the south-east caisson spandrel of *Apotheosis* photographed under darkfield reflected light (2016/27). 200× magnification at capture;

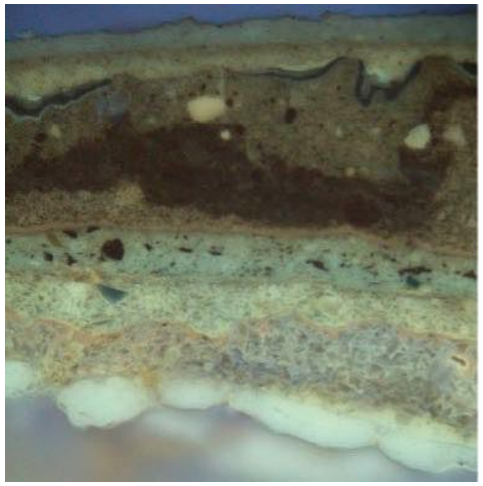

FIG. 8 Cross-section sample from the south-east caisson spandrel of *Apotheosis* photographed under ultraviolet light with Leica filter cube A (2016/27). 200× magnification at capture; printed magnification not calculated.

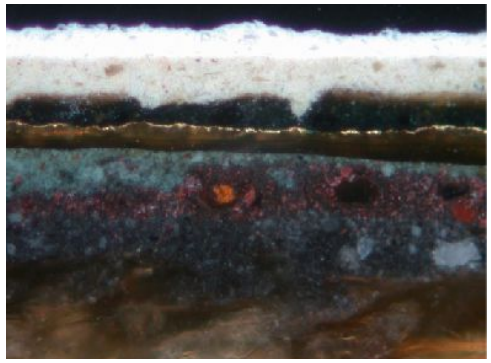

FIG. 9 Cross-section sample from the north-west caisson spandrel of *Apotheosis* photographed under darkfield reflected light (2014/4).
200× magnification at capture;
printed magnification not calculated.

The figurative elements of Soane's scheme, such as the putti, were applied over the graining, and comprise gilding followed by painted details and glazes, and a final varnish. The varnish over the gilding and toning is a distinctive orange-yellow under ultraviolet light and appears well-integrated with the layer below. In a sample from the north-west spandrel caisson of *Apotheosis* (2014/4), the black paint layer over the gilding has cracked – possibly due to the varnish being applied before the paint was totally dry – and the varnish does not run into cracks in the black paint (FIG. 9); these factors indicate that the varnish is likely to be original to the scheme. The grained background to the designs was overpainted in the 20th century, first a pale biscuit colour and finally the white we see today.

Planceers

Of ten samples taken from the planceers, only one bears evidence of paint pre-dating Soane's redecoration; sample 2016/30, from the curved planceer at the northern end of *Minerva*, gives the only indication of the early decoration of this element (FIGS 10 and 11). In this cross-section, Jones' 1630s scheme consists of a grained background over which there is gilding on pigmented oil size with dark painted or glazed details over the gold leaf. There are layers of varnish and paint between Jones' scheme and Soane's 19th-century redecoration, which are likely to relate to the overlapping of the second Jones scheme graining of the background based on its close similarity with the equivalent layers in sample 2016/35, where these layers are all clearly part of the same intervention.

FIG. 10 Cross-section sample from the curved planceer at the northern end of *Minerva* photographed under darkfield reflected light (2016/30).
200× magnification at capture;
printed magnification not calculated.

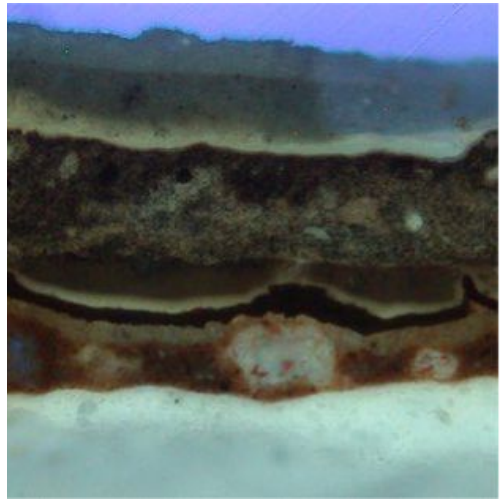

FIG. 11 Cross-section sample from the curved planceer at the northern end of *Minerva* photographed under ultraviolet light with Leica filter cube A (2016/30).
200× magnification at capture;
printed magnification not calculated.

There is no evidence of pre-19th-century paint in any of the other planceer samples; however, based on visual observations during site visits, the wooden substrate of the planceer is continuous (at least in places) with that of the adjacent frames or other mouldings where early paint from Jones' schemes has been identified. It seems likely that the flat surfaces of the planceers were stripped or scraped to remove earlier paint prior to Soane's redecoration (and referred to as 'preparing' by Turner *et al.*), while the more intricate mouldings were simply repainted or regilded at this point. Soane's distinctive graining is the earliest layer seen in cross-section in the majority of the planceer samples. In Soane's scheme, the gilded figurative elements were applied over the grained background, as on the caissons. Glazes of blue and mixed green – both based on Prussian blue – were applied over the graining around parts of the figurative elements to create deep shadows, whilst brown glazes were applied over the gilding itself to create modelling and tonal modulation. Just as on the caissons, in the 20th century the background was painted over with a pale biscuit colour and then later with white. The overpaint of the background has encroached on the gilded elements slightly further with each repainting.

Paint over the square bolt heads was sampled from the planceers at the northern ends of *Minerva* and *Hercules*. The latter showed evidence of Soane's graining, whilst the former contains lead in the lower layers, but has distinctive gilding on yellow pigmented size over the top, and is deemed to be later than Soane's redecoration.

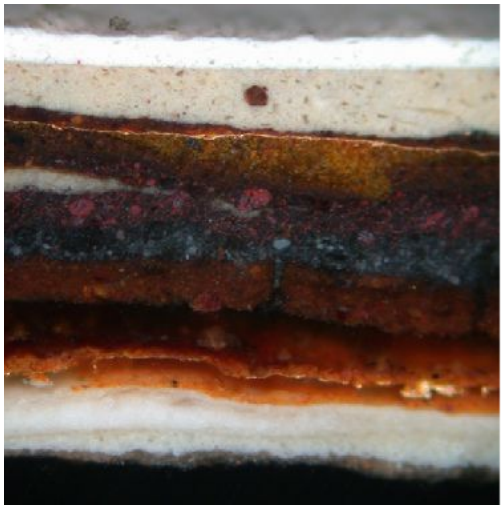

FIG. 12 Cross-section sample from large cyma reversa north-east (*Minerva*) section, photographed under darkfield reflected light (2014/15). 200× magnification at capture; printed magnification not calculated.

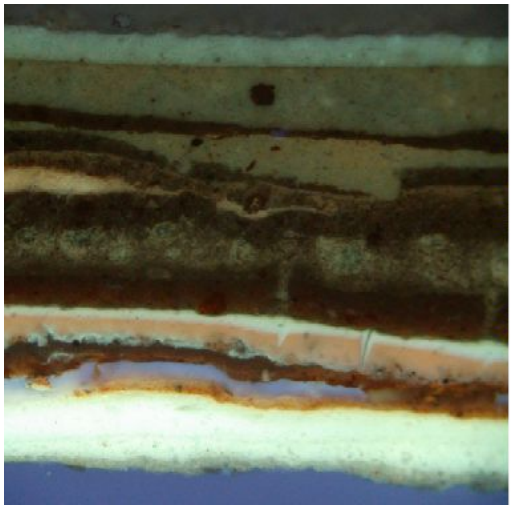

FIG. 13 Cross-section sample from large cyma reversa north-east (*Minerva*) section, photographed under ultraviolet light with Leica filter cube A (2016/30).(2014/15). 200× magnification at capture; printed magnification not calculated.
The shellac layer between Jones' second sceme and Kent's material appears bright orange in UV and had already developed cracks when it was coated with a natural reson varnish (bright greenish-blue in UV); likewise, the dark brown that we attribute to Kent had developed cracks by the time Soane's graining was applied

FIG. 14 Cross-section sample from small cyma reversa between spandrel caisson and recangular section of planceer, north-east (*Minerva*) section, photographed under darkfield reflected light (2014/16). 200× magnification at capture; printed magnification not calculated.

Mouldings

It appears that the mouldings, including the cyma reversa and the fillets, were initially painted brown during Jones' second scheme, before graining and gilding were applied to certain mouldings as part of the same scheme. Most samples from the mouldings bear varnish which is associated with Jones' second scheme and which was probably intended to have been applied to the grained regions, but with inevitable overlaps onto adjacent gilded elements. A varnish which appears dark in UV seems to be associated with Streater, but is not seen everywhere. Soane applied graining, which seems to have been worked up to quite a high degree of finish overall, with the gilded sections decorated afterwards.

The large cyma reversa outside the planceer of *Procession of Cherubs* (henceforth: *Putti Ram*), and the upright band between the gilded mouldings between painting and planceer around *Union of Crowns*, both currently painted white, were grained in Jones' second scheme and re-grained by Soane before being overpainted with modern paint. A sample from the large cyma reversa outside the planceer of *Minerva* (FIGS 12 and 13) bears graining followed by gilding in both Jones' second scheme and Soane's scheme, indicating it may have been gilded, but this sample was taken from the edge so this may be an overlap from the adjacent section. This sample also includes dark-brown paint with a coating of natural resin varnish layer over Jones' second-scheme gilding; this is probably also part of Jones' scheme – again, the stratigraphy in this sample may well be complicated by the fact that it is taken from the edge of the large cyma reversa adjacent to the rinceau ornament of the planceer and the brown paint may be attributable to this

decoration. This sample might also suggest that there was some figurative decoration on the large cyma reversa. Over the brown there is a thick transparent layer which is thought to be shellac based on its orange fluorescence under ultraviolet illumination (FIG. 12). Shellac has been seen at this level in the stratigraphy of samples from other areas: the application of shellac to disparate and localised regions of the ceiling may well date from the same intervention. Although the shellac is unlike the more widepread varnish that is generally attributed to Streater, which is dark under ultraviolet light, it is possible that the selective application of shellac was part of Streater's work; alternatively, it may be part of a different early intervention. Natural resin varnish was applied over the shellac at a later stage, after the shellac had developed cracks. Brown paint was applied over this, probably as part of Kent's repairs, and this had developed cracks by the time Soane's work was carried out. This element, as well as the upright band around *Union of Crowns*, bears later white paint over the 19th-century scheme.

Samples from the small cyma reversa near *Minerva* and the inner and outer gilded mouldings between *Union of Crowns* and the surrounding planceer were gilded over graining in Jones' second scheme, before being re-grained and re-gilded during Soane's intervention. Most of Soane's gilding is made up of two layers of gilding, consisting of gold leaf on pigmented size on a buff undercoat, followed by gold leaf on transparent size (FIG. 14). This is similar to the double gilding observed in a caisson sample, attributed to Turner during Soane's era. The Soane-era gilding remains as the visible surface in these regions.

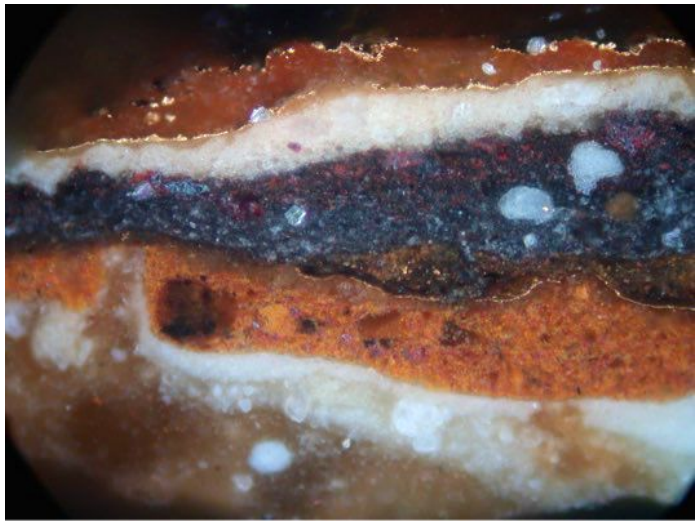

FIG. 15 Cross-section sample from arris of gilded frame around *Minerva*, north end, photographed under darkfield reflected light (2018/14). 500× magnification at capture; printed magnification not calculated.

Frames around Rubens paintings

Somewhat surprisingly, the vast majority of samples taken from the gilded frames around the paintings – even some of those taken from areas thought *in situ* to possibly be repairs – bear evidence of Jones' original paint schemes (FIG. 15). One of the samples from the frame arris of *Union of Crowns* does not bear any paint earlier than Soane's scheme, but a sample from a few millimetres away taken from the moulding of the frame rather than the arris has evidence of Jones' paint, further supporting the theory that the flat planceers were stripped at this point.

Generally, the gilded surface that we see now over the major part of the frames of the paintings is from Soane's redecoration. There is some evidence, for example in samples from the frames of *Putti Ram* and *Apotheosis*, of localised repair and re-gilding over Soane's surface. The earliest of these seems to be contemporaneous with the intervention of the 1960s and includes a distinctive yellow pigmented size, which may be similar to that seen over the bolt head on the planceer of *Minerva*. Two schemes of subsequent re-gilding from the latter part of the 20th century are seen in just one sample, from the frame of *Apotheosis*, and seem to have been quite localised. These schemes – possibly from the 1970s and 1980s – consist of gilding

of brown pigmented size and gilding on translucent size on a white undercoat respectively.

Soffit, guilloche and rose bosses

Samples from the soffit, guilloche and rose bosses indicate that the placement of gilding in the current scheme is largely correct. A sample from the background of the guilloche (2016/14) – a region thought to have been grained from Jones' second scheme onwards – has graining layers plus a fragment of gold leaf, confirmed by SEM.EDX; however, the gold leaf flake is likely to have been accidentally incorporated into the paint layer as there is no oil size. This is not an uncommon occurence in situations where multiple workmen have been painting and gilding in the same space at the same time. Two other samples from the arris edge of the guilloche background (2014/7 and 2016/23) bear evidence only from the Soane scheme onwards, which may indicate that the flat guilloche backgrounds were stripped prior to redecoration by Soane's workmen, like the planceers and other flat regions, although the arris edge would obviously be more susceptible to damage than the inner parts of the guilloche background, as well as being easier to strip deliberately, so some earlier mateiral may survive further from the edges.

FIG. 16 Cross-section sample from vertical edge of guilloche edge band at south end of ceiling, photographed under darkfield reflected light (2016/8). 200× magni-fication at capture; printed magnification not calculated.

FIG. 17 Cross-section sample from vertical edge of guilloche edge band near *Apotheosis*, photographed under darkfield reflected light (2016/9). 200× magni-fication at capture; printed magnification not calculated.

The placement of gilding on the vertical edges of the guilloche remains slightly unclear. A sample from the edge of the white painted area (2016/8) appears to show gilding from Jones' second scheme and certainly at Soane's time, which would indicate that the region might have been gilded until it was painted in the 20th century (FIG. 16); however, a sample from further along the vertical edge (2016/9), also currently painted white, shows continuous graining schemes with no evidence of gilding (FIG. 17). This might suggest that the boundary between gilding and graining was different in the past, not necessarily corresponding with the boundary between gilding and white visible at the time of sampling.

FIG. 18 Cross-section sample from waterleaf and dart moulding of coffer adjacent to *Hercules*, photographed under darkfield reflected light (2014/12). 200× magnification at capture; printed magnification not calculated.

FIG. 19 Cross-section sample from repaired waterleaf and dart moulding at north end of *Union of Crowns*, photographed under darkfield reflected light (2014/12). 200× magnification at capture; printed magnification not calculated.

In other areas where gilding is now present it appears to repeat early gilding and to copy the design of Jones's second scheme gilding. For example, the central band of the guilloche (2014/1) was gilded in the second Inigo Jones scheme and this was repeated by Soane. This is also the case for the raised edge bands and curves which link the recessed and raised areas together (for example 2016/21 and 2016/11). The guilloche rosettes and rose bases were fully gilded throughout their history.

Entablature – cornice (including coffering)

Waterleaf and dart

Samples of gilding from the waterleaf and dart moulding were taken from one of the coffers adjacent to *Hercules* and in two places at the north end of *Union of Crowns*, one of which appeared to be a later infill. A sample was also taken of the waterleaf and dart moulding adjacent to the gilded frame of *Apotheosis*; this sample is categorised as a frame sample within the report structure, but is useful for comparison. In all waterleaf and dart samples except the repair there is evidence of the lead white paint of Inigo Jones' first finish, followed by the graining and gilding dating from the second Jones scheme; the moulding remained generally unchanged until it was painted again with graining and regilded as part of Soane's scheme (FIG. 18).

The area at the northern end of *Union of Crowns* which appeared slightly different in style is a 19th-century repair. The only decorative scheme evident in this sample is Soane's, which consists of graining followed by gilding (FIG. 19). The substrate of this area is an open-grained timber with the apperance of softwood, which in cross-section closely resembles the support of the non-original caissons which were replaced during Soane's era.

Coffering

In all samples from coffer soffit backgrounds, the early paint layers include Jones' first white scheme, followed by Jones' 1630s graining, then some evidence of varnish, followed by Soane's graining. Next, probably later in the 19th century, although very possibly as part of Soane's scheme, the soffits were painted blue with a Prussian-blue-containing paint mixture (FIG. 19). This is not contemporaneous with the Prussian blue overpaint of the caisson backgrounds, which dates from before Soane's intervention. Sample 2018/11 includes a varnish coating over Soane's graining and there seems

to be quite a distinct line in ultraviolet light between this and the overlying blue, possibly supporting that it is later. It was previously suggested that the blue coffer soffit backgrounds may have been added in reference to the original blue background of the caissons; however, since the caisson backgrounds seem to have been grained in Soane's scheme and therefore the blue would not have been visible to later decorators, this seems less likely.

A sketch by V.C. Hardingham documents that the coffer soffits were still blue in 1950 (FIG. 5).[5] The blue coffer soffits were not painted over until the 1960s or 1970s, when they were painted pink on a beige undercoat, before being overpainted with the white that we see today. The sample from the arris edge shows a brown paint layer over the blue – these are possibly overlapping elements from the different surfaces and may well be from the same scheme; the brown is varnished and may be graining. Later pink on beige undercoat and then white is the same as the layers seen on the coffer soffit samples.

FIG. 19 Detail of an uncovering trial in the coffer soffit, north-east corner of *Union of Crowns*, showing 19th-century blue background.

Modillions, Fascia, Egg & dart, Cyma reversa above vitruvian scroll

Two samples from the fascia above the egg and dart and cyma reversa within the lower part of the cornice (2016/35 and 2014/9) bear the only clear, definite evidence of graining in the second Jones scheme: a dark-brown paint applied wet-in-wet on the typical Jones brown of the second scheme. However, the close similarity of the layers seen in these two samples with layers which were previously misinterpreted as being from later interventions in many other paint samples makes a compelling case that the Jones second-scheme figurative graining was fairly widespread.

The early and original gilding in these regions seems to be in the same locations we see today. The coffer rosettes were gilded both by Jones and by Soane. The modillion acanthus moulding was gilded and the background to the modillion and the fascia were grained. The placement of gilding on the egg and dart moulding appears to be the same as shown today but, as here, in Jones' second scheme the gilding was set against graining as opposed to a plain brown walnut-tree colour.

[5] Hardingham, V.C., sketch 1950, reproduced by Granville and Burbidge, *The Banqueting House, Whitehall: Condition Survey of the Carved and Polychrome Timberwork of the Ceiling - January* 2008, 2010, p.10.

FIG. 20 Detail of the date painted on the flat top of the east-wall cornice showing sample location.

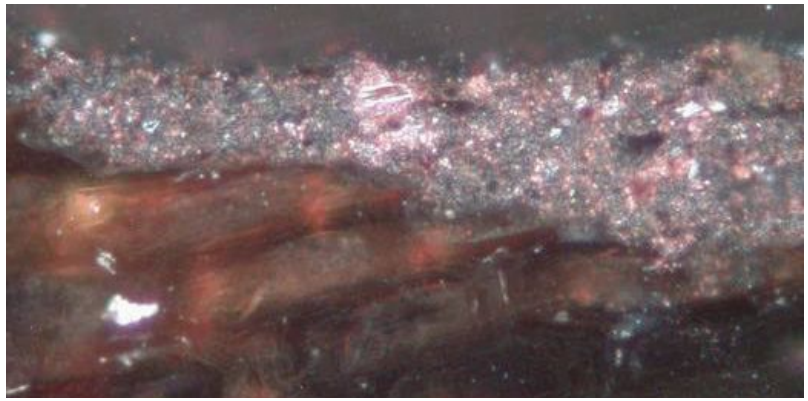

FIG. 21 Cross-section sample from the date on top of the cornice, photographed under darkfield reflected light (2016/24). 200× magnification at capture; printed ~~magnification not calculated~~.

[6] Reference needed for marble

CORNICE FLAT TOP DATE

The date '1836' on top of the cornice at the east side was painted using the same grey paint as is found within the Soane decoration elsewhere (2016/24) (FIGS 20 and 21).

Entablature – frieze

Frieze mouldings

The mouldings of the entablature frieze have been gilded since Jones' scheme of the 1630s. At this time the vitruvian scroll seems to have been gilded by applying pigmented oil size directly onto the lead-white oil paint of Jones' first finish. In the buds and tendrils, which are smaller, it seems that the elements were first grained, along with the background, before being picked out with gilding. Streater's varnish seems to be evident in some places. In the 19th century Soane's team applied graining over the whole area before gilding the scroll, buds and tendrils with a pale undercaot, pigmented oil size and gold leaf. Some regions have been regilded at a later date, possibly in the late 19th or early 20th century.

Frieze background

The background of the entablature frieze, sampled on the north wall (2016/37), was grained in the second Inigo Jones scheme; this was repaired and retouched by Kent and/or Streater and regrained at Soane's time, before being painted pale-biscuit colour on a grey undercoat and finally white, both in the second half of the 20th century.

Entablature – architrave

This area appears to mark the transition between the ceiling and the upper wall surfaces, with clear evidence of the lighter decoration found on the walls and some evidence of figurative decoration — this perhaps the most significant evidence thus far supporting the possibility that 'marble colour'[6] meant a white fictive marble painted

FIG. 22 (right) Cross-section sample from the fillet moulding on the north-wall architrave, adjacent to uncovering, photographed under darkfield reflected light (2016/ 44). 200× magnification at capture; printed magnification not calculated.

FIG. 23 (below) Cross-section sample from the cyma revers moulding above the entablature frieze, photographed under darkfield reflected light (2016/ 48). 200× magnification at capture; printed magnification not calculated.

on the walls. There is no significant evidence of graining to the entablature architrave.

Fillet and cavetto

Samples from the white painted fillet and cavetto show a full paint history (2016/44 and 2016/45). Jones' first scheme consists of a thinly applied pale brown, over a translucent brown on a lead white and yellow ochre ground, which sits on an opaque lead white and translucent lead white undercoats. This first Jones decoration is interesting as its surface is marked by a dark brown heterogenous thinly applied paint which may be evidence of a brush stroke from figurative work (FIG. 22). This thin brown sits over white, semi-translucent white and translucent undercoats. The second Inigo Jones decoration appears to indicate either gilding (although no gold leaf is present) or evidence of brown and golden yellow figurative work. Over this is a single darkened varnish layer. An off-white scheme was applied next and may relate to work by Soane, or to early documented restorations by Kent or Streater. At least two schemes of off-white may be attributable to Soane, and there is a single dark grey layer, including some large red aggregates, from the Soane re-graining over the top, which may be an anomaly arising from accidental overlap rather than evidence of graining on this element. Next, there is a buff and brown decoration believed to date from the late 19th century, followed by 20th-century pale-biscuit and white paint schemes.

Cyma reversa mouldings

Two samples from the cyma reversa moulding above the entablature frieze were taken near the north-west corner of *Union of Crowns* (2016/46 and 2016/48). In both samples the first Inigo Jones scheme, which elsewhere generally consists of lead-white oil paint or distemper, includes a pale orange-brown paint layer over lead white (FIG. 23), which suggests two possibilities: on one hand, it may be evidence of figurative paint of white 'marble' finish on a translucent white undercoat or on the other, as the orange-brown is not disimilar in appearance to the pigmented size of the slightly later Jones scheme seen elsewhere, it may indicate that this element was gilded, although if this were the case the

FIG. 24 Detail of well-preserved Soane-era gilded decoration on the anthemion fascia at the at north-west corner, near sample 2018/12 site, showing quality of gilding and design attributed to Soane, overlying earlier decoration visible in raking light.

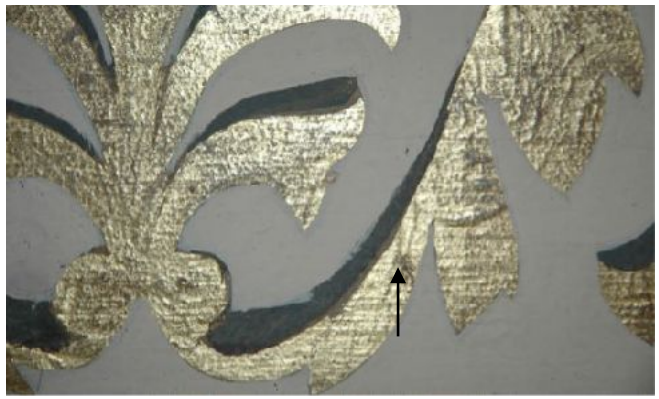

FIG. 25 Detail of the 'weak' foliate pattern on the anthemion fascia sampled as 2014/22, showing continuous gilding and no glazing. The absence of glazing might suggest the area has been overcleaned in the past. In addition, in raking light a different design is partially visible.

region must be significantly abraded as neither sample includes any gold leaf. Both samples include evidence of gilding in the second Jones scheme, with some overlying varnish which may be from a later treatment. Soane's paint consists of lead-white-based off-white, repeated several times, before size and gold leaf were applied, probably also as part of Soane's scheme.

Anthemion fascia

Several samples taken from the anthemion fascia during the various phases of research have helped to build a picture of the decorative schemes of this element. The very first Jones scheme in this region is thought to be a white fictive marble decoration, evidence of which is seen elsewhere, for example on the cyma reversa.

In some regions in raking light there is some evidence of a different – or, more likely, a similar but offset – pattern beneath the later decoration (FIGS. 24 & 25). There is evidence in cross-section of a figurative design dating from the second Inigo Jones scheme in some of the anthemion fascia samples (FIG. 26) and it is likely that the ridges of underlying paint relate to this. In cross-section Jones' second scheme consists of a dark mixed-brown paint layer (e.g. 2014/22, JSA 2016/65), in some cases on a pale background which seems to have a degree of figuration, possibly marbling (2016/47, 2018/12). It is possible that there may have once been gilding in some regions (2018/13), as the brown paint of the second Jones scheme in places seems to resemble the pigmented size which would remain if the gilding were abraded, but given the variation seen across samples within the figuration of this scheme it is hard to be sure that this is not just part of the figuration. There is varnish over this scheme which is dark in ultraviolet light, and appears similar to the varnish attributed to Streater seen in samples from many parts of the ceiling. In most samples there are multiple lead-based buff paint mixtures which fall between the second Jones decoration and Soane's restoration of the early 19th century; in sample 2014/22 a distinct dirt layer is visible between the lower of these and the overlying paint, which is otherwise quite well-integrated possibly suggesting the earlier, slightly darker buff might relate to Streater, or possibly Kent, while all of the material above the surface dirt probably dates from Soane's intervention (FIG. 26).

A region of 'weak' foliate pattern at the north end of *Hercules* was initially thought to date

from a later scheme than Soane's, but cross-section analysis (2014/22) indicates that the underlying background is a distinctive cool green-grey mixture including yellow ochre which is very characteristic of Soane's scheme; there is a strong possiblity that the overlying gilding is also from Soane's time but that it has been overcleaned, although there remains a possiblity that the gilding could be later. The flatness and lack of modelling of the overcleaned or later region is particularly noticeable when it is compared with better-preserved regions of Soane decoration, where the glazes over the gold leaf survive (FIGS 24 and 25). Some of the anthemion fascia samples include only 19th-century and later paint, but many of the samples from this region include a full paint history.As elsewhere, the Soane-era gilded pattern was retained during later work and remains visible, but the background was overpainted twice in the 20th century.

FIG. 26 Cross-section sample from the 'weak' foliate pattern on the anthemion fascia, photographed under darkfield reflected light (2014/22). 200× magnification at capture; printed magnification not calculated.
Image shows dark brown paint of design of Jones' second scheme, lead-based buff paint possibly attributable to Streater with surface dirt, followed by Soanes paint layers, including characterstic grey-green with yellow ochre and, uppermost, gilding dating from Soane's scheme or later.

Band fillet above Corinthian capital

The band fillet above the Corinthian capital was sampled on the north wall near the north-west corner of *Union of Crowns* (2016/49). The cross-section does not bear any evidence of the earlier Jones decoration in white or walnut graining. The use of red lead in white as a primer on the timber substrate is typical of the later-18th and 19th centuries. The earliest scheme probably dates from 19th century and consists of warm off-white, lead-based paint, which was repeated at least twice. These paint mixtures have similarities with samples from the anthemion fascia, where similar-coloured layers have been associated with Soane's restoration. Later, lead-based buff-coloured paint was applied to the band fillet, followed by the later 20th century schemes of buff on a blue-grey undercoat and more modern white paint seen in most other samples.

Corinthian capitals

Samples of paint and gilding from the Corinthian capitals at the top of the pilasters on the upper tier show a fairly consistent layer structure in all regions sampled, and confirm that this element has been gilded for most of its history. Not all cross-section samples contain the very earliest layers but, where present, these consist of at least two applications of lead-white-based paint over the substrate; the lower of these contains some translucent material and red and brown particles in a lead-white matrix. This lead white was followed by an application of warm pale-brown translucent paint containing a range of pigments including carbon black, red lead and probably some earths, this probably indicates that gold leaf was applied to the capitals but no actual gilding survives in the samples taken. There follow multiple layers of translucent lead white which are seen in all samples except regions of later repair, these are the lower preparatory layers of the second Jones scheme. Jones' second scheme was

FIG. 27 Cross-section sample from volute leaf tip of north-east Corinthian capital, photographed under darkfield reflected light (2016/54). 200× magnification at capture; printed magnification not calculated.

prepared with another layer of lead white, followed by pigmented size and gold leaf. From this point onwards the Corinthian capitals were gilded. A sample from the most recent phase of analysis (2018/20) provided the first physical evidence that the recessed background surfaces of the capitals were gilded from the second Jones scheme, and that gilding in this region is not a later introduction.

Based on cross-section evidence, the 1637–1638 record of 'richly guilding all the carved worke [of the ceilings and windows]'[7] included the Corinthian capitals. This first gilding consisted of gold leaf on translucent size containing some lead white and earth pigments, on a lead white undercoat. In some samples the gold leaf is hard to see in cross-section (FIG. 27), possibly indicating abrasion of some regions . In some samples, over the first gilding we see traces of varnish: probably Streater's application dating from the 1680s when he went to work 'cleansing and varnishing & guilding the BHW ceiling and cornice and painting the spandrels & all the cornice and fret and architrave and gold used in the cornice and spandrels.'[8]

A subsequent application of gilding over much of the capitals consists of gold leaf (now much abraded) on a buff-coloured paint consisting of lead white and earth pigments. This may also be the work of Streater, or could be attributable to Kent about fifty years later in the 1730s.

There follows a distinctive sequence of layers, seen in most paint samples from the Corinthian capitals: a pale pinkish consisting of lead white and a little red lead, followed by a pale greenish buff layer, followed by a warm buff colour, followed, in some places, by a paler layer, followed by a translucent pigmented size and gold leaf. These layers are well integrated with one another and there is no sign of dirt or debris between them in any sample. They are probably all part of Soane's redecoration of 1829–1837. This gilding scheme, and all preceding schemes, stain positively for lead using potassium chromate, confirming that they pre-date the mid-20th century. Some capital samples show slightly different layers of re-gilding at around this point in the stratigraphy, some of which may be attributed to Soane and some of which are probably from unknown interventions from both before and after Soane. Two of the samples show a later layer of 'Dutch metal' paint, which must have been applied locally during work in the 20th century.

[7] Thurley, Whitehall Palace, p.95. Cf. TNA E351/3271 (folio ref. not given).

[8] Thurley, Whitehall Palace, p.136. Cf. TNA Work 5/42 f.52.

Wall frieze

The frieze is noted as appearing to have been heavily restored in Granville and Burbidge's 2010 condition report of the 2008 inspection of the Banqueting House ceiling.[9] Indeed, several regions sampled, including two samples from the west wall and one from the north, bear only 20th-century paint on plaster repairs (2016/56, 2018/24, 2018/25); samples from other regions of the other three walls include underlying paint which dates from the 19th century or before, but bear significant 20th-century overpaint (2014/18, 2016/1, 2016/2, 2016/5) (FIG. 28). In some regions, however, the visible surface of the frieze does seem to be the Soane re-decoration (2016/2, 2016/3, 2016/4, 2016/57, 2016/58, 2018/26) (FIG. 29), which suggests that the visible decoration in many parts of the frieze is a version of Soane's scheme – albeit heavily restored – which probably does not differ much from that time in terms of the actual placement of the decorative elements. The north-wall frieze near *Hercules* seems to have been restored during Soane's era, and samples from this location do not bear any earlier material (2014/18, 2018/26); however, samples taken from eastern half of the north wall, adjacent to *Minerva* and *Union of Crowns*, bear evidence of decoration going back to Jones' era (2016/57, 2016/58), as do samples from the south- and east-wall frieze next to *Temperance* (2016/3, 2016/4, 2016/5).

The layer structure of the wall frieze background and

FIG. 28 Cross-section sample from wall-frieze background, east wall, photographed under darkfield reflected light (2016/5). 200× magnification at capture; printed magnification not calculated.

FIG. 29 (below) Cross-section sample from eyebrow of east-bay mask wall frieze, north wall, photographed under darkfield reflected light (2016/5). 200× magnification at capture; printed magnification not calculated.

[9] Granville and Burbidge, *The Banqueting House, Whitehall: Condition Survey of the Carved and Polychrome Timberwork of the Ceiling - January* 2008, 2010, p.15

figurative elements differ from one another; in both regions, though, the earliest paint layers of the first Jones painting – which pre-dates the figurative frieze scheme – consist of lead-white-based paint. Some of these early lead-white paint layers include red lead and other materials; some are bound in distemper and some in oil. An oil-based lead white paint layer with little adulteration probably constitutes the earliest pre-figurative finish of 1619–1622. In some regions this layer seems to have been left more-or-less exposed in the original figurative wall frieze, which dates from the second Jones decoration of 1635–1637. In the original figurative frieze decoration, the background appears to have been a lead-based pale buff colour, and the figurative elements blocked in with an opaque orange-brown paint mixture, before modelling was applied with darker brown medium-rich glazes. During Streater's intervention, varnish was applied to some parts of the wall frieze but little else seems to have been done. In the 19th century, probably as part of Soane's restoration, brown, grey and orange paint mixtures were used to strengthen and repaint the figurative elements and the background was repainted with several layers of warm buff paint.

In the late 19th century, possibly as part of the documented intervention of the late 1880s, the wall frieze was extended onto the region above the window on the south wall. This region of the wall frieze was not included in the original Jones' decorative scheme, as a large throne canopy was present in this location at that stage. There does seem to have been some decoration pre-dating the most recent paint finish as, upon examination in raking light from scaffolding in 2016, there was clear evidence of a figurative painted scheme in this area beneath the current surface. As anticipated, paint samples from this region do not bear evidence of the original Jones decoration; the appearance of the paint layers of the underlying scheme suggest the figurative decoration is probably 19th-century. However, this paint does not look similar to the Soane decoration elsewhere, hence the proposal that it may date to the 1888 scheme. This figurative decoration included gold leaf highlights and appears to have been a considered and significant decoration. In the 20th century, the background of the frieze was repainted a pale buff at least twice, whilst the figurative elements generally were strengthened and overpaint using thick impasto, dutch metal highlights and dark glaze shadows. Localised uncovering elsewhere on the north wall, carried out by conservators after the final tranche of samples had been taken, appears to have some interesting, possibly early decoration which warrants further investigation.[10]

[10] Pers. comm. with Jane Spooner, 18th May 2018.

Balcony

There is no evidence in the samples examined that the balcony woodwork was gilded. Of the balcony samples, cross-sections from the balusters show the earliest paint: priming with traces of red on the timber, followed by lead white in oil. There follow several warm buff schemes based on lead white and earth pigments, followed by Soane's lead-based off-white, of which there are several layers, consistent with the 1832 specification for this work which orders that such areas are to be painted '5 times in oil'.[11] The flat surface of one of the upright posts on the east side of the balcony bears only paint dating from Soane's scheme and later, whilst two samples from the engaged baluster and a separate baluster nearby have several layers of earlier paint. This may indicate that the flat surface of the lower levels were scraped or stripped prior to repainting during Soane's intervention, just like the planceers on the ceiling, whilst the curved balusters and other mouldings were simply repainted.

Drips of grey paint on the main balcony, which resemble that of Soane's graining on the ceiling, are just below Soane's repainting of the balcony woodwork (FIG. 30). This point in the stratigraphy corresponds with the earliest layers of samples taken from the minstrels' gallery, which is consistent with the fact that minstrels' gallery was installed by Smirke and first painted during Soane's intervention.

The balcony and minstrels' gallery woodwork was later repainted pale brown/red-brown with zinc-white-containing paint, of which there are at least two separate schemes; based on the presence of zinc white, these must date from some time after *c*.1850. In the latter part of the 20th century, the woodwork was painted beige and finally the white that we see today.

FIG. 30 Cross-section sample from baluster of east-side balcony, photographed under darkfield reflected light (2018/38). 200× magnification at capture; printed magnification not calculated.

[11] needs reference

FIG. 31 Cross-section sample from the window reveal of the northernmost window at the first-floor level, photo-graphed under darkfield reflected light (2014/34). 200× magnification at capture; printed magnification not calculated.

FIG. 32 (below) Cross-section sample from the south-side, ground-floor window reveal of the second-from-north west-wall window, photographed under darkfield reflected light (2014/34). 200× magnification at capture; printed magnification not calculated.
A thick layer of dirt is visible between the late-19th-century paint and the modern schemes, possibly indicating damage to the window during WWII.

Walls

Paint samples from the lower parts of the room show evidence of more numerous decorative interventions than the ceiling, as would be expected. Many parts of the walls have suffered damage over the years, but some samples from the window splays (FIGS 31 & 32) and wall face retain early paint, including the 'builders' finish translucent white distemper on the plaster surface, followed by a pure-lead-white scheme comprised of semi-translucent undercoats and a densely pigmented lead white top coat, which corresponds to Jones' work in the 1630s. This is generally followed by several schemes of varying pale buff or stone-coloured paint, which are likely to correspond to interventions by Streater, Kent, Soane and Smirke, as well as the later 19th-century and 20th-century schemes, before more modern, paler paint was introduced in the 20th century.

The pilasters, gallery consoles and entablature moulding

There is some evidence that during Jones' second scheme the pilasters and entablature moulding regions were painted with a white *faux*-marble finish (2014/26, 2014/28, 2014/30) For example, sample 2014/26 (FIG. 33 below) shows a dark paint layer immediately on the surface of the densely pigmented pure white Jones' decoration. Sample evidence suggests that after Jones' second scheme the pilasters, lower-tier pilaster capitals, entablature moulding and gallery consoles, including the soffits, were painted a similar pale buff or stone colour to the walls and remained like this for most of their early history, including during Soane's redecoration.

FIG. 33 Cross-section sample from the bead moulding of the entablature, photographed under darkfield reflected light (2014/26). 200× magnification at capture; printed magnification not calculated.

In the later 19th century, probably 1888 or 1893, the pilasters including lower capitals, the gallery consoles and soffits and the entablature moulding were painted brown, possibly grained. The brown paint includes zinc white, which supports its dating as mid-19th-century or later. Samples show disruption at the top of this scheme, probably from preparatory sanding prior during later work.

A single sample from the gallery console appears to show very fragmentary evidence of gilding at this point in the layer structure (2014/23), but this may be an accidental inclusion of gold leaf from gilding being carried out elsewhere in the space at the same time, — an accident which is not uncommon. It is possible that physical evidence of gilded detailing in these regions in the late-19th-century scheme may have been destroyed by the sanding of the surface prior to repainting in the 1960s, but in that case we would still expect to see a few gold fragments in cross-section so it seems unlikely. The Hardingham sketch of *c.*1950 (FIG. 3), which records the late 19th-century scheme, documents the pilasters as being brown, with no mention of gilding in this region, supporting the idea that the scheme did not include gilded detailing of these areas.

In the 1960s, these regions were painted a pale-biscuit colour on a greyish undercoat, with some gilded decoration on the pilaster capitals and gallery underside soffit. The 1960s gilding consists of white undercoat, bright-orange pigmented size and gold leaf. As elsewhere, there is some evidence of localised retouching with Dutch metal in the 20th century.

Lower walls and window splays

Despite extensive removal and repair of material around the windows during Soane and Smirke's intervention,[12] four out of five samples taken from window splays show a relatively full decorative history for the walls (FIGS. 31 & 32). This includes evidence of original distempers, followed by Jones' white paint, over which there are numerous stone- and buff-coloured paint layers, often with dirt between them, which account for the phases from the

[12] Jane Spooner, pers. comm., 22th July 2014.

18th and 19th centuries, including a slightly green-grey-toned buff with large particles of yellow ochre which seems to be typical of Soane, with a return to slightly paler stone or off-white in the 20th century. A sample from the ground-floor level of the northern-most window on the west wall (2014/33) is from a damaged region which was repaired during Soane and Smirke's time.

A window-splay sample from the south-side, ground-floor window reveal of the second-from-north west-wall window (2014/31) includes a very thick layer of dirt between the late 19th-century paint and the more modern layers (FIG. 32), which may relate to the Second World War. This is not seen to the same degree on most of the window-splay or wall samples; it would be interesting to investigate whether there is a record of this particular window having been damaged at this stage. On the ground-floor level few aesthetic changes seem to have taken place on the walls. In a sample from the lower-level wall face (2014/30), a lower lead-white layer is visible, which may correspond to the second scheme by Jones in the 1630s, followed by several buff or stone-coloured paint layers, which are likely to correspond to Streater, Kent, and Soane and Smirke's interventions, and possibly even the later-19th-century scheme of 1888. A pale-grey paint layer over the buff layers includes lead and dates from the later 19th century or 20th century. This is followed by up to three layers of cream or very-pale-buff modern paint.

CONCLUSIONS

Physical evidence provided by paint cross-sections provides insight into the complex decorative history of the Banqueting House interior. There is widespread proof of very early paint including, in many samples, material that can be securely attributed to Jones' first and second finishes. Painted graining and marbling as well as gilding, all dating from Jones' 1630s scheme, are seen in various cross-sections. Originally, the background of the caissons was a blue mixture of smalt and lead white; this was altered to graining in Soane's scheme when many of the damaged caissons were replaced entirely. Conversely, the backgrounds of the coffer soffits were originally grained, but altered to blue either during or some time after Soane's redecoration. The planceers originally had a grained background. In some cross-sections from the wall frieze there is material which seems to date from the 1630s; this offers tantalising clues about Jones' decoration of this region, but it is impossible to clarify the design based on cross-sections alone.

Major aesthetic changes were carried out in the 20th century, with the widespread application of a pale, cool 'biscuit' colour over much of the interior, although notably the coffer soffits were pale pink at this stage. The most recent white redecoration is still seen over much of the interior today, although Soane's decorative gilding is visible on regions such as the planceers, caissons and anthemion frieze, where the modern paint has been applied around the pattern. The strong contrast between the surface-dirt-covered Soane-era pattern and the white surrounding paint means that the subtleties of modelling and detail are currently obscured, especially when viewed from floor height. Cross-sections, and the simultaneous uncovering of historic paint carried out by conservators, make clear the high quality of Soane's painted decoration including the clever use of blue-toned glazes to give depth to the shadows on the rinceau decoration on the planceers.

Appendix I: Methodology

On site samples were taken with the aid of a scalpel blade, numbered and placed in separate storage containers. The location of numbered samples was recorded graphically, in writing and the locations photographed.

In the studio samples were mounted in polyester resin and polished in cross-section with a range of graded abrasives. Samples were examined microscopically at high magnification under dark field reflected and ultraviolet illumination (UV was used in conjunction with with Leica filters A and D), photographed and drawn when necessary. Once an understanding of the sequence of paint layers had been established microchemical tests were undertaken to identify pigments on a number of key strata.

Dispersions of pigment were created by placing small amounts of pigment onto a clean glass slide. A glass cover slip was then placed on top, and the slide was heated before a small amount of Cargille Meltmount™ was placed at the edge of the coverslip and allowed to melt and wick underneath the coverslip, embedding the sample. These samples, or 'dispersions', were viewed at up to 500× magnification in reflected dark-field and ultraviolet light, and up to 630× magnification in transmitted polarised light with both plane and crossed polars. Optical properties such as particle morphology, refractive index and birefringence were observed in order to identify the pigments.

Scanning electron microscopy with energy-dispersive X-ray spectroscopy (SEM/EDX) was carried out on selected cross-section samples at the Interface Analysis Centre (IAC), School of Physics, at the University of Bristol on the 26th September 2016. An FEI Helios Nanolab 600 combined focused ion beam (FIB) and scanning electron microscope (SEM) 'Dualbeam' instrument was used to obtain secondary electron images and backscattered electon images of the samples. The images were obtained with an electron beam of 15keV acceleration energy and 0.34nA beam current. Energy dispersive X-ray analysis (EDX) was performed on this instrument using an Oxford Instruments Xmax-50 silicon drift detector using an electron beam of 15keV energy and 2.7nA current. Quantifications of the EDX spectra are performed, but these usually overestimate the carbon content of the materials due to the deposition of carbon on the substrate by the electron beam, and also due to the composition of the EDX window. Hence, carbon weight percentages should be treated with caution.

Samples were submitted to Art Analysis and Research Ltd for FTIR-ATR analysis in September 2016.

Two paint samples, consisting of single fragments of paint, were submitted for analysis by FTIR. The paint fragments were placed on the detector for analysis. The fragments appeared to consist of single layers and no indications were given regarding which surface to analyse. Thus, the orientation was chosen by the analyst, assuming a homogeneous composition. The instrument used was a Bruker Vertex 70 FTIR instrument equipped with a mid-

infra-red source, a potassium bromide (KBr) beamsplitter, a HeNe laser and a deuterated triglycine sulfate detector. The spectrometer was equipped with Pike GladiATR accessory. The ATR element was a diamond. The sample was placed directly on the diamond ATR accessory. This took a 'bulk' IR spectrum of the material placed on the diamond window. The IR spectra were collected between 4000 and 600 cm^{-1} using 64, 128, 256 and 512 sample scans and a spectral resolution of 4 cm^{-1}. The identification of the material was performed by comparing the measured spectra with standard spectra such as those in the IRUG database, or to spectra derived from samples in the Pigmentum Collection.

Raman spectroscopy is a non-destructive, non-invasive technique that measures the change in energy of light scattered by a sample. The advantages of Raman spectroscopy over other techniques are that it can be used in situ, with no sampling from the object required. It is a rapid and effective technique for characterising materials and gives both chemical and structural information on a material. Raman spectroscopy involves illuminating the sample with a monochromatic beam of light. The majority of the incident light (consisting of a stream of photons with energy E) is scattered by elastic collision with the molecules of the sample. In elastic collision, no change in energy is involved - this is known as Rayleigh scattering. However, a very small percentage of the incident photons (<<1%) are scattered inelastically. This is known as Raman scattering, after its reported discovery in 1928 by Chandrasekhara Raman. The inelastic, or Raman, scattering occurs when the incident photons gain or lose a small amount of energy, e, by interaction with the sample. The technique of Raman spectroscopy measures the energy (E-e or E+e) of these inelastically scattered photons. Each material is composed of a unique set of atoms bound together in a characteristic way that distinguishes it from any other material. The atoms in a material vibrate about their equilibrium positions in a number of particular ways, at frequencies which are related to the mass of the constituent atoms and to the geometry and strength of the bonds between them. Thus each material is characterised by a particular set of vibrational frequencies unique to that material. The change in energy of a photon scattered inelastically by the material corresponds to the energy of a vibration of the sample. Thus, by measuring the energy changes of a set of scattered photons (a Raman spectrum) we can determine the characteristic vibrational frequencies of the sample. The Raman spectrum is unique to each material and can therefore be treated as a 'fingerprint', thus allowing rapid characterisation. Raman scattering is a very weak phenomenon that requires an intense light source to generate readily detectable effect. For this reason, a laser excitation source is used, although the laser power is kept to a minimum, never exceeding 4 mW at the sample surface. The instrument used for the Raman microscopy here was a Bruker Senterra Raman system equipped with two laser wavelengths, that used for this study being 785nm. The power setting was 10mW, 9-15cm^{-1} spectral resolution with a 10x objective lens.

Staining with SYPRO® Ruby: SYPRO® Ruby is a stain for protein of the metal chelate type13 that was adopted for the staining of paint cross-sections, having been developed for electrophoresis applications. When used on cross-sections, it has been found to be very reliable in identifying the presence of proteinaceous materials, causing them to display a distinct fluorescence under UV light conditions. While it is thought to be fail safe against false positives, small amounts of protein present in emulsion systems, such as with oil, may not be ideal candidates for such stains, allowing for false negatives in cases where small amounts of proteins are present.

13 Its use and nature is described in: Schäfer, S., 'A Luminescent Metal Chelate Stain and its Application Protocol for the Identification of Proteinaceous Binding Media within Paint Cross Sections', pp. 709-13. In book: E. Emmerling, M. Kühlenthal & M. Richter (Eds), *Lüsterfassungen des Barock und Rokoko/Coloured Glazes on Metal Leaf from the Baroque and Rococo*. *Studien aus dem Institut für Baugeschichte; Kunstgeschichte, Kunst und Design; Restaurierung mit Architekturmuseum, Technische Universität München*, Anton Siegl Fachbuchhandlung GmbH: Munich (2013).

Appendix II: Sample List

List of all samples from every phase of analysis, organised by architectural area, with rectified sample locations where possible. 2018 samples emphasised in black.

Report section	Sample	HRP rectified photograph	Location description/notes
3.1 Caissons and planceers			
3.1.1 Caissons	2014/4	Apotheosis_C_M12	
	2016/27	Apotheosis_C_Y6	From south-east caisson spandrel of Apotheosis; planks visible. Smalt found in cross-section.
	2016/28	Hercules_NW_B14	
	2016/29	Minerva_NE_B3	
	2018/15	Coffer_C_Y6	South-east caisson spandrel of *Apotheosis*; planks visible in this caisson. (Cf. 2016//27: smalt found; planks visible; 2018/16, 2018/17 and 2018/18.)
	2018/16	Coffer_C_Y11	South-west caisson spandrel of *Apotheosis*; planks visible in this caisson.
	2018/17	Coffer_C_Y11	South-west caisson spandrel of *Apotheosis*; planks visible in this caisson.
	2018/18	Minerva_NE_B3	Caisson spandrel to north end of *Minerva*, where Soane scheme uncovered, green/shadow of Soane scheme. (Cf. 2018/8 and 2018/9.)
3.1.2 Planceers	2014/5	Union_N_J12	
	2016/26	Puttiram_E_N4	
	2016/30	Minerva_NE_C3	
	2018/8	Union_ N_C6	Green-looking shadow in rinceau decoration on planceer, north part of east edge of *Union of Crowns* – region of uncovering of Soane scheme. (Cf. 2018/9 and 2018/18.)

	2018/9	Union_ N_C6	Brown glaze on gilding from rinceau decoration on planceer, north part of east edge of *Union of Crowns* – region of uncovering of Soane scheme. (Cf. 2018/8 and 2018/18.)
	2018/21	Minerva_NE_C3	Planceer, paint over square bolt head, north end of *Minerva*.
	2018/22	Hercules_NW_C15	Planceer, paint over square bolt head, north end of *Hercules*.
	2018/33	PuttiRam_E_Y4	Planceer along west edge of *Putti Ram* (south end).
	2018/34	WiseRule_S_AD6	Long panel within planceer along east edge of *Wise Rule* (north end).
	2018/35	WiseRule_S_AD6	Short panel (insert?) within planceer along east edge of *Wise Rule* (north end).
3.1.3 Mouldings	2016/25	Puttiram_E_N4	(including cyma and fillet)
	2014/15	Coffer_NW_J14	
	2014/16	Coffer_NW_J14	
	2016/38	Union_N_B11	
	2016/39	Union_N_B11	
	2016/40	Union_N_B11	
3.1.4 Frames to paintings	2018/5	Union_N_C7	Arris of frame around *Union of Crowns,* north part of east edge – area of uncovering at junction between Sir John Soane and Inigo Jones work.
	2018/6	Union_N_C7	Frame around *Union of Crowns*, north part of east edge – Inigo Jones gilding in uncovering trial.
	2018/7	Union_N_C7	Frame around *Union of Crowns*, north part of east edge – Soane gilding in uncovering trial.
	2018/14	Minerva_NE_C3	Frame arris at north end of *Minerva*
	2018/23	Hercules_NW_F16	Frame arris, south-central part of west edge of *Hercules*.
	2018/27	Apotheosis_C_X9	Frame arris, south end of *Apotheosis*.
	2018/28	Apotheosis_C_X9	Leaf & dart (original?) of frame, south end of *Apotheosis*.

	2018/29	WiseRule_S_AD6	Frame arris, north part of east edge of *Wise Rule*.
	2018/30	Temperance_SE_AH4	Frame arris (possibly later moulding?), south-west end of *Temperance*.
	2018/31	Temperance_SE_AH4	Arris between planceer and gilded frame, south-west end of *Temperance*.
	2018/32	PuttiRam_E_Y4	Frame arris, south-west corner of *Putti Ram*.
3.2 Soffit, guilloche and rose bosses			
3.2.1 Guilloche – recessed centre band	2014/1	Coffer_W_T13	
	2016/11	Coffer_E_S5	
	2016/20	Coffer_E_L5	
	2016/7	Coffer_SW_AE13 OR Coffer_SW_AF13	
3.2.2 Guilloche – edge ribbons	2016/21	Coffer_E_M5	
	2014/2	Coffer_W_U13	
	2016/6	Coffer_SW_AE13 OR Coffer_SW_AF13	
	2016/12	Coffer_E_S5	
3.2.3 Guilloche – vertical outer edge	2016/8	Coffer_SW_AE13 OR Coffer_SW_AF13	Currently white
	2016/9	Coffer_E_S5	Currently white
	2016/10	Coffer_E_S5	Currently gilded
	2016/19	Coffer_E_L5	Currently gilded
3.2.4 Guilloche rosette	2014/6	Coffer_NW_E13	Guilloche - rosette (currently gilded)
	2016/13	Coffer_E_S5	

	2016/22	Coffer_E_L5	
3.2.5 Soffit, guilloche background	2014/7	Coffer_NW_E13	Background (currently white)
	2016/14	Coffer_E_S5	
	2016/23	Coffer_E_M5	
3.2.6 Rose boss	2016/15	Coffer_E_T5	Rose boss, centre seeds (currently gilded)
	2016/17	Coffer_NE_K5	
	2016/18	Coffer_NE_K5	
	2014/17	Coffer_NW_F13	Rose boss, upper petals (currently gilded)
	2016/16	Coffer_E_S5 or T5	
	JSD 2016/67	Coffer SW_AF13	
3.3 Entablature; cornice (including coffering)			
3.3.1 Waterleaf and dart	2014/12	Coffer_NW_H_13	
	2016/41	Coffer_N_A11	
	2016/42	Coffer_N_A6	
3.3.2 Coffers	2014/13	Coffer_NW_H14	Coffering background (currently white)
	2014/14	Coffer_NW_H13	Coffering rosette (currently gilded)
	2018/10	Union_N_B6	Arris edge of coffer, adjacent to uncovering trial revealing Prussian blue, north-east corner of *Union of Crowns*.
	2018/11	Union_N_B6	Coffer soffit background, adjacent to uncovering trial revealing Prussian blue, north-east corner of *Union of Crowns*.
3.3.3 Modillion	2014/11	Coffer_NW_H13	Modillion leaf (currently gilded)

Modillion	2016/36	Coffer_NE_A2	Background to modillion (currently white)
3.3.4 Fascia	2016/43	Coffer_N_A11	
3.3.5 Egg and dart	2014/10	Coffer_NW_J13	
	2016/31	Coffer_NE_C1	
	2016/32	Coffer_NE_C1	
	2016/33	Coffer_NE_C1	
	2016/34	Coffer_NE_C1	
	2016/35	Coffer_NE_C1	East wall. egg & dart
3.3.6 Cyma reversa above vitruvian scroll	2014/9	Coffer_NW_J13	
3.3.7 Cornice flat top date	2016/24	tbc	
3.4 Entablature; frieze			
3.4.1 Frieze mouldings	2014/8	Coffer_NW_E13	
	JSE 2016/68	Coffer_SW_AJ17	
	JSF 2016/69	Coffer_SW_AJ17	
3.4.2 Background	2016/37	Coffer_NE_A2	
3.5 Entablature; architrave			
3.5.1 Fillet and cavetto	2016/44	Coffer_N_A11	
	2016/45	Coffer_N_A11	

3.5.2 Cyma reversa mouldings	2016/46	Coffer_N_A11	
	2016/48	Coffer_N_A11	
3.5.3 Anthemion fascia	2014/22	Coffer_NW_A15	
	2016/47	Coffer_N_A11	
	JSA 2016/64	Coffer_SE_AK1	
	JSB 2016/65	Coffer_SE_AK1	
	JSC 2016/66	Coffer_SE_AB1	
	2018/12	Coffer_NE_A1	East-wall anthemion fascia, at north-east corner of *Minerva* – raised line visible in raking light.
	2018/13	Coffer_NE_A4	From north-wall anthemion fascia, at north-west corner of *Minerva* – raised line visible in raking light.
3.5.4 Band fillet above Corinthian capital	2016/49	Coffer_N_A11	
3.6 Corinthian capitals			
	2014/19	Coffer_NW_A13	NE corner
	2016/50	Coffer_NW_A17	NE corner
	2016/51	Coffer_NW_A17	NE corner
	2016/52	Coffer_NW_A17	NE corner
	2016/53	Coffer_NW_A17	NE corner

	2016/54	Coffer_NW_A17	NE corner
	2016/55	Coffer_NW_A17	NE corner
	2018/19	In line with: Hercules_NW_F_17 (ceiling) / BHW_Hercules_2016_02_ WFC_04 (vertical faces)	Corinthian capital, west wall – top fleuron.
	2018/20	In line with: Hercules_NW_F_17 (ceiling) / BHW_Hercules_2016_02_ WFC_04 (vertical faces)	Corinthian capital, west wall – flat background behind corner scroll.
3.7 Wall frieze			
3.7.1 North-wall frieze	2014/18	Coffer_NW_A15	
	2016/56	Coffer_NE_A2	
	2016/57	Coffer_NE_A3	
	2016/58	Coffer_N_A6	
	2018/26	In line with: Coffer_NW_A14	North-wall frieze – translucent yellow paint of swag bow (earlier than 1960s?)
3.7.2 East-wall frieze	2016/5	Coffer_SE_AG1	
3.7.3 South-wall frieze	2016/1	Coffer_S_AK9	
	2016/2	Coffer_S_AK10	
	2016/3	Coffer_SE_AK3	
	2016/4	Coffer_SE_AK3	

3.7.4 West-wall frieze	2018/24	In line with: Coffer_NW_G17	West-wall frieze – background within swag bow.
	2018/25	In line with: Coffer_NW_F17	West-wall frieze – background to right of Corinthian capital.
3.8 Balcony			
3.8.1 Balcony	2018/36	Shown on elevations	Balcony, east side, third bay from south end, upright 'post'.
	2018/37	Shown on elevations	Balcony, east side, third bay from south end, engaged baluster.
	2018/38	Shown on elevations	Balcony, east side, third bay from south end, southern baluster, facing room.
3.8.2 Minstrels' gallery	2018/39	Shown on elevations	Minstrels' Gallery, north end of balcony level, centre bay, east side, upright 'post'.
	2018/40	Shown on elevations	Minstrels' Gallery, north end of balcony level, centre bay, east side, engaged baluster.
3.9 Lower walls			
	2014/20	Shown on elevations	
	2014/21	Shown on elevations	
	2014/23	Shown on elevations	
	2014/24	Shown on elevations	
	2014/25	Shown on elevations	
	2014/26	Shown on elevations	
	2014/27	Shown on elevations	
	2014/28	Shown on elevations	
	2014/29	Shown on elevations	
	2014/30	Shown on elevations	

	JSa 2014/31	Shown on elevations	
	JSb 2014/32	Shown on elevations	
	JSc 2014/33	Shown on elevations	
	JSd 2014/34	Shown on elevations	
	JSe 2014/35	Shown on elevations	
Rubens paintings – *see separate report*			
	2018/1	Puttirram_E_T3	*Procession of Cherubs* (*c*.1632–1634), known as '*Putti Ram*', by Sir Peter Paul Rubens (1577–1640) and Studio: blue sky centre of repair
	2018/2	Puttirram_E_S3	*Procession of Cherubs* (*c*.1632–1634), known as '*Putti Ram*', by Sir Peter Paul Rubens (1577–1640) and Studio: inside of repair near edge of repair
	2018/3	Puttirram_E_S3	*Procession of Cherubs* (*c*.1632–1634), known as '*Putti Ram*', by Sir Peter Paul Rubens (1577–1640) and Studio: outside of repair near edge of repair
	2018/4	Puttirram_E_U3	*Procession of Cherubs* (*c*.1632–1634), known as '*Putti Ram*', by Sir Peter Paul Rubens (1577–1640) and Studio: full stratigraphy of sky in an area thought to be original