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Virtual St Stephen's: The Medieval Model and the Art Historian

One Object by **Tim Ayers**

Abstract

The recent research project on St Stephen's Chapel (2013–2017) included the creation of virtual models of the building at two stages in its history: as a palace chapel in 1360 and as the House of Commons in 1707. The present article considers the modelling of the medieval chapel from the perspective of the art historian. It reflects upon the process methodologically, and presents some research questions about this great lost building and its that we have explored through modelling. It also documents, in an appendix, the sources for the model and decisions that were made about how to use them, including alternative possibilities and open questions.

Introduction

In 1831, striking "Illuminated Paintings and Architectural Illustrations" of St Stephen's Chapel and the Palace of Westminster were put on public exhibition in London's Pall Mall.[1] They included a coloured view in perspective that imagined Edward III and his family viewing the interior of the recently completed chapel (fig. 1). The paintings were made by Adam Lee, who had become Labourer in Trust at Whitehall and Westminster in 1806. In this office, he was responsible for repairs on the former chapel, then the House of Commons, so he knew well the brightly coloured remains that had been coming to light in recent years.[2] These had

also been the subject of major antiquarian publications, the first to record a medieval building in such detail, at a key moment in the Gothic Revival.[3] Lee described the exhibition as an opportunity not for financial reward, but for the public to learn about these "Remains of Antiquity".[4] In its attempt to integrate known features of the chapel into a representation of three-dimensional space, and the dramatic incorporation of colour, Lee's view has similarities with the visualisations that were created for the recent project "St Stephen's Chapel, Westminster: Visual & Political Culture, 1292–1942" (2013–2017) that we have called "Virtual St Stephen's".[5] In a sense, Lee's drawings had been the first virtual St Stephen's.

Figure 1

Adam Lee, *Perspective view of the Chapel, as it was finished in the reign of King Edward III*, circa 1820s, varnished watercolour, on paper, 111.5 × 128 cm. Collection of Museum of London (A15454). Digital image courtesy of Museum of London (all rights reserved).

We planned to make use of virtual modelling from the beginning (fig. 2). On one level, we were looking for an engaging way to present a great lost building to the public, to convey its architectural form and significance at different periods, and our research findings. There are similarities here with Lee's ambition. On another level, however, the modelling process was intended to engage with, and be a part of, the research itself, as a way to test out questions. This essay is one of two in this

issue of *British Art Studies* that present those processes, from the different perspectives of the art historian, who project managed the visualisation and researched the medieval model, and the modeller, who translated data and ideas into a visual form.[6] This essay reflects on how we went about visualising the medieval chapel methodologically. The work has run in parallel with a related project, funded by the Leverhulme Trust, to publish a critical edition of the extensive fabric accounts for St Stephen's, spanning the entire building period.[7] These have been important sources for the model, and the task of editing them set up an interesting challenge for the present author. The bald lists of craftspeople, materials, and tasks, within a time-frame, could be brought into relation with the process of modelling made objects, and therefore with aspects of their original creation. The student of medieval craft was forced to become a maker.

Figure 2

Visualisation of the interior from the west door, towards the east. Digital image courtesy of University of York (all rights reserved).

The development of virtual modelling in three dimensions offers new opportunities to historians of art and architecture, as outlined briefly in the introduction to this special One Object feature.[8] The present paper explores a number of research questions that modelling has allowed us to ask about this great lost building. First,

it was a way to reinterpret a rich but incomplete group of sources, variously interpreted in the past, towards a better understanding of major architectural features. It was also highly effective as a way to investigate the spatial implications of major lost furnishings about which little is known, but which have been central to discussions about the relationship between liturgical and political space, over time. Finally, it invited us to bring together parts of the structure and its decoration that have tended to be studied separately, to ask how they may have been made in dialogue with one another, to provide insights into the creative process for a great royal chapel in the reign of Edward III.[9] In each case, accurate reconstruction was impossible. For such exploratory models, the term "visualisation" has been adopted by scholars, rather than "reconstruction", which suggests the possibility of a fixed retrievable state for what is represented.[10]

There remains a fundamental methodological challenge in the way that such visualisations present their evidence, for scholarly purposes. On the one hand, virtual models have the expressive power to convey an overall impression of many aspects, at one moment in time, visually and in three dimensions.[11] On the other hand, they are less good at explaining things. A finished model alone does not reveal how it was created, the underlying purposes, the evaluation of sources and the process of interpretation. Indeed, the level of visual finish can convey a misleading authority. (The final product is therefore completely different from our critical edition of the accounts, which presents a set of sources in words, with a commentary, in all their ambiguous complexity.) These issues have been explored by archaeologists, art historians, and heritage professionals, and they are addressed in the so-called London Charter for the Computer-Based Visualisation of Cultural Heritage, reissued in 2012.[12] This sought to establish a process to enable interrogation of the thinking behind a model, by documenting the research questions, sources, hypotheses and choices that informed it, in accompanying paradata.[13] The present article (with its Appendix), and its companion piece, set out to do that for Virtual St Stephen's.[14]

The Visualisation Project

Collaboration sits at the heart of such visualisation projects because many different skills are required.[15] At the University of York, art historians and historians worked with a team at the Centre for the Study of Christianity & Culture, coordinated in monthly project meetings (2013–2016).[16] Many other art and architectural historians, archaeologists, historians, and curators shared their knowledge in a series of workshops, focusing upon issues as various as sources, liturgical practice, and the medieval paintings. In deciding formats for the online presentation, we were guided by Christianity & Culture, which had worked extensively on visualisations of this kind. For the website and for touchscreens on site at Westminster, in St Stephen's Hall and the Jewel Tower (in the care of English Heritage), we developed a combination of interactive models and short film sequences.[17] They include visualisations of the upper chapel of St Stephen in the 1360s and the House of Commons in 1707. It was a priority to be able to compare the interior of the same building, from the same viewpoint, in its different functions. The dates were determined by the surviving evidence. Technical parameters for these models are set out in the companion piece by Anthony Masinton and James Jago, "Mapping the Unknown".

We had to address the challenge of balancing viewing experience with scholarly integrity, and for different audiences. There is a tension potentially between the desire for a compelling visual image for public consumption and more scholarly presentations, visualising levels of doubt, for example.[18] After much discussion, we decided to present the two interiors in a fully modelled way (fig. 3). In this case, the evidence for the medieval chapel invited an attempt to integrate the surviving evidence as far as possible. As Adam Lee realised for his exhibition in 1831, the interior decoration had been spectacular and we wished to convey the overall effect of this, even if it was only an approximation. On the website, we decided to offer insights into the evidence and decision-making processes, for those who wished to explore them. As visitors navigate the models from fixed viewpoints, they can interrogate features via information panels. A short film titled

How Do We Know identifies sources. These could never present a full evaluation but they explain the nature of the evidence and, selectively, how we used it.

Figure 3

Visualisation of the interior from the choir, towards the east. Digital image courtesy of University of York (all rights reserved).

Sources and Interpretation

The gathering of primary source materials was a major task, including the scrutiny of the fabric accounts for the building, surviving parts of the structure, and a vast range of antiquarian sources, scattered across more than half a dozen collections. Those for the medieval chapel are set out in the Appendix to this article. Those for the House of Commons are addressed in the accompanying article, "New Approaches to St Stephen's Chapel, Palace of Westminster". For each model, the source materials were different in kind and extent. In both models, however, we found that the process demanded a similar kind of analysis, not only of individual sources but also of many sources together, in reconstructing a partially furnished, three-dimensional space. The decision-making process proved unforgiving. It forced us to confront issues about the relationships between parts that you might

avoid in writing. Similarly, in a visual presentation on paper, you can choose what to show and what to conceal. In a navigable model, there are fewer places to hide.

After the initial analysis, the creation of the models was not a linear process but rather involved continuing dialogue with other parts of the visualisation, and a return to the sources or other expert help for alternatives. An initial version of the screen or pulpitum (see below) was rejected, for example. If the resulting visualisation looks finished, it is imperfect in both senses: it was always the result of a series of choices, which could sometimes have been resolved differently. The creation of a virtual model through the resolution of challenges posed by the sources (or lack of them) and by multiple possibilities for interpretation is therefore equivalent to the construction of an argument.[19] Beyond the present case studies, the Appendix documents the choices that were made, alternative possibilities, and open questions for future work.

Conflicting Evidence: The Clerestory

The first case study concerns the architecture of the structure, focusing on the lost upper part of St Stephen's Chapel, its clerestory. It shows how the team evaluated conflicting evidence. As long ago as 1844, the architectural draughtsman Frederick Mackenzie established that the clerestory had been removed in 1692, during Sir Christopher Wren's refurbishment of the House of Commons.[20] He found a few possible traces of it at the level of the upper frieze, at the upper limit of the fabric that had been retained.[21] On top of the frieze and integral with it, towards the interior, he identified traces of a stone wall and stubby shafts, to support a roof or vault. Towards the exterior, he found evidence for a further structure. Between them, he identified a clerestory passage or walkway. Mackenzie was trained in the analysis of buildings, with unique access to the surviving evidence, now lost. He also attempted to interpret and represent the original form of the structure. In large and detailed reconstructions, he suggested an upper storey with two skins of wall, windows on the exterior face, and an open timber roof (figs. 4 and 5). These are the earliest of a number of reconstruction drawings of the clerestory in two dimensions

and they have been criticised severely for having, in many respects, no basis in the surviving evidence.[22]

Figure 4

South Elevation, exterior view of the south side of St Stephen's Chapel, showing the clerestory, from Frederick Mackenzie, *The Architectural Antiquities of the Collegiate Chapel of St Stephen* (London, 1844), pl 4. Collection of The Miriam and Ira D. Wallach Division of Art, Prints and Photographs: Art & Architecture Collection, The New York Public Library. Digital image courtesy of New York Public Library (all rights reserved).

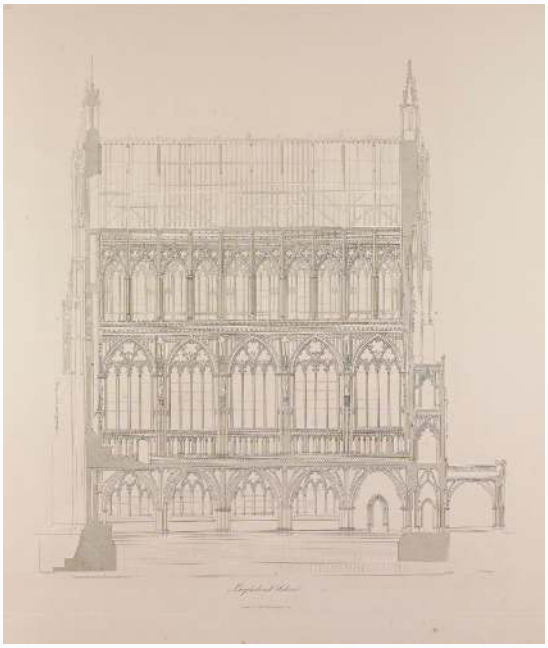

Figure 5

Longitudinal Section, interior views of the south side of St Stephen's Chapel, showing the clerestory, from Frederick Mackenzie, *The Architectural Antiquities of the Collegiate Chapel of St Stephen* (London, 1844), pl 7. Collection of The Miriam and Ira D. Wallach Division of Art, Prints and Photographs: Art & Architecture Collection, The New York Public Library. Digital image courtesy of New York Public Library (all rights reserved).

Other kinds of sources also throw his reconstruction into doubt. The medieval fabric accounts suggest a timber vault, rather than an open roof, including references to a *vosura* and bosses.[23] Another medieval source seems to promise a crucial measurement. In Henry VI's instructions for the building of Eton College Chapel, composed in the mid-fifteenth century, a comparison is made to the height of St Stephen's.[24] It specifies an overall height at Eton of 80ft, and states that St Stephen's is less high; it does not say by how much or where the latter measurement was taken. In a recent article on St Stephen's, John Goodall took the measurement of less than 80ft to be an overall height for the exterior of the building.[25] He had good reason to do so, because the measurement for Eton describes the height from the ground to the battlements. He presented this in a new

cut-away view of the chapel, on paper (fig. 6).[26] The added clerestory is a low one, as a result.

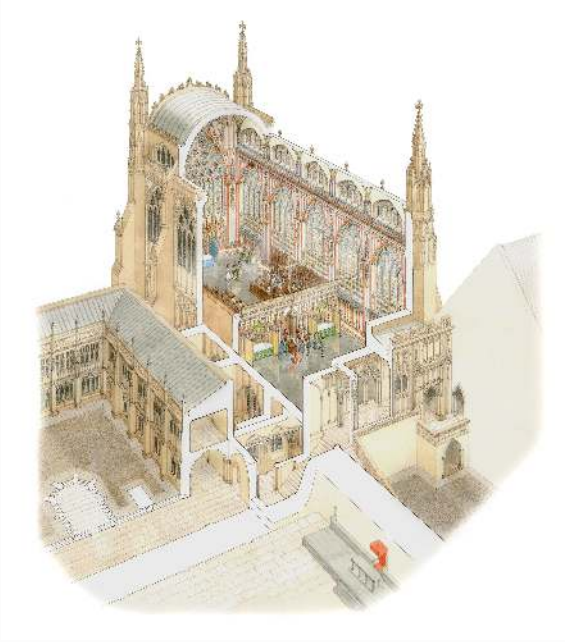

Figure 6

Stephen Conlin, *Reconstruction drawing of St Stephen's Chapel, circa 1530* Digital image courtesy of Stephen Conlin 2015, commissioned by Country Life Magazine (all rights reserved).

This contradicts the pictorial evidence for the exterior of the chapel, however. The earliest is a panoramic view of Westminster from the River Thames, in pen and ink, made before the dissolution of the college, about 1530 (fig. 7).[27] The windows of the clerestory are not visible but the drawing shows a taller upper storey, with short flying buttresses, apparently spanning the depth of the substantial buttresses below. Where it can be checked against better recorded or surviving features, this small drawing seems to be carefully observed. Wenceslaus Hollar's well-known panorama, dated 1647, again shows a row of five tall windows at clerestory level (fig. 8). A third source is the frontispiece to John Nalson's, *An Impartial Collection of the Great Affairs of State*, published in 1683 (fig. 9).[28] This allegorical print was not setting out to record the building accurately but various details suggest the desire to make it recognisable to contemporaries. This too seems to corroborate the

taller clerestory windows. Nevertheless, each of these images represents the building differently.

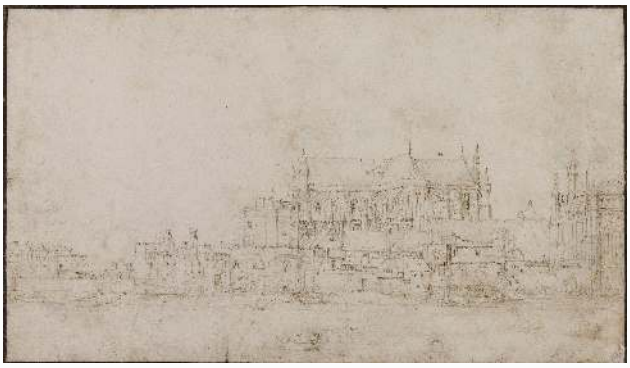

Figure 7

Westminster Palace and Westminster Abbey from the River Thames, circa 1530, pen and ink, on paper, 10.1 × 17.4 cm. Collection of Victoria & Albert Museum, London (E 128-1924). Digital image courtesy of Victoria & Albert Museum, London (all rights reserved).

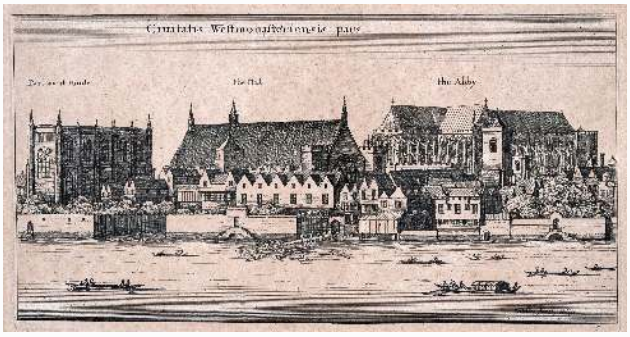

Figure 8

Wenceslaus Hollar, *Ciuitatis Westmonasteriensis pars*, 1647, etching, 15.2 × 28.6 cm. The ‘Parliament House’ is on the left. Parliamentary Art Collection (WOA 845). Digital image courtesy of Palace of Westminster (all rights reserved).

Figure 9

Frontispiece by Robert White to John Nalson, *An Impartial Collection of the Great Affairs of State*, Vol. II, London, 1683, engraving, 29.8 × 17.8 cm. Collection of British Museum (1877,0811.1288). Digital image courtesy of Trustees of the British Museum (CC BY-NC-SA 4.0).

After assessing these conflicting sources, and previous visualisations, we decided to explore an alternative interpretation, prioritising the sources differently (fig. 10).[29] On our reading, the Eton document could perhaps be referring to the height of the upper chapel, instead of the total height of this two-storey building. We therefore applied this measurement to the upper level, alone. We also decided to experiment with two skins of masonry at clerestory level, separated by a passage, as Mackenzie had done. Instead of placing the windows on the outside, sitting implausibly on the relatively fragile masonry of the openwork parapet, our model leaves them and the main masonry of the clerestory structure on the inside, where the wall below is thicker.[30] This was also fundamental to the appearance of the interior model, determining the visual relationship between the upper windows and the walls. To the outside, we represented an openwork window, in each bay. As a parallel for such a construction, we looked to the eastern bays of the Lady Chapel

of York Minster, begun in 1361. It has been argued that the master mason for this was aware of St Stephen's.[31]

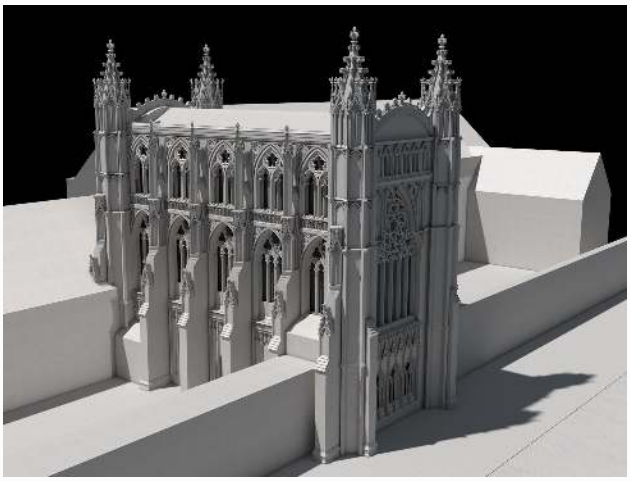

Figure 10

Visualisation of the exterior of St Stephen's Chapel from the south-east. Digital image courtesy of University of York (all rights reserved).

The broader point is that the exploration of alternative visualisations for lost structures has value where the evidence is contradictory. Here the process of modelling was itself a kind of research, the development of a hypothesis. Our visualisation is in dialogue with a succession of previous drawings, back to the beginning of the study of the building. The modelling of the outside was beyond our immediate brief, to visualise the interior, and remains a work in progress.[32]

Spaces and Gaps in the Evidence: The Chapel Fittings

The second case study concerns the fitting out of the chapel and, for this, the sources posed a different challenge. In materials and labour costs, the fabric accounts leave no doubt about the richness of the sculpture, stained glass, and woodwork that were commissioned in the 1350s.[33] Yet almost nothing survived to be recorded by the antiquaries of the late eighteenth and early nineteenth centuries, in either words or images. It is hardly surprising that relatively little detailed attention has been paid to them previously. To make plausible simulations for our model, however, we were forced to confront what we did not know. Although the quantity, materials, and value of some fittings were documented, many aspects of

their appearance remained mysterious. This need to visualise so many different kinds of objects led naturally to consultation with specialists in different media and across disciplines—historians, art historians of many kinds, buildings archaeologists, and musicologists.[34] The integrated character of our virtual model actively encouraged such working together, and proved one of the most interesting and fruitful aspects of the process.

The screen, or pulpitum, serves as an example. Like the screens in other collegiate churches, it will have been important to the practice of worship, and it will have had a fundamental effect on the experience of the chapel for the clerical community and for visitors.[35] It has also been the object of speculation about the afterlife of the building, as the home to the House of Commons, namely, that its presence or former presence may have shaped the layout of this, in relation to its lobby.[36] For the position of our screen, we therefore ran the hypothesis that its western face was on the line of the later division between lobby and Commons, in the second bay from the west. In attempting to create this structure, we needed to fit it into a pre-existing (virtual) architectural space. In this, we were facing a similar challenge to that confronting Edward III and his agents in the 1350s; they were setting out to provide furniture for the king's new college, in a building that had been begun in the 1290s, as a palace chapel.[37] There is no reference to such a screen in the building accounts. We do have a reference to one in a second document about Eton College Chapel, however, in the 1440s.[38] This names the stalls and rood loft at Westminster as the model for furnishings there. It also suggests the possibility of a very substantial structure, twelve feet deep, in total.[39] There is no further information on it. Nor are there surviving timber examples of fourteenth-century date in England, so we turned to other contemporary and later woodwork, such as the watching loft in St Albans Abbey (fig. 11), and to stone pulpita, especially that in Exeter Cathedral (fig. 12).[40]

Figure 11

The north side of the watching loft, overlooking the shrine of St Alban in St Albans Cathedral, Hertfordshire, second half fourteenth century. Digital image courtesy of St Albans Cathedral (all rights reserved).

Figure 12

West side of the pulpitum, Exeter Cathedral, built 1318–1325. Digital image courtesy of J. Hannan-Briggs (CC BY 2.0).

For advice on these matters, and to create a timber structure that would stand up, we worked with art historian Charles Tracy, a specialist in timber structures Hugh Harrison, and the architectural draughtsman Peter Ferguson. In conversation over

two months, we developed designs on paper: a plan, section and elevation (figs. 13, 14, and 15). The position of the screen, projecting into the second bay, required us to create a free-standing structure; in this, the great timber frames around which the pulpitum was built (three of them, each running north to south) could have been dismantled in whole, or even in part, after the dissolution of the college. The design process also forced us to consider the screen's functions as determining factors for its form.[41] We made adjustments to facilitate processional movement through it, and experimented with the position of gates and steps up to a rood loft, which will have been used during services. The process helped us to understand how the screen could have been experienced and used in worship, within the chapel.

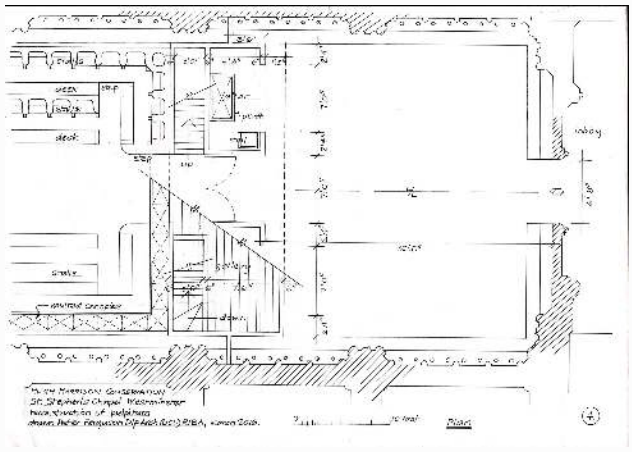

Figure 13

Peter Ferguson, *Plan of the pulpitum*, March 2016. Digital image courtesy of Peter Ferguson (all rights reserved).

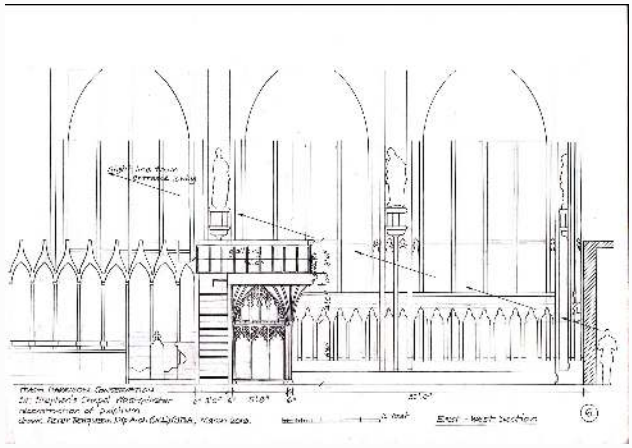

Figure 14

Peter Ferguson, *Section of the pulpitum*, March 2016. Digital image courtesy of Peter Ferguson (all rights reserved).

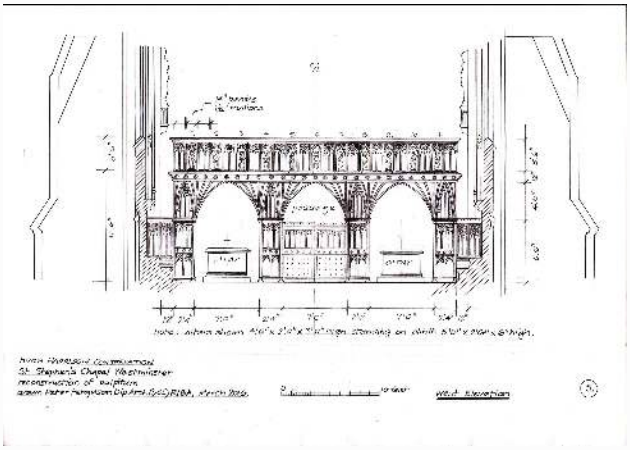

Figure 15

Peter Ferguson, *Elevation of the pulpitum from the west*, March 2016. Digital image courtesy of Peter Ferguson (all rights reserved).

We also had to work out how this substantial structure would have interacted in three dimensions with existing wall arcades and floor levels, and accommodated side altars, within a confined setting.[42] The depth of the structure suggested that the altars could have been enclosed within it, as at Exeter. In appearance, the height of the loft was adjusted to sight-lines from the west, so that adjacent sculptures would be visible.[43] To north and south, it raised questions about the visibility of wall paintings below the windows. We polychromed and decorated the object, deriving both palette and ornament from schemes on later timber screens and other structures.[44] The finished object is not an accurate representation of the original—it never could be; this is an imaginary structure—but it still matters (fig. 2).[45] Leaving it out would have been misleading. The pulpitum was fundamental to the experience of this space for those who worshipped or visited here, constraining and controlling both movement and visibility. It shaped and was shaped by the liturgy, and may have informed the later political life of the building.

The finished model represented the pulpitum in keeping with our aim to communicate the experience and significance of this lost building to the public. Equally, the process of designing it informed our thinking about the liturgy and appearance of the chapel.

Creative Combination: The Stained Glass

The final case study concerns light, colour, and imagery, with reference to the stained-glass windows in the chapel and their role in the wider programme. The antiquarian sources leave no doubt that the wall paintings and polychromy of the upper chapel were astonishing.[46] The architectural draughtsman Frederick Mackenzie, an eyewitness, wrote that "Every part of the Chapel, except the polished columns and shafts of pedestals, was painted and gilded".[47] Another contribution here discusses the paintings.[48] The evidence for the stained glass is also remarkable, although in a different way. The fabric accounts are among the richest surviving sources for the medium anywhere, for the organisation of labour, glazing processes, and resources—almost everything except what the windows actually looked like.[49] They also record that the work was done between 1349 and March 1352, at the same time as work on the stalls, sculpture, and wall paintings. What the virtual model has invited, in its nature, is a bringing together again of these things. How could the glass be visible in relation to the height and position of the stalls, for example? Could the better-recorded paintings and sculpture contribute anything to an understanding of possible imagery in the glazing?

The chapel was lit by many large windows (two gable windows, ten lower side windows, and at least another ten above), whose glazing will have determined the illumination, visibility, and experience of the interior. Of this glass, we know only the three plates of fragments published by J.T. Smith in 1807 (fig. 16).[50] Discovered during the architect James Wyatt's interventions in 1800, these fragments are reported to have come from a window or windows in the eastern bay. They reveal that some windows had heraldic borders, containing lions and fleurs-de-lis, deriving from the royal arms of England. These are ubiquitous in English fourteenth-century stained glass, but also highly appropriate in this context, to a moment of triumph in Edward III's war to claim the French throne.[51] The fragments also suggest the presence of architectural frames, in white glass with silver staining, again of a kind common in contemporary glazing.[52] Canopies like these would have let in a lot of light, quite different from the saturated colour of

the Sainte-Chapelle, in Paris, glazed a century earlier. Such canopies limit the width available for imagery, and often contain single figures, rather than narratives. At St Stephen's, we know that extensive narratives were painted on the walls.[53] The precise extent and arrangement of these features in the glass are now unknowable but the surviving evidence informed our hypothetical reconstruction of a well-lit interior (fig. 3).[54]

Figure 16

John Thomas Smith, one of three plates showing stained glass from St Stephen's Chapel, published by John Thomas Smith, *Antiquities of Westminster*, (London: T. Bensley, 1807), pl. opposite p. 233. Digital image courtesy of Tim Ayers (all rights reserved).

The exercise also invited consideration of the lost glazing within the wider context of the building, including both the architectural setting and the surrounding imagery. Stained glass is always in dialogue with its architectural frame. In relation to the east window, the V&A drawing and Nalson's print suggest that the tracery once included a rose (figs. 7 and 9). Our model for this was a window in Canterbury Cathedral, documented to have been made by one of the master masons at St Stephen's, Thomas of Canterbury, in the same decade (fig. 17).[55] Medieval glaziers met the challenge of how to fill these many little openings in a variety of

ways but heraldry was a popular solution, and seems plausible here, given its importance elsewhere in the chapel: in the stained glass borders, the painted window heads, and along both upper and lower carved and painted stone cornices.[56] More specifically, we turned to the recorded paintings on the lower parts of the east wall, at the foot of the window (fig. 18). Within the wall arcade knelt the king and five of his sons, bearing their arms on their chests. In the five compartments of the great rose, we therefore arranged five differenced shields around those of the king himself, extending this presentation of the Plantagenet dynasty.

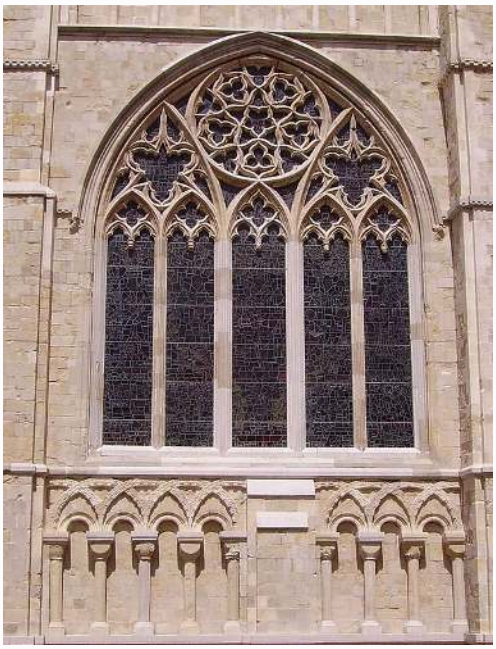

Figure 17

South window in St Anselm's Chapel, Canterbury Cathedral, designed by master mason Thomas of Canterbury, 1336. Digital image courtesy of Immanuel Giel (public domain).

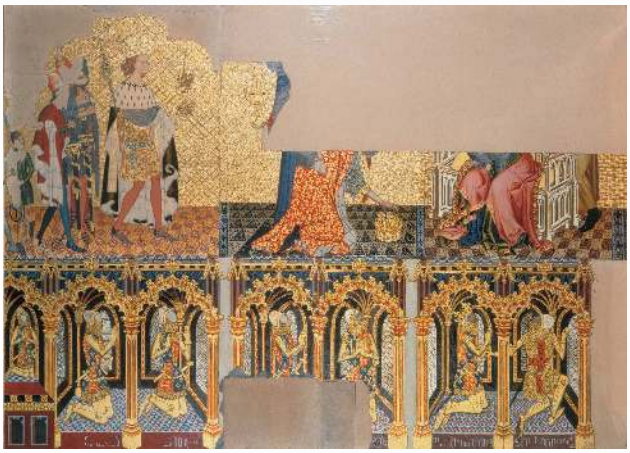

Figure 18

Edward III and his sons, *led by St George, a reconstruction by Richard Smirke*, made circa 1800 of paintings on the east wall of the chapel, made originally in the 1350s, tempera and gold leaf on paper, 83 × 116 cm. Collection of Society of Antiquaries of London. Digital image courtesy of Society of Antiquaries of London (all rights reserved).

We also looked to the paintings on this wall as a way to think about the iconography in the main lights of the east window. Here, the architecture was useful again. The even number of main lights, six, is relatively unusual for an east window; we could rule out any scheme that prioritised a single subject in a central light, such as the Crucifixion, which was popular elsewhere. At the foot of the window, flanking the high altar, the men and women of the royal family pray to images of the Adoration of the Magi and the Presentation of the Christ Child in the Temple. Both subjects have a Marian character, which may have been picked up elsewhere in the imagery of the altar region.[57] We put the Coronation of the Virgin at the top of the east window, therefore, in a position of honour across the two central lights—a representation of heavenly kingship in a royal chapel. For a model, we turned to the greatest surviving ensemble of contemporary English glass, in the east window of Gloucester Cathedral (formerly St Peter's Abbey), where the king's father, Edward II, is buried (fig. 19).[58] Here Christ and the Virgin Mary preside over a heavenly hierarchy of saints. We also took from the Gloucester window the distinctive combination of red, blue and white glass, which would become widely popular in late medieval English glazing.

Figure 19

East window, Gloucester Cathedral, third quarter of the fourteenth century. Digital image courtesy of John Jones of Skycell (all rights reserved).

Conclusion

As Adam Lee recognised in the early nineteenth century, the rediscovery of the medieval chapel of St Stephen invited visualisation and presentation to the public; it was a *cause célèbre* in the Gothic Revival. This had been a building of great splendour, at the very heart of national political life, presenting exciting possibilities for interpretation. The source materials were, and remain, abundant and diverse. Virtual modelling now allows new ways to present and interpret the lost chapel in three dimensions. We have seen that none of the features presented in the case studies offers a definitive resolution of the evidence. We have tried hard to avoid being "wrong", but the evidence may be largely lacking, or contradictory. Rather, the model provides viewers with a new kind of imaginative access to this great architectural space, the interrelationship of the furnishings within it, and their functions. More generally, it suggests the experience of light and colour in one of the most richly decorated interiors of English medieval architecture.

For researchers on the project, the process forced us on one level to analyse every scrap of evidence and to scrutinise the gaps. On another level, it made us think synthetically. The creation of a furnished, three-dimensional model encouraged us to gather specialists in different fields to pool their knowledge. Working together, we came to understand more about the problems facing the designers of the pulpitum, for example. The challenge of furnishing the chapel also encouraged us to think about ways in which the different parts of the building may have worked together, structurally, liturgically, iconographically and aesthetically. The modelling process made us think holistically about the coordination and interaction of many different craftsmen on a single building site at one time—in fact, about the particular character of the creative process at St Stephen's.

Appendix

Introduction

This section sets out the sources that were used for the modelling of the interior of the medieval chapel. We addressed the architecture, fixed furnishings, and decoration, but omitted moveable liturgical equipment and reading desks. The following explains briefly how the sources were prioritised in making choices, presents some alternative choices, and poses new research questions. As points of reference for the features described below, and as a record of the model, we present a plan, an elevation and a section of the chapel (figs. 20, 21, and 22).

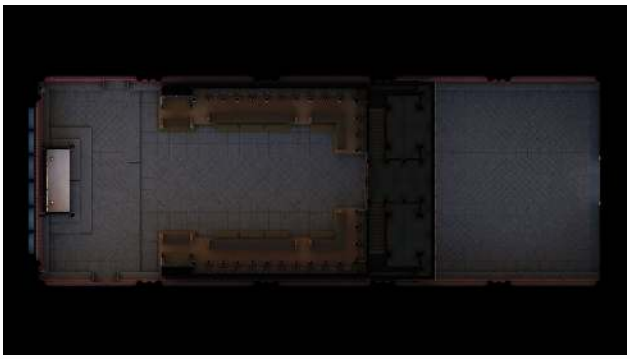

Figure 20

Anthony Masinton, *Reconstruction of the interior of St Stephen's Chapel about 1360: Plan*, 2016. Digital image courtesy of Anthony Masinton.

Figure 21

Anthony Masinton, *Reconstruction of the interior of St Stephen's Chapel about 1360: longitudinal section, looking south*, 2016. Digital image courtesy of Anthony Masinton.

Figure 22

Anthony Masinton, *Reconstruction of the interior of St Stephen's Chapel about 1360: transverse section, looking east*, 2016. Digital image courtesy of Anthony Masinton.

Sources for Architecture

The upper chapel may be lost, but measured plans, elevations, and sections were made before its destruction. The main sources are the records made for the Society of Antiquaries in the 1790s and 1800s, by John Carter and John Dixon, when the building was under threat from an expanding House of Commons;[59] and those made after the fire in 1834, which led to the destruction of the building.[60] We gathered these, and as many other antiquarian drawings, watercolours, and prints of the chapel, as possible.[61] A study day was held at the Society of Antiquaries and the Houses of Parliament, to evaluate their collections with curators.[62] A number of previously unknown images emerged during the project, and it is likely that more will be discovered.

Both Carter and the architectural draughtsman Mackenzie invented parts that were hidden or lost, to different degrees for different audiences, just as we have done. They are not consistent with each other. Carter saw the interior before parts were lost in 1800, but much was then concealed by panelling; access was denied to him during James Wyatt's removal of the panelling and subsequent destruction of parts of the east end, at this time.[63] Mackenzie saw the shell of the whole building, with freedom of access. We had to weigh up the evidential value of what they recorded. For the parts that were surviving after 1834, we prioritised Mackenzie's record and measurements, as he had had better access, but Carter was valuable as a control, and for parts that were lost between their respective campaigns of recording.

Lower Elevations

For the north and south elevations, up to the great frieze running above the main windows, we used the fine drawing and resulting print of the easternmost bay on the north side, made by John Dixon and published in 1811 (fig. 23).[64] Mackenzie's plates provided further details. On his evidence, we included pairs of blind arches on the main piers, for example. The accounts record that the tabernacles between the windows were designed and made in the 1320s and 1330s.[65] We used Mackenzie's speculative reconstruction of their form, because he had better access to the surviving evidence than anyone else; he had seen and drawn the scars that were left by their removal.[66]

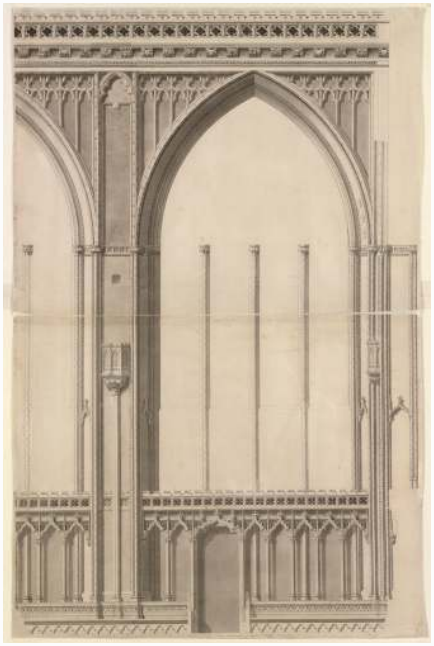

Figure 23

John Dixon, *Eastern bay on the north side of St Stephen's Chapel*, 1811, pen and ink, 94.5 × 60.3 cm. Collection of Society of Antiquaries of London (236/E, SSC 15). Digital image courtesy of Society of Antiquaries of London (all rights reserved).

The form of the window tracery is not known; only the mullions, jambs, and arch heads are reliably recorded. We followed Mackenzie's speculation, based on a form that is recorded to have been painted under the wall arcade on the east wall;[67] the split cusps of this were also consistent with our visualisation of the east window tracery (see below). Other designs have been proposed for both east and side windows.[68] Carved stones survive from the lower frieze that ran around the chapel, which we were able to "incorporate" into the model.[69] A number of aspects of the building were confirmed by the medieval building accounts, such as the lavish use of a dark Purbeck marble for "columns around the chapel".[70]

East and West Walls. For parts of the east wall that survived the fire, we prioritised Mackenzie's detailed record of the overall ensemble, as he had seen more than Carter; we used earlier sources for the lowest parts, which were destroyed in 1800.[71] Both Carter and Mackenzie confirm the unusual, hipped form of the east window arch, seen also in earlier views of the exterior, but the tracery is

speculative (see above). The west wall of the chapel had been much changed by 1834 and is poorly recorded, so we avoided modelling it in full;[72] it is wholly or partly concealed from both available points of view. We assumed that the west window tracery was the same as that to the east, as Mackenzie had done, and duplicated other features; flanking tabernacles have been included, making up the total to twelve, appropriate to their recorded occupants (see below). There is evidence for the continuation of the wall arcade on the west wall.[73]

Clerestory

As discussed previously, an upper tier of five windows is shown in early visual sources for the exterior (fig. 8), and a clerestory is recorded to have been removed in 1692.[74] Mackenzie argued that the clerestory had a narrow passage separating two skins of masonry. We concluded that the window plane was on the inner face of the wall, where the weight of wall and window would be better supported. The form of the windows and their tracery is unknown. We reproduced that of the lower windows, to avoid inventing another design. The model does not make full use of the eleven short shafts for corbels, which were recorded by Mackenzie above the upper frieze on the interior, standing both over the tabernacles between the side windows and over the middle of each window.[75] It would be interesting to explore alternatives for the fenestration and vault.

Vault

The building accounts record that a timber vault was designed by the king's master carpenter William Hurley in the 1320s, and installed over the upper chapel in the 1340s.[76] The form of it is unknown (although bosses are mentioned), and it is unclear how it was supported on the corbels recorded by Mackenzie. We therefore decided to borrow a roughly contemporary design from the building itself: a lierne vault, based on that recorded in the undercroft chapel by John Carter.[77] The nineteenth-century restoration has maintained or reproduced this in a simplified form. Our design makes use of alternate corbels (see above), for support. Detailed inventories of the timbers for the original king-post roof survive in the medieval accounts.[78] Further study of these may provide clues to the form of the vault (*vosura*), which was attached to it, according to the accounts. The master carpenter

was probably responsible for the extraordinary octagon vault and lantern at Ely Cathedral, so the design is potentially of great interest.

Sources for Polychromy, Sculpture, and Stained Glass

Antiquaries and artists from the 1790s, and after the fire in 1834, reported that the interior had been a blaze of colour and gilding.[79] The richness of this decoration is confirmed by fabric accounts for the 1350s, which record the purchase of vast quantities of gold leaf and other materials.[80] The architectural polychromy had a strongly heraldic character, and both this and the choices of subjects for the narrative and other paintings were informed by the character of this institution as a royal foundation.

It included painted narrative scenes, of which a few survive in the British Museum.[81] These show Old Testament subjects with verse inscriptions and were originally located on masonry inserted into the lower parts of the side windows. They have recently been subjected to a new scientific analysis.[82] Others were carefully drawn (and in one case painted) by Richard Smirke at the time of their discovery and destruction, in 1800; and published in 1811.[83] The making of the model provided an opportunity to see how the surviving and recorded paintings fitted into the architecture. It revealed at once that assumptions based on an illustration published in 1807, showing eight compartments in the southern window of the eastern bay, and a description in 1811, needed revision.[84] There could have been as many as sixteen scenes, in two rows. The preponderance of evidence for the eastern bay also raised questions about such paintings further west. We were dependent upon descriptions that windows at the other end of the chapel were similarly blocked and decorated.[85] We also had to consider whether there were paintings in the bays containing the stalls (see below).

Other groups of paintings were also recorded only partially. Going on the brief suggestions of J.T. Smith and Richard Smirke in the 1800s, we duplicated around the western bays the angels that they had recorded standing under the wall arcade in the eastern bay.[86] The colouring is taken from Ernest William Tristram's full-size, twentieth-century restorations, based upon Smirke's description.[87] Smith also described two standing saints in armour, which he saw at the foot of the window

splays in the second bay from the east on the north side.[88] We duplicated these around the other windows, following Smith and Smirke. Similarly, Mackenzie described and drew tall figures of angels in the blind panelling that filled the window spandrels.[89] We have indicated these in the panelling of every spandrel. Given how much had been lost or was still hidden in the 1790s, it is likely that there were more figurative paintings of which we now have no record, so figurative paintings are probably under-represented in the model. The upper gable walls and clerestory are devoid of them.

The architectural polychromy was carried out in the 1350s, as recorded in the accounts. We were guided especially by John Carter's detailed watercolours in the Society of Antiquaries and Frederick Mackenzie's observations, which identified patterns in the use of colour on architectural features, such as mouldings.[90] For shades of colour, we consulted a wall-painting specialist, Dr Jane Spooner, to help us match the pigments described in the building accounts, and to be found on fragments of painted masonry from the chapel in the British Museum.[91]

Again, the partial evidence was a major challenge. Although Carter provides detailed drawings for the upper parts of the walls (below the clerestory), in a rich palette of red, blue, and gold (fig. 24), there is less evidence for lower parts, and none at all for the lost clerestory and vault. We followed the principles described by the antiquaries in the parts that they saw but blank areas remained. The use of a strong colour for these, often blue in the model, is probably misleading, if they were originally painted with figural subjects, as Mackenzie thought. There are also discrepancies in the antiquarian records. We followed Mackenzie in decorating the arch heads of the side windows with gold fleurs-de-lis on a blue ground, and gold leopards on red, alternately by bay. Other visual sources suggest that they may have alternated within the reveals of each window, a format that we trialled for the east window.[92]

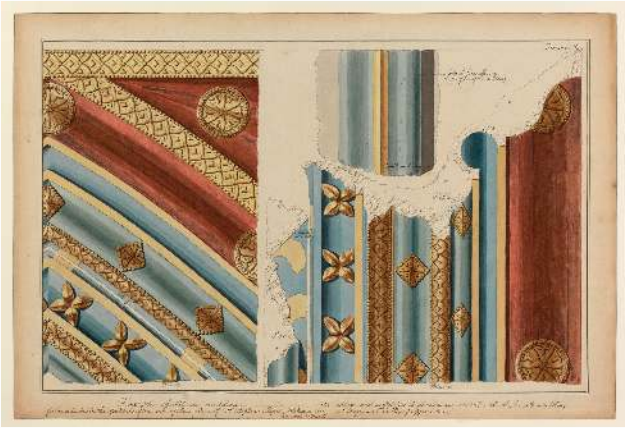

Figure 24

John Carter, *Coloured drawings of architectural features*, Plate X, in John Carter, *Plans Sections & Specimens of the Architecture and Ornaments of St Stephen's Chapel Westminster*, 1795, pen and ink, and watercolour, on paper, 54.7 × 37cm. Collection of Society of Antiquaries of London (236/E, SSC 10). Digital image courtesy of Society of Antiquaries of London (all rights reserved).

The building accounts leave no doubt that the interior was inhabited originally by many figure sculptures.[93] We were able to represent some of these, but not all. We put the recorded patronal image of St Stephen in the customary position to the north of the high altar, and an image of the Virgin Mary on the south side, as elsewhere.[94] The latter is modelled on the figure of the Virgin and Child, from Flawford parish church (Nottinghamshire).[95] It is appropriate in form and subject, but it is of alabaster; there is no record of alabaster in the Westminster chapel. The prominent tabernacles around the walls contained figures of Apostles, according to a seventeenth-century source, and the canopies were originally inhabited by angels, with censers.[96] No suitable set of Apostle sculptures survives in England from this period. With the help of the department of art history at the University of Cologne, a photogrammetric survey was made of a set on the so-called St Peter Portal of Cologne Cathedral.[97] These were installed originally in the second half of the fourteenth century, and share some features stylistically with English art of the period. We did not have time to model the angels in the canopies.

The accounts record other figures, without specific locations.[98] They include a payment to William of Patrington for a group of eleven figures, among other work on the stalls in 1357–1358.[99] They were presumably in wood, as he is listed among the carpenters. The odd number is striking. It would be consistent with a sequence of English kings from William I to Edward III, that is, since the Norman Conquest; or perhaps from Edward the Confessor (as this is Westminster) to Edward II, the predecessor of the current king.[100] For this royal chapel, we decided to speculate on how such a set of figures could have been incorporated into the timber furnishings. We placed them on the west face of the pulpitum, equivalent to those in such positions in larger churches, but here on the loft front.[101] As models, we took the set of kings that was made three decades later for the south wall of the adjacent Westminster Hall.[102] Other subjects and locations for Patrington's figures are possible.

The accounts record the purchase of materials for the decoration of sculpture, including gold leaf, tin-relief ornaments, and imitation jewels.[103] A drawing by John Wykeham Archer of a painted fragment, discovered during work on the chapel in the early nineteenth century, confirmed that some draperies were brightly coloured, with borders in relief, and gilded.[104] To give an impression, we coloured the figures, which proved a very time-consuming process.[105] The palette includes paler colours, inspired by those found in the paintings under the windows, to contrast with the powerful heraldic combination of red, blue, and gold on the walls. Our colour scheme is entirely speculative but the process of deciding upon it raised a major issue in the modelling of this polychromed interior, namely, how colours were modulated overall.

The upper chapel was illuminated by many substantial windows, as described above. Fragments of glass survived to be recorded in 1800.[106] Previous writers have pointed to similarities in the style of these with the surviving glazing of the Lady Chapel in Ely Cathedral (under way in 1349).[107] This is true of some fragments, but not all, and it is known from the accounts that the glaziers at St Stephen's came from a very wide variety of places. We decided to incorporate a castellated architecture, becoming popular around mid-century in the windows of a

number of churches with close connections to Edward III's comrades in arms and a key administrator for St Stephen's, William Edington, Bishop of Winchester, Treasurer of England: Edington (Wiltshire), Elsing (Norfolk; Sir Hugh Hastings), and Heydour (Lincolnshire; Henry, Lord Scrope of Masham).[108] This fitted the military tenor of other aspects of the chapel's decoration. Some of the fragments suggest that the architecture was inhabited, but we did not have time to populate it.

The figure subjects are also conjectural, but they respond to a number of known features. As discussed above, we followed cues in the recorded wall paintings to include a prominent image of the Virgin Mary, enthroned in heaven, in the east window. This and various universal saints were taken from the hierarchy in the east window at Gloucester Cathedral. The hierarchy was adapted to prioritise saints particular to the chapel and its patron (Saints Edward and Edmund, George and Stephen), including further royal saints in the bottom row (taken from the choir clerestory at Wells Cathedral, and the antechapel at New College, Oxford). The Apostles, sometimes represented in the choir windows of earlier and later college chapels, were represented here in sculpture.[109] We therefore incorporated kings and prophets in the side windows, to represent Old Testament kingship, and the Apostles' precursors. The recorded wall paintings in the eastern bay also represented Old Testament subjects. The figures in the glass are borrowed from the clerestory glazing of Tewkesbury Abbey.[110] As in some other college chapels, it has been imagined that the windows to the west of the liturgical choir followed a different site-specific logic, iconographically; perhaps they responded to the dedication of altars there, or represented other saints, as later at Winchester College.[111] The clerestory windows are largely invisible in the model, so we simply duplicated the canopies and tracery glazing in the side windows.

Sources for the Stalls, Pulpitum, and Liturgical Furniture

Although a pulpitum is mentioned in a fifteenth-century source (see above), suggesting a timber structure and its dimensions, it is not mentioned in the accounts, and no part of the fabric seems to have survived into the eighteenth century. As discussed above, we therefore commissioned Charles Tracy and Hugh Harrison, specialists on medieval timber structures, to create a screen that was

structurally sound, in keeping with recorded dimensions, and consistent with the period. The comments of a medieval observer, regarding an iron *clausura* in the chapel, remain unexplained.[112]

Equally, although the making of the stalls is recorded in the building accounts, their form is not.[113] As a source for our visualisation, we chose a drawing by John Carter of roughly contemporary stalls in the chapel of another royal foundation nearby, of approximately the same date, the hospital of St Katharine by the Tower of London (fig. 25).[114] The position of the adjoining pulpitum determined their overall location. For their arrangement, adapted for use by the college, we were guided by John Harper.[115] The modelling confirmed that a community of this size could be accommodated in the two bays west of the sanctuary bay. In keeping with recorded practice in the previous chapel of St Stephen, we imagined separate seats for the king and queen.[116] We put them close to the altar and the door to the privy palace in the sanctuary bay; other positions are possible. One consequence of our choice of model for the stalls was the concealment of the lower parts of the windows, behind the stall backs. We had to assume, therefore, that these areas were not painted with figure subjects, like the eastern and western bays. For these to be included and visible, we could have chosen stall backs of a lower form, without canopies, such as those in the later fourteenth-century collegiate chapels at Arundel and New College, Oxford.[117]

Figure 25

John Carter, *View from the altar of St Katharine's church, near the Tower*, 1780, pen and ink, on paper, 59 × 48.5 cm. Collection of British Library (Add. MS 36402, f.44r.). Digital image courtesy of British Library Board (all rights reserved).

The polychromy of these timber structures posed a further challenge. Was there any? The comparative contemporary evidence is slight. We agreed that the pulpitum would probably have been painted, like the earlier stone pulpitum in Exeter Cathedral and later rood screens, but there is little evidence for the painting of English medieval choir stalls.[118] There is rich polychrome decoration on the sedilia in Westminster Abbey nearby (about 1307), however, and the bishop's throne at Exeter (1313–1324).[119] In other respects, too, there is no doubt about the lavishness of the painting and gilding in the chapel. We therefore decided to decorate both the pulpitum and stalls. For a colour palette and designs, we looked to the sedilia and to Exeter, to later rood screens, and decorative patterns in the chapel's wall paintings;[120] those on the stall backs derive from the chapel's ubiquitous representation of English royal heraldry, and from paintings of textiles under the wall arcade in the sanctuary. The scheme is inevitably entirely hypothetical.

Sources for the Floor and Steps

The floor of the upper chapel was made of Purbeck marble. The fabric accounts record the purchase of 1,200 pieces for it in 1353–1354.[121] After consulting Christopher Norton, a specialist in medieval pavements, it was decided to lay these slabs in carpets, lozenge-wise to the axis of the chapel, framed by strips of slabs set square (Fig. 26). Purbeck floors of this kind are found, for example, in the ambulatory of Canterbury Cathedral. The floor at St Stephen's was probably laid around the timber frames for the stalls, as elsewhere, once these had been installed.[122] We experimented first with slabs of two-feet square, but the number employed was too few. Our model uses about 1,400 slabs of one-foot square. Minor adjustments to the timber-framed structures, for example, would easily reduce this number, so that this is a feasible match for the figure of 1,200 pieces purchased.

There is no evidence in the longitudinal sections of the upper chapel by Carter or Mackenzie for the presence of steps, across its width.[123] It is possible that the evidence had been lost, or that they both missed it, but the height of the continuous wall bench in these sources would make more than one step unlikely. Liturgically, the absence of any steps would be unusual, however, especially the sanctuary step.[124] We therefore added a single step, to the west of the eastern bay. This well-recorded bay is shown to have had the same floor level along both side walls. Around the high altar, Mackenzie represented a pedestal of steps. There is no known evidence for these, but altar steps were usual in liturgical practice, so we followed him; the height of the wall bench appeared to limit the number to two, although one might expect three, for the priest, deacon, and subdeacon, celebrating mass.

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Tim Ayers is Professor of the History of Art at the University of York. His research interests include high and late medieval English art and architecture, monumental art and its relationship to architecture (especially stained glass), the international trade in window glass, word and image relations in monumental contexts, art and architecture and the medieval university. Recent publications include *The Medieval Stained Glass of Merton College, Oxford* (2013) and a critical edition of the *Fabric Accounts of St Stephen's Chapel, Westminster* (2020).

Footnotes

1. Mireille Galinou, "Adam Lee's Drawings of St Stephen's Chapel, Westminster. Antiquarianism and Showmanship in early 19th-century London", *Transactions of the London & Middlesex Archaeological Society* 34 (1983): 231–244.
2. Galinou, "Adam Lee's Drawings of St Stephen's Chapel, Westminster", 235–236.
3. Rosemary Hill, "'Proceeding like Guy Faux': The Antiquarian Investigation of St Stephen's Chapel Westminster, 1790–1837", *Architectural History* 59 (2016): 253–279. For antiquaries and images, see Stephanie Moser, "Making Expert Knowledge through the Image: Connections between Antiquarian and Early Modern Scientific Illustration", *Isis* 105, no. 1 (March 2014): 58–99; Martin Myrone, "The Society of Antiquaries and the Graphic Arts: George Vertue and his Legacy", in Susan Pearce (ed.), *Visions of Antiquity: The Society of Antiquaries of London 1707–2007* (London: Society of Antiquaries of London, 2007), 99–122; Sam Smiles, *The Image of Antiquity: Ancient Britain and the Romantic Imagination* (New Haven, CT: Yale University Press, 1994).
4. Galinou, "Adam Lee's Drawings of St Stephen's Chapel, Westminster", 241.
5. See https://www.virtualststephens.org.uk (accessed 9 February 2018).

6. See Anthony Masinton and James Jago, "Mapping the Unknown: Using Incomplete Evidence to Craft Digital Three-Dimensional Models of St Stephen's", *British Art Studies* 16 (2020), 10.17658/issn.2058-5462/issue-16/amasinton.
7. Tim Ayers (ed.) and Maureen Jurkowski (transcriber and translator), *The Fabric Accounts of St Stephen's Chapel, Westminster, 1292–1396* (Woodbridge: Boydell, 2020).
8. Caroline Bruzelius, "Digital Technologies and New Evidence in Architectural History", *Journal of the Society of Architectural Historians* 76, no. 4 (Dec. 2017): 436–439; and Elaine Sullivan, Angel David Nieves, and Lisa M. Snyder, "Making the Model: Scholarship and Rhetoric in 3-D Historical Reconstructions", in Jentery Sayers (ed.), *Making Things and Drawing Boundaries: Experiments in the Digital Humanities* (Minneapolis, MN: University of Minnesota Press, 2017), 301–317.
9. James Hillson, "Edward III and the Art of Authority: Military Triumph and the Decoration of St Stephen's Chapel, Westminster, 1330–1364", in Kate Buchanan and Lucinda H.S. Dean, with Michael Penman (eds), *Medieval and Early Modern Representations of Authority in Scotland and the British Isles* (Abingdon: Routledge, 2016), 105–123.
10. Drew Baker, "Defining Paradata in Heritage Visualization", in Anna Bentkowska-Kafel, Hugh Denard, Drew Baker (eds), *Paradata and Transparency in Virtual Heritage* (Farnham: Ashgate, 2012), 163–164.
11. Sorin Hermon, "Scientific Method, *chaîne opératoire* and Visualization: 3D Modelling as a Research Tool in Archaeology", in Anna Bentkowska-Kafel, Hugh Denard, Drew Baker (eds), *Paradata and Transparency in Virtual Heritage* (Farnham: Ashgate, 2012), 14.
12. See http://www.londoncharter.org (accessed 9 February 2018). For a commentary, see Hugh Denard, "A New Introduction to the London Charter", in Anna Bentkowska-Kafel, Hugh Denard, Drew Baker (eds),

Paradata and Transparency in Virtual Heritage (Farnham: Ashgate, 2012), 57–71.

13. For the implementation of the charter, see Anna Bentkowska-Kafel, Hugh Denard, Drew Baker (eds), *Paradata and Transparency in Virtual Heritage* (Farnham: Ashgate, 2012). For paradata, see Baker, "Defining Paradata in Heritage Visualization", 163–175.
14. For an art-historical case study, see Lisa M. Snyder, "Research, Process, Publication, and Pedagogy: Reconstructing the World's Columbian Exposition of 1893", in Kathryn Baker (ed.), *The Routledge Companion to Digital Humanities and Art History* (London: Routledge, 2020), 459–478. For methodology and paradata in archaeological modelling, see Hermon, "Scientific Method, *chaîne opératoire* and Visualization," 13–22.
15. For the skills and visual competency required for archaeological visualisations, see Simon James, "Visual Competence in Archaeology: A Problem Hiding in Plain Sight", *Antiquity* 89, no. 347 (October 2015): 1189–1202, at: DOI:10.15184/aqy.2015.60 (accessed 9 February 2018).
16. See http://www.christianityandculture.org.uk, with Anthony Masinton, virtual modeller; Patrick Gibbs, web design; Louise Hampson, project manager. The project meetings were chaired by the present author, and the minutes are available on the project website, at: http://www.virtualststephens.org.uk (accessed 18 June 2020).
17. See http://www.virtualststephens.org.uk (accessed 18 June 2020).
18. For different audiences and purposes, see Franco Niccolucci, "Setting Standards for 3D Visualization of Cultural Heritage in Europe and Beyond", in Anna Bentkowska-Kafel, Hugh Denard, Drew Baker (eds), *Paradata and Transparency in Virtual Heritage* (Farnham: Ashgate, 2012), 23–36.
19. Sullivan, Nieves, and Snyder, "Making the Model", 302.
20. Frederick Mackenzie, *The Architectural Antiquities of the Collegiate Chapel of St. Stephen, Westminster, The Late House of Commons: Drawn from actual survey and admeasurements made by direction of the commissioners*

of her majesty's woods and works, &c. accompanied by observations on the original and perfect state of the building, and a description of the plates (London: John Weale, 1844), ix. For Wren's recommendation, see *Designs by Sir Chr. Wren for Westminster Abbey, The New Dormitory Westminster School, Works at Westminster Palace for the Houses of Parliament, and the House, Library and Garden of Sir John Cotton; also for Sir John Moore's School at Christ's Hospital, Newgate Street, and for his School at Appleby in Leicestershire*, Wren Society XI (1934): 47 (report 18 January 1692).

21. Mackenzie, *The Architectural Antiquities of the Collegiate Chapel of St. Stephen*, vii–viii.

22. Maurice Hastings, *St Stephen's Chapel and its Place in the Development of Perpendicular Style in England* (Cambridge: Cambridge University Press, 1955), 37.

23. Ayers and Jurkowski, *The Fabric Accounts of St Stephen's Chapel, Westminster, 1292–1396*, nos 37, m.1 (*vosura*); 38, m.2 (week beginning 15 October 1347, bosses). R. Allen Brown, Howard M. Colvin, and Arnold J. Taylor, *The History of the King's Works*, Vols I and II, *The Middle Ages* (London: HMSO, 1963), Vol. I, 517.

24. Robert Willis and John Willis Clark, *The Architectural History of the University of Cambridge, and of the Colleges of Cambridge and Eton*, Vol. 1 (Cambridge: Cambridge University Press, 1988 [1886]), 367: "Item that the walles of the seid Qwere and Churche schull conteyne in hegtht from the grownde werke unto the Crest of the batilments of the same . iiij^{xx} . fote of assise [.…] And so the seide Qwere schall be [.…] also heyer than the walles of seynt Stephenes Chapell at Westmonstre."

25. John Goodall, "St Stephen's Chapel, Westminster", in Warwick Rodwell and Tim Tatton-Brown (eds), *Westminster, The Art, Architecture and Archaeology of the Royal Abbey and Palace*, British Archaeological Association Conference Transactions, 39 (for 2013), 2 parts (2015), Part II, 113.

26. Goodall, "St Stephen's Chapel, Westminster", Fig. 1 by Stephen Conlin.
27. A drawing in the V&A, showing the privy palace and Westminster Abbey, is the companion to a drawing showing Westminster Hall, in the Musée du Louvre, Paris. For the date, see Ann Saunders, "Westminster Hall: A Sixteenth Century Drawing?", *London Survey'd: Essays in Honour of F.H.W. Sheppard*, *The London Journal* 12, no. 1 (1986): 29–35.
28. Frontispiece by Robert White to John Nalson, *An Impartial Collection of the Great Affairs of State*, Vol. II (London: A. Mearne, T. Dring, B. Tooke, T. Sawbridge, and C. Mearne, 1683).
29. These were discussed in two workshops, attended by the project team, Stuart Harrison, Christopher Norton, Norbert Nussbaum, and Lisa Reilly. Christopher Norton's comparisons with York Minster were determining factors for the resulting model (see below).
30. In this, see also Goodall, "St Stephen's Chapel, Westminster", 113, fig. 1.
31. Sarah Brown, *"Our Magnificent Fabrick": York Minster, An Architectural History, c1220–1500* (Swindon: English Heritage, 2003), 156–157.
32. See the Appendix.
33. Ayers and Jurkowski, *The Fabric Accounts of St Stephen's Chapel, Westminster, 1292–1396*; and Brown, Colvin, and Taylor, *The History of the King's Works*, Vol. I, 517–522.
34. The minutes of our workshops are available on the website, at: http://www.virtualststephens.org.uk (accessed 18 June 2020).
35. Aymer Vallance, *Greater English Church Screens: Being Great Roods, Screenwork & Rood Lofts in Cathedral, Monastic & Collegiate Churches in England & Wales* (London: Batsford, 1947), Chapter 6, "Some Collegiate Churches".
36. Hastings, *St Stephen's Chapel*, 106; and Goodall, "St Stephen's Chapel, Westminster", 118.

37. For the transformation of palace chapel into collegiate chapel, see John Harper, "St Stephen's Chapel, Westminster: The Transition from a King's to a Collegiate Chapel", in John Cooper, Caroline Shenton and Tim Ayers (eds), *St Stephen's Chapel and the Palace of Westminster*, forthcoming.

38. Willis and Clark, *The Architectural History of the University of Cambridge*, Vol. 1, 354: "Item, in the saide Quere oon either side xxxii stalles and the rode loft there, I wol that they be made in the like maner and fourme as be the stalles and rodeloft in the chapell of saint Stephen atte Westminster, and of the lengthe of . xxxii . fete and in brede clere . xii . fete of assise."

39. We took this to refer to the total depth, at gallery height. The later "avyse", the third design, specifies a depth of 6ft from the provost's seat, to the choir door, see Willis and Clark, *The Architectural History of the University of Cambridge*, Vol. 1, 366. In our model, the choir door is set directly to the west of the steps up to the loft; enclosed chapels lie beyond, further west.

40. Vallance, *Greater English Church Screens*, Chapter 6; and Charles Tracy, *English Gothic Choir-Stalls, 1200–1400* (Woodbridge: Boydell, 1987), Chapters 9–10. For Exeter, see Veronica Sekules, "The Liturgical Furnishings of the Choir of Exeter Cathedral", in Francis Kelly (ed.), *Medieval Art and Architecture at Exeter Cathedral*, British Archaeological Association Conference Transactions, XI (for 1985) (1991), 172–179. We also considered and rejected as evidence a pen-and-ink drawing in the British Library (BL), inscribed in pencil, "?Restoration of Screen in St. Stephen's Chapel, Westminster", attributed to Georg Scharf: BL, Add. MS 36489 A, no. 65. Although some detailing could be of the period, in structure the screen appears to be a fantasy. Anthony Masinton made a photogrammetric survey of the back of the St Albans watching loft.

41. The music historian and liturgist John Harper advised on liturgical uses. For the liturgy of St Stephen's College, see Harper, "St Stephen's Chapel, Westminster".

42. For the floor levels, see the Appendix.

43. We found that the floor could be set at approximately the height of the committee room above the later lobby of the House of Commons, see Edward Wedlake Brayley and John Britton, *The History of the Ancient Palace and Late Houses of Parliament at Westminster: Embracing Accounts and Illustrations of St. Stephen's Chapel, and its Cloisters, Westminster Hall, The Court of Requests, the Painted Chamber, &c. &c.* (London: John Weale, 1836), pl. XXV.
44. We are grateful to Dr Lucy Wrapson for her help.
45. For the value of imagination, see Richard C. Beacham, "Defining our Terms in Heritage Visualization", in Anna Bentkowska-Kafel, Hugh Denard, Drew Baker (eds), *Paradata and Transparency in Virtual Heritage* (Farnham: Ashgate, 2012), 11.
46. John Thomas Smith, *Antiquities of Westminster: The Old Palace; St. Stephen's Chapel, (Now the House of Commons) &c. &c., Containing Two Hundred and Forty-Six Engravings of Topographical Objects, of which One Hundred and Twenty-Two no Longer Remain* (London: Thomas Bensley, 1807), 152–154, and 155–164. John Topham, *Some Account of the Collegiate Chapel of St Stephen, Westminster*; *Plans, Elevations, Sections, and Specimens of the Architecture and Ornaments, of the Remaining Parts of Saint Stephen's Chapel, Westminster* (London: Society of Antiquaries, 1795); and *Additional Plates*, text by Sir H.C. Englefield (London: Society of Antiquaries, 1811), 8–9, and 12–22. Mackenzie, *The Architectural Antiquities of the Collegiate Chapel of St. Stephen*, 28–29.
47. Mackenzie, *The Architectural Antiquities of the Collegiate Chapel of St. Stephen*, 29.
48. See the essay in this edition of the journal by Helen Howard, Lloyd de Beer, David Saunders, and Catherine Higgitt, "The Wall Paintings at St Stephen's Chapel, Westminster Palace: Recent Imaging and Scientific Analysis of the Fragments in the British Museum", *British Art Studies* 16 (2020), DOI:10.17658/issn.2058-5462/issue-16/oneobject.

49. The relevant entries are in: Ayers and Jurkowski, *The Fabric Accounts of St Stephen's Chapel, Westminster, 1292–1396*, no. 40. They are calendared in Louis Francis Salzman, "The Glazing of St. Stephen's Chapel, Westminster", *Journal of the British Society of Master Glass-Painters* i, no. 4 (1926): 14–16; i, no. 5 (1926): 31–35; ii, no. 1 (1927): 38–41.
50. Smith, *Antiquities of Westminster*, 232–234, plates between pages 232–233.
51. Hillson, "Edward III and the Art of Authority", 105–123. For borders, see Tim Ayers, *The Medieval Stained Glass of Wells Cathedral*, Corpus Vitrearum Medii Aevi, Great Britain, IV, 2 vols (Oxford: Oxford University Press, 2004), Vol. I, 15–16.
52. Richard Marks, *Stained Glass in England during the Middle Ages* (London: Routledge, 1993), 147–148.
53. See the Appendix.
54. For sources, see the Appendix.
55. Christopher Wilson, *The Gothic Cathedral*, *The Architecture of the Great Church, 1130–1530* (London: Thames & Hudson, 1990), 194.
56. For the cornices, see Smith, *Antiquities of Westminster*, 235–242; and Topham, *Some Account of the Collegiate Chapel of St Stephen*, 9, pls XII–XIII. For the window heads, see the Appendix.
57. Paul Binski, *Westminster Abbey and the Plantagenets: Kingship and the Representation of Power, 1200–1400* (New Haven, CT: Yale University Press, 1995), 183.
58. For the architecture, see Wilson, *Gothic Cathedral*, 207–208. For the glass, see Jill Kerr, "The East Window of Gloucester Cathedral", *Medieval Art and Architecture at Gloucester and Tewkesbury*, British Archaeological Association Conference Transactions, VII for 1981, (1985): 116–129.
59. Topham, *Some Account of the Collegiate Chapel of St Stephen*. For the finished drawings, see London, Society of Antiquaries (SAL), 236/E, SSC 2–13, 15. Preliminary drawings: BL, Add. MS 29930, f.99r to f.132r; Add. MS 29943, f.67r to f.71v.

60. Brayley and Britton, *The History of the Ancient Palace and Late Houses of Parliament*; and Mackenzie, *The Architectural Antiquities of the Collegiate Chapel of St. Stephen*. For Mackenzie's drawings, see TNA, Work 29/763, 766.

61. The sources for these include, in London: British Library, British Museum (BM), Museum of London, and the Society of Antiquaries; in Westminster: City Archive, and Parliamentary Art Collection. For others: Howard Colvin, "Views of the Old Palace of Westminster", *Architectural History* 9 (1966): 40–43, Figs 85–100.

62. We are grateful to the Houses of Parliament for making high-resolution colour images of items at the Society of Antiquaries.

63. On Carter's accuracy, see Sir Henry Englefield, in Topham, *Some Account of the Collegiate Chapel of St Stephen*, 11. On his work, see Hill, "'Proceeding like Guy Faux'", 253–279; and J. Mordaunt Crook, *John Carter and the Mind of the Gothic Revival*, occasional paper 17 (London: Society of Antiquaries, 1995), 36–37.

64. Topham, *Some Account of the Collegiate Chapel of St Stephen*, pl. XV; and SAL, 236/E, SSC 15.

65. Ayers and Jurkowski, *The Fabric Accounts of St Stephen's Chapel, Westminster, 1292–1396*, no. 18, m. 1, week beginning 21 November 1324 (first reference).

66. Mackenzie, *The Architectural Antiquities of the Collegiate Chapel of St. Stephen*, 24.

67. Mackenzie, *The Architectural Antiquities of the Collegiate Chapel of St. Stephen*, 10.

68. For example, Hastings, *St Stephen's Chapel*, 94–99.

69. BM, 1814,0312.2. See Helen Howard, Lloyd de Beer, David Saunders, and Catherine Higgitt, "The Wall Paintings at St Stephen's Chapel, Westminster Palace: Recent Imaging and Scientific Analysis of the Fragments in the

British Museum", *British Art Studies* 16 (2020), DOI:10.17658/issn.2058-5462/issue-16/oneobject.

70. Ayers and Jurkowski, *The Fabric Accounts*, no. 18, m.12, week beginning 1 April 1325.
71. Smith, *Antiquities of Westminster*, pl. opp. p. 153; and Topham, *Some Account of the Collegiate Chapel of St Stephen*, pl. VI.
72. The fullest account is Mackenzie, *The Architectural Antiquities of the Collegiate Chapel of St. Stephen*, 19. There is a drawing of its state after the fire by Georg Scharf: BM, 1862,0614.660 (west wall, from east).
73. Mackenzie, *The Architectural Antiquities of the Collegiate Chapel of St. Stephen*, 24.
74. Mackenzie, *The Architectural Antiquities of the Collegiate Chapel of St. Stephen*, vii–ix; and Brown, Colvin, and Taylor, *The History of the King's Works*, Vol. 1, 523.
75. The shafts in the angles of the chapel were not modelled fully.
76. Ayers and Jurkowski, *The Fabric Accounts of St Stephen's Chapel, Westminster, 1292–1396*, nos 18, m.11, week beginning 11 March 1325 (Hurley's arrival); 21, rot.41d, m.1d (roof, in store); 37, m.1 (roof, installation).
77. SAL, 236E, SSC 2.
78. Ayers and Jurkowski, *The Fabric Accounts of St Stephen's Chapel, Westminster, 1292–1396*, no. 21, rot.41d, m.1d. There is no room for such a roof in the reconstruction drawing by Stephen Conlin, see Goodall, "St Stephen's Chapel, Westminster", Fig. 1.
79. Smith, *Antiquities of Westminster*, 152–154 and 155–164; Topham, *Some Account of the Collegiate Chapel of St Stephen*, 8–9 and 12–22; and Mackenzie, *The Architectural Antiquities of the Collegiate Chapel of St. Stephen*, 28–29.

80. The fullest source is Ayers and Jurkowski, *The Fabric Accounts of St Stephen's Chapel, Westminster, 1292–1396*, no. 40, for June 1351 to 25 August 1352. Later rolls reveal that painting continued into the early 1360s.

81. BM, 1814,0312.2. For these, see Ernest William Tristram, *English Wall Painting of the Fourteenth Century* (London: Routledge & Kegan Paul, 1955), 48–58 and 206–219; Binski, *Westminster Abbey and the Plantagenets*, 183–185; Jane Spooner, "The Iconography of the St Stephen's Chapel Painting Fragments", in John Cooper, Caroline Shenton and Tim Ayers (eds), *St Stephen's Chapel and the Palace of Westminster*, forthcoming. We inspected them with curators, wall-painting scholars, and paint specialists.

82. See the essay on the paintings, "St Stephen's Chapel, Westminster Palace", by Howard *et al*.. A new photographic record has been made by the museum, at a high resolution.

83. Topham, *Some Account of the Collegiate Chapel of St Stephen*, pls XVI–XXVIII. Drawings: SAL, 236E, SSC 16–28. For the present project, the Houses of Parliament kindly had these photographed in colour.

84. Smith, *Antiquities of Westminster*, 153–154, 163, pl. opp. p. 153; Sir Henry Englefield, in Topham, *Some Account of the Collegiate Chapel of St Stephen*, 17; repeated in Tristram, *English Wall Painting of the Fourteenth Century*, 49. A more plausible figure was suggested by John Cherry and Neil Stratford, *Westminster Kings and the Medieval Palace of Westminster*, British Museum, Occasional Paper 115 (London: British Museum Press, 1995), 36.

85. Smith, *Antiquities of Westminster*, 153–154; and Topham, *Some Account of the Collegiate Chapel of St Stephen*, 17.

86. Topham, *Some Account of the Collegiate Chapel of St Stephen*, 16–17, pl. XVIII; and Smith, *Antiquities of Westminster*, 153 and 163. For Smirke's drawings, see SAL, 236E, SSC 18.1–2.

87. Palace of Westminster Collection, WOA 2918, 2919.

88. Smith, *Antiquities of Westminster*, 160 and 163; and Topham, *Some Account of the Collegiate Chapel of St Stephen*, 22, pl. XXVIII.

89. Mackenzie, *The Architectural Antiquities of the Collegiate Chapel of St. Stephen*, 28, pl. 14.

90. SAL, 236E, SSC 10–13; and Mackenzie, *The Architectural Antiquities of the Collegiate Chapel of St. Stephen*, 28–29, pl. XIV.

91. BM, 1814,0312.2. The most important documentary source was Ayers and Jurkowski, *The Fabric Accounts of St Stephen's Chapel, Westminster, 1292–1396*, no. 40. We are grateful to Dr Jane Spooner and Lloyd de Beer for their help. For a further discussion of the choices of colour, see Masinton and Jago, "Mapping the Unknown".

92. G. Moore records the arrangement of alternating arms in both locations, 1834: Palace of Westminster Collection, WOA 260, 1281.

93. The most important are Ayers and Jurkowski, *The Fabric Accounts of St Stephen's Chapel, Westminster, 1292–1396*, nos 40, esp. m.27d; 45, m.1 (week beginning 10 August 1355); 46, mm.5 (week beginning 2 February 1356), 8 (week beginning 11 April 1356).

94. Richard Marks, *Image and Devotion in Late Medieval England* (Stroud: Sutton, 2004), 73–75.

95. *Age of Chivalry*, *Art in Plantagenet England*, *1200–1400*, exhibition catalogue (London: Royal Academy of Arts, 1987), cat. no. 699. It is in the Nottingham Castle Museum. We are grateful to Revd Gordon Plumb for photographing it.

96. University of Minnesota Library, Z 942.062 (diary of Sir Thomas Peyton), f.121; and Ayers and Jurkowski, *The Fabric Accounts*, no. 40, m.20 (week beginning 21 May 1352).

97. We are grateful to Prof. Norbert Nussbaum and his students for making the survey. The sculptures that they photographed are twentieth-century copies of medieval originals, which are now in the museum.

98. There is a summary in Brown, Colvin, and Taylor, *The History of the King's Works*, Vol. I, 521.

99. Ayers and Jurkowski, *The Fabric Accounts of St Stephen's Chapel, Westminster, 1292–1396*, no. 47, m.5. They cost eight shillings each.

100. For thirteen sculptures of kings, ordered by Richard II for Westminster Hall in 1385, and their identification, see Phillip Lindley, "Absolutism and Regal Image in Ricardian Sculpture", in Dillian Gordon, Lisa Monnas, and Caroline Elam (eds), *The Regal Image of Richard II and the Wilton Diptych* (London: Harvey Miller, 1997), 74–75.

101. Laura Slater, "Visual Reflections on History and Kingship in the Medieval English Great Church", *Journal of the British Archaeological Association* 167 (2014): 83–108.

102. Cherry and Stratford, *Westminster Kings and the Medieval Palace of Westminster*, esp. 61–91; and Lindley, "Absolutism and Regal Image in Ricardian Sculpture", 74–83. We are grateful to the Houses of Parliament for commissioning a new photogrammetric survey.

103. Ayers and Jurkowski, *The Fabric Accounts of St Stephen's Chapel, Westminster, 1292–1396*, no. 46, mm.1 (week beginning 20 October 1355: gold leaf, "prentes"), 3 (week beginning 23 November 1355: "doublettes", or false jewels).

104. BM, inv. no. 1874,0314.187 (*c*.1834).

105. See Masinton and Jago, "Mapping the Unknown".

106. Smith, *Antiquities of Westminster*, plates between pages 232–233.

107. Marks, *Stained Glass in England during the Middle Ages*, 159 and 161.

108. Marks, *Stained Glass in England during the Middle Ages*, 169. For Heydour (Lincolnshire): Penny Hebgin-Barnes, *The Medieval Stained Glass of the County of Lincolnshire*, Corpus Vitrearum Great Britain, Summary Catalogue 3 (Oxford: Oxford University Press, 1996), 121 and 125–127.

109. Tim Ayers, *The Medieval Stained Glass of Merton College, Oxford*, Corpus Vitrearum Medii Aevi, Great Britain, VI (Oxford: Oxford University Press, 2013), Vol. 1, no. 89, 44–49.

110. Sarah Brown, "The Medieval Stained Glass", in Richard K. Morris and Ron Shoesmith (eds), *Tewkesbury Abbey: History, Art and Architecture* (Almeley: Logaston Press, 2003), 183–196.

111. John D. Le Couteur, *Ancient Glass in Winchester* (Winchester: Warren, 1920), 84–98.

112. Oxford, Bodleian Library, MS Rawlinson D 1066, f.26v; and Brown, Colvin, and Taylor, *The History of the King's Works*, Vol. 1, 520–521.

113. For the final set of stalls, see Ayers and Jurkowski, *The Fabric Accounts of St Stephen's Chapel, Westminster, 1292–1396*, nos 46, 47, and 53.

114. BL, Add. MS 36402, f.44r. and Tracy, *English Gothic Choir-Stalls*, Ch. 9, esp. 53 and 55.

115. See Harper, "St Stephen's Chapel, Westminster". Liturgical arrangements were discussed in a workshop attended by the project team, John Harper and Charles Tracy.

116. See Harper, "St Stephen's Chapel, Westminster".

117. Tracy, *English Gothic Choir-Stalls*, Ch. 10, esp. 58–59, pls 187–188. For a visualisation of such stalls, see Goodall, "St Stephen's Chapel, Westminster", Fig. 2. Given the high expenditure on paintings in 1351–1352, it is possible that those beneath the windows had been completed before the second design for the stalls was undertaken (from 1355).

118. Tracy, *English Gothic Choir-Stalls*, 3–4, 35–37, and 44.

119. Lucy Wrapson, "The Materials and Techniques of the *c*.1307 Westminster Abbey Sedilia", in Jilleen Nadolny *et al*. (eds), *Medieval Painting in Northern Europe: Technique, Analysis, Art History. Studies in Commemoration of the 70th Birthday of Unn Plahter* (London: Archetype, 2006), 114–136; Eddie Sinclair, "The Medieval Polychromy Scheme of the Exeter Cathedral Bishop's Throne: A Summary", in Charles Tracy, with

Andrew Budge (eds), *Britain's Medieval Episcopal Thrones: History, Archaeology and Conservation* (Oxford: Oxbow, 2015), 165–170. For later screens, see Lucy Wrapson and Eddie Sinclair, "The Polychromy of Devon Screens: Preliminary Analytical Results", in Spike Bucklow, Richard Marks, and Lucy Wrapson (eds), *The Art and Science of the Church Screen in Medieval Europe: Making, Meaning, Preserving* (Woodbridge: Boydell, 2017), 150–175.

120. We are grateful to Dr Lucy Wrapson for her advice.
121. Ayers and Jurkowski, *The Fabric Accounts of St Stephen's Chapel, Westminster, 1292–1396*, no. 42, m.2.
122. It was laid in 1355–1356, see Ayers and Jurkowski, *The Fabric Accounts of St Stephen's Chapel, Westminster, 1292–1396*, no. 46, m.1d. Work on the stalls was begun again in the same roll.
123. Topham, *Some Account of the Collegiate Chapel of St Stephen*, pl. VII; and Mackenzie, *The Architectural Antiquities of the Collegiate Chapel of St. Stephen*, pls 6–7. Both agree that there were steps up to the entrance.
124. We are grateful to John Harper for his advice.

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