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Record of Emergency Consolidation and Protection Procedures,

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Our Town Hall Project
Mural Conservation & Restoration

Phase 1: Emergency Consolidation & Protection works

Pre-works Condition Survey &
Record of Emergency Consolidation and Protection Procedures,
Manchester Town Hall Murals by Ford Madox Brown

February 2020

Hirst Conservation
Manchester Town Hall
November- December 2019

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Project Summary

Scope:	Section 1: An updated condition survey of twelve murals painted by Ford Madox Brown prior to the essential Phase 1 Emergency Consolidation Works, and an extended programme of refurbishment at the Town Hall. The murals are located in the Great Hall of Manchester Town Hall. Section 2: A record of the testing rationale, and final methods and materials used during the Phase 1 Emergency Consolidation Works for the stabilisation and protection of the murals prior to the Town Hall refurbishment.
List Entry Number:	1207469.
Listing:	Grade 1.
Date First Listed:	25th February 1952.
Name & Address of Client:	Conlon Construction Limited, Chamley Fold Lane, Bamber Bridge, Preston, PR5 6BE.
Name & Address of Architect:	Helen Walker, Purcell, St James', 79 Oxford Street, Manchester, M1 6FQ.
Name of Conservators:	Alison Aynesworth ACR, and Sabina van de Bruck ACR.
Address of Conservators:	Hirst Conservation Ltd., Laughton, Sleaford, Lincolnshire, NG34 OHE.
Date of Survey:	November-December 2019.
Author of Conservation report:	Alison Aynesworth ACR, Hirst Conservation
Date of Conservation report:	January 2020.
Methods employed:	Section 1: *Condition survey:* Inspection of the paintings in visible, raking and ultraviolet light; tactile survey of plaster substrate; moisture survey to painting number 11; digital photography; documentation of new observations in written and diagrammatic format using previous surveys as a datum line for comparison. Section 2: *Phase 1 Emergency Consolidation Works:* Dry clean to remove loose surface dirt; swab removal of food deposits; consolidation of loose and flaking paint; consolidation of delaminated canvas edges; application of supporting tissue facing strips to areas of cracked plaster; Application of protective strip to painting 11; application of a protective tissue facing to all of the paintings.

Contents Page

Project summary 3

Contents 4

1. Introduction 5

2. Brief description of the Manchester murals 6

3. Updated Condition Survey 7
- 3.1 Methodology 7
  - 3.1.1 Photographic and diagrammatic recording 7
  - 3.1.2 Macroscopic Inspection 8
  - 3.1.3 Environmental and moisture survey to Painting 11 8
  - 3.1.4 Documentation 8
- 3.2 Condition overview 9
  - 3.2.1 Food and drink deposits 9
  - 3.2.2 Active flaking 9
  - 3.2.3 Paint losses with vulnerable edges 9
  - 3.2 4 Impact damage 10
  - 3.2.5 Detached canvas 10
  - 3.2.6 Salt activity and damage painting 11 10
- 3.3 Further notes and observations 10
  - 3.3.1 Brown spots, Painting 2 10
  - 3.3.2 Uneven gloss over surface of paintings 11
  - 3.3.3 Dark edges to the paintings 12

4. Diagrams showing previously undocumented defects on the paintings 13

5. Phase 1 Testing and Treatment Record 26
- 5.1 Pre-treatment tests 26
- 5.2 Stabilisation of plaster substrate 27
- 5.3 Removal of loose surface dirt 27
- 5.4 Consolidation of loose and flaking paint: 27
- 5.5 Treatment of delaminated sections of canvas along the edges of the paintings: 28
- 5.6 Treatment of section of delaminated canvas on the Painting 11 29
- 5.7 Treatment of flat air pockets 30
- 5.8 Application of facing paper 30
- 5.9 Environmental monitoring of paintings during works 31

Appendix A: Selected photographs 32

1. Introduction

Hirst Conservation was commissioned by Lendlease to undertake Phase 1 Emergency Consolidation Works to twelve nineteenth century murals, by Ford Madox Brown, located in the Great Hall of Manchester Town Hall.

Section 2 - 4 presents an updated condition survey made by Hirst Conservation prior to the Phase 1 Emergency Consolidation Works. This was initially submitted as an interim report (Hirst Conservation, 2019). The aim of the condition survey was to assess any further deterioration that may have occurred in the paintings since the last Condition Survey made by Hirst Conservation in February 2019, and to provide a record of the condition of the paintings prior to them being protected for the duration of the Town Hall Refurbishment (expected completion date 2024).

Section 5 details the testing rationale, methods and materials used in the Phase 1 Emergency Consolidation Works for the stabilisation and protection of the paintings for the duration of the Town Hall refurbishment.

The updated Condition Survey and Phase 1 Emergency Consolidation Works were undertaken by Alison Aynesworth ACR and Sabina van de Bruck ACR of Hirst Conservation between November and December 2019.The paintings were accessed from ground level and a mobile tower scaffold.

2. Brief description of the Manchester Murals

Object:	Murals
Location:	North and south walls of the Great Hall, Manchester Town Hall
Designer of the building:	Alfred Waterhouse (1830-1905). Completed 1877.
Artist and Date:	Ford Madox Brown (1821-1893).Commissioned 1877, painted 1879-1893.
General description:	Twelve paintings depicting historical events or figures important to the history of Manchester, executed in late Pre-Raphaelite style with titles gilded on the stone lintel above each composition.
Dimensions:	North wall: 1.46 (h) x 3.17m (w) each South wall: 1.46 (h) x 3.18 (w)
Materials:	Lime plaster support; top coat containing marble dust (murals 1-5) or river sand (murals 6 and 7) Marouflaged canvas support (paintings 8-12) Spirit fresco: Gambier Parry's commercial preparation composed of elemi resin, pure white wax, copal varnish and oil of spike lavender in turpentine. Later restoration layers.

3. Updated Condition Survey

This updated Condition Survey carried out in November 2019 ((Hirst Conservation, 2019) is based upon two previous surveys:

- *1.024 Record of Condition and Recommendations for Manchester Town Hall Murals* by Ford Madox Brown', Hirst Conservation, (unpublished report, February 2019).
- *Conservation Report for the Manchester Town Hall Murals by Ford Madox Brown*, David Everingham Conservation Ltd., (unpublished report, 2015).

These two surveys were used as a datum line by which to assess any further deterioration that may have occurred to the paintings since February 2019, and to provide a record of their condition prior to direct protection measures being implemented during the refurbishment works at the Town Hall. Previously undocumented incidents of flaking paint, paint losses, physical impacts, food deposits, and canvas delaminations on the paintings were noted and logged. Amended diagrams showing newly observed defects are included in Section 4.

For detailed information relating to the history of the murals and all previous documented conservation and restoration interventions, please refer to Hirst Conservation's '*1.024 Record of Condition and Recommendations for Manchester Town Hall Murals by Ford Maddox Brown',* February 2019. This document also contains a recent interpretation of the site, a detailed written and illustrated Condition Survey, and a discussion of materials analysis. The information contained in Hirst Conservation's February 2019 report will not be replicated here; new observations only will be included, and discussed in the light of previous research and required treatments for the stabilisation of the paintings.

3.1 Methodology:

The aims of the survey were identified as follows:

- To record any previously undocumented areas of deterioration that may have occurred since February 2019, or previously been undocumented, prior to the application of direct protection measures.
- To provide a record of the condition of the paintings prior to the refurbishment works to the Town Hall, to facilitate a comparison survey following removal of the protection circa 2024.
- To compare the present condition of the wall paintings with the earlier records to gain a better understanding of any ongoing problems and deterioration.
- To assess the impact of further potential moisture movement and salt migration on Painting 11 ('Opening of the Bridgewater Canal') prior to the application of direct protection measures and programme of refurbishment.

3.1.1 Photographic and diagrammatic recording

A detailed photographic record was made of the paintings before, during and after Phase 1 Emergency Consolidation Works. These images will facilitate an overall understanding of the condition of the paintings and allow a comparison of their condition in the future and their condition in the past. Diagrams were produced utilising the earlier logging system (adopted by David Everingham Ltd in 2015 and Hirst Conservation in February 2019) to facilitate comparison.

3.1.2 Macroscopic inspection

Visual assessment of the paintings was carried out to allow the identification of any previously unidentified areas of failure, and to guide further treatment recommendations. The assessment utilised reflected, raking and ultraviolet light sources. A select number of images are included in this document to highlight particular areas of deterioration. All of the photographs taken during the survey are provided with this document in digital format.

3.1.3 Environmental and moisture survey to Painting 11 ('Opening of the Bridgewater Canal').

Environmental conditions, moisture movement and salt migration/crystallisation cycles can have a severe impact on the condition of the historic fabric. Painting 11 has already been affected by salt activity resulting from an incident of direct water ingress into the adjacent building fabric. An updated survey of the moisture content in the painting's substrate was therefore undertaken to help determine the most appropriate conservation strategy for its treatment during Phase 1 Emergency Consolidation Works.

Non-invasive readings with a Protimeter in capacitance mode were taken in a systematic, grid-like fashion across Painting 11.

Environmental readings were taken with an electronic Protimeter in a hygrometer mode inside the Great Hall at approximately the same times of day throughout the three weeks of Phase 1 works to allow a snapshot of the temperature and relative humidity (RH) within the room.

3.1.4. Documentation

The results of the various phases of investigation allowed conclusions on the nature of historic and ongoing failure to be drawn, along with the formation of an informed conservation strategy. The Conservation Report will serve as lasting evidence a source of comparable information in the future.

3.2 Condition overview

A summary of all previously undocumented areas of damage and deterioration observed on the wall paintings is given below. These newly recorded areas of paint loss, flaking, food deposits and canvas edge delaminations are mapped on diagrams in Section 4, and should be read in conjunction with the previous diagrams made by Hirst Conservation (February 2019) and David Everingham Conservation Ltd (2015).

3.2.1 Food and drink deposits:

The identification and removal of food deposits is essential prior to the facing of the paintings. Such deposits can become more difficult to dissolve over time, possibly requiring more interventive methods of removal in the future. In addition, organic deposits can encourage biological growths and mould in conditions of raised relative humidity (above 60-70%). Possible fluctuations and raised levels of relative humidity may occur during the planned works to the building envelope.

The previously undocumented areas of food and drink deposits ranged from small 1-2mm spots, to fainter splash and drip marks covering a larger area. It should be noted that no catered events have been held Great Hall since the Hirst Conservation February 2019 Condition Report was made, meaning that these food deposits are not new, but were overlooked in previous inspections.

3.2.2 Active flaking:

It is essential that all areas of active flaking paint are consolidated prior to the application of a tissue facing, as these vulnerable areas could be damaged or become fully detached during the application and removal of the tissue facing. Previous condition surveys and treatment records made since the late nineteenth century have documented areas of active flaking in the paint layer which have been variously corrected, but which have reoccurred or occurred in other sections of the paintings. The problem of flaking is likely to continue over the lifetime of the paintings.

Several previously undocumented areas of actively flaking paint were identified during the present inspection. It cannot be confirmed with absolute certainly whether these are new areas of damage that have occurred since February 2019, or whether they were overlooked in the previous surveys. The losses were most prevalent and active on Painting 9, ('Bradshaw's Defence of Manchester'), where tiny detached flakes of paint were observed on the wooden dado ledge below the painting, suggesting continued loss. This is the last painting in the series, anecdotally said to have been painted by Madox Brown with his left hand after his right side was paralysed by a stroke. It is dated 1893, the year of his death. The painting appears unfinished: It is possible that the continued losses may be related to this, and to the technique used by the artist, such as the paint being slightly underbound and therefore more friable and prone to loss.

3.2.3 Paint losses with vulnerable edges:

Areas of complete paint loss with vulnerable, unsecured edges require consolidation prior to the application of a protective facing. Such areas of loss are vulnerable to damage during the removal of the facing tissue. Several undocumented areas of complete paint loss were noted. These losses ranged in size from 1-5mm in diameter.

3.2.4 Area of impact damage:

Areas of impact damage were noted in this survey, although these will not have an immediate effect on the Phase 1 Emergency Consolidation Works unless they also exhibit flaking paint.

3.2.5 Detached canvas

Further small sections of detached canvas around the edges of the painting were noted and will need to be attached prior to the application of the facing tissue.

3.2.6 Salt activity and damage to Painting 11

Damage to the right side of Painting 11 includes: Detachment of the canvas from the wall; a large accumulation of 'crunchy' salts behind the canvas (visually evident from bumpy distortions in the canvas and paint layer); an amount of associated flaking in the paint layers; previous paint losses; evidence of previous restoration (retouching along the right side appear to be in acrylic paints, the use of which was documented by Tom Organ in the 2009 restoration of the paintings[1]); the glossy residue of a previous consolidant (likely to be Beva 371®, as recorded to have been used by Organ in 2009); and some retouched vertical cracks in the paint layer in the lower right corner, suggestive of an attempt to peel back the canvas to inspect to the reverse.

Damage to the canvas was not noted in the detailed condition survey made of the paintings by Brian Cardy in 1998. However, the damage was noted in Tom Organ's 2009 report as 'the canvas (having) delaminated in many places on the right hand side. A strip approximately 15-20 cm wide has suffered from water ingress in the past and the marouflage canvas has become partially detached in a zone which extends from the top of the painting to the bottom' (pg. 27). This confirms that the water ingress occurred between 1998-2009.

A brief inspection of the external walls made by Hirst Conservation in February 2019 noted 'the lighter colour of the stonework surrounding the downpipe to the west side of the painting number 11, which may indicate a long-term rainwater infiltration issue in this area' (pg 51). On-site discussions with the Project Architect in November 2019 confirmed that this downpipe is likely to have been the source of the water penetration. Electrical capacitance readings made across the painting's surface by Hirst Conservation in February 2019 suggested that the paintings and supporting fabric are essentially dry. Further readings taken by Hirst Conservation in November 2019 confirmed the finding that the painting and supporting fabric are dry.

However, there is no record or undocumented recollection of the problem of water ingress in this area being addressed, or of the downpipe being fixed, meaning that the water infiltration could potentially reoccur. The downpipe will be fully inspected during the current refurbishment works, and made fully secure.

[1] 'Condition Assessment and Treatment Record of the Conservation of the 'Manchester Murals' by Ford Madox Brown', The wall Paintings Workshop, Tom Organ (unpublished report , March 2009)

3.3 Further notes and observations

During the close inspection of the paintings, the following observations were made:

3.3.1 Brown spots on Painting 2 'The Baptism of Edwin'

'The Baptism of Edwin' is dated in the lower right corner to 1879, and was the first of the murals to be executed by Madox Brown using the Gambier Parry spirit fresco technique. The 'Gambier Parry process' was a new manner of painting murals, devised to emulate the classic visual qualities of *buon* or true fresco, whilst allowing a greater breadth of palatte and a level of durability that could withstand the often high relative humidity found in northern Europe. Madox Brown had no previous experience of this technique, and there existed very few examples of its use by other artists to which he could refer.

Brown patches of discolouration have long been noted in the lighter areas of this painting, and were interpreted by E. Clive Rouse during his examination of the paintings in 1959 as heat spots caused by condensation from hot food plates placed in front of the painting.

However, documentary evidence and close examination of the painting in normal and ultraviolet (UV) light suggests that these brown patches may be integral to the paint layer, and represent a very early failure in Madox Brown's evolving Spirit Fresco technique. It is possible that the discolouration occurred within Madox Brown's lifetime, and that the artist returned to this mural to retouch or paint over many of the worst affected areas.

Many of the brown patches are in lighter passages of paint (Appendix A, photographs 1 and 2). It could be suggested that the use of lead white on the alkaline lime plaster substrate required by the Gambier Parry process resulted in a chemical reaction and an uneven, patchy darkening effect in the paint layer. This could only be confirmed with further research, and with chemical analysis of the materials involved.

Madox Brown is documented as having returned to this painting to rework it (as he did with many of his paintings). He also reworked 'The Romans Building a Fort at Macenion', the second of the murals to be painted. Interestingly, there is what appears to be a second 'FMB' monogram signature in the lower right corner of 'The Baptism of Edwin', with a possible date of 1890, eleven years after the 1879 signature in the lower left corner. Could 1890 be the date of Madox Brown's reworking made in response to the unfortunate appearance of the brown spots in his early paintings? Further analysis would be required to confirm that this is, indeed, a second signature

Large passages of retouching or over painting are apparent on 'The Baptism of Edwin', such as in the tiles on the floor. The retouching appears dark in UV light against the fluorescence of the underlying paint layer (Appendix A, photograph 3). However, the retouching is not *total* across the entire passage of the tiles; several tiles have not been repainted (Appendix A, photograph 4). These unrepainted tiles display faint brown spotting, but may have been deemed visually acceptable. The retouching is identical in colour, texture, and saturation to the original paint and can only be discerned in UV light. It is different from the retouching made by conservators, which examination in UV light shows is confined to specific areas of damage, such as areas of impact damage, or filled/unfilled paint loss, and can often be easily identified with the naked eye (Appendix A, photograph 5). The brushstrokes of the over painting likely to applied by Madox Brown also extend slightly over surrounding

features in the painting in an illogical manner, for example, to paint the background overlapping a detail that would normally be applied later.

In conclusion, it is not recommended that any measures are taken to remove or disguise the brown spots, but that they are (at this time and until further research is undertaken) viewed as integral to the history of the Manchester murals.

3.3.2 Uneven gloss over the surface of the paintings

Inspection of the paintings in normal light showed an extremely uneven surface appearance, with some areas appearing very glossy, and others matte. Many layers of wax (and possibly varnish) have been applied by various restorers over the years to resaturate the colours, the last documented application being in the 1950s. These layers of wax have been variously removed and redistributed by conservators over the years. It is notable that the most glossy areas of the painting appear to be in the darker passages of the painting, suggesting that a degree of selective cleaning has been undertaken by conservators in the past, with waxy coatings retained in the darker, more solvent sensitive passages of paint.

However, it is possible that Madox Brown himself may have applied a saturating coating to the dark colours as he was creating the works. In a lecture given on 12th May, 1881 on 'Mural Painting and Coloured Decoration; the Gambier Parry Process', Madox Brown noted that one of two drawbacks that he had found with the new technique was for the '…tendencies of several of the colours to dry in different degrees of glossiness. For instance, ivory black will dry perfectly dead compared with every other pigment on the palette…other colours have a tendency to shine too much'.

Although it is likely that any original coatings applied by the artist to address this problem of contrasting gloss have long since been removed by previous restorers, the problem of uneven surface gloss and the relative sensitivity of the dark colours is an important consideration in any future cleaning of the paintings.

3.3.3 Dark rebate edges to the paintings

All of the paintings contain a dark strip of approximately 1cm wide around their edges, as though layers of discoloured coatings and dirt, removed elsewhere, remain in place. It is possible that previous conservators have cleaned the paintings and left this small edge to prevent chemicals and water from staining the surrounding stone and wooden dado.

The very dark strip is most obvious along the lower edge of the paintings, just above the dado (Appendix A, photograph 6). Research shows that a recommendation was made by Professor Laurie in 1919 to treat areas of paint loss along the lower edges of each painting with a solution of Shellac varnish. Shellac varnish is known to become very dark and virtually insoluble with age. It is not know whether the shellac was actually applied, but it would explain the blackness of this area. Another possibility is that the area has been deliberately painted black to disguise the exposed, unpainted canvas edges, and that the same effect was applied to the plaster substrate murals for the sake of visual continuity.

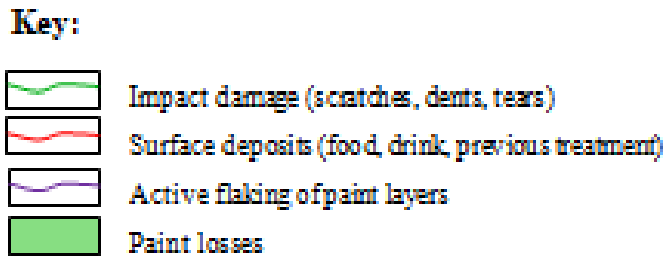
An explanation for the dark, uncleaned side and upper rebates on all of the pictures is that the paintings were once framed, and that the pictures were previously cleaned with this frame in place. Strips of discolouration and remnants of red and gold paint on the surrounding stone supports this hypothesis (Appendix A, photograph 7). Interestingly,

however, there is no photographic or documentary evidence for this whatsoever for a frame ever being fixed to the paintings. There is therefore no absolute explanation for the dark rebate edges. Again, The presence of this dark rebate edge will have to be considered in any future cleaning and conservation programme for the murals.

4. Diagrams showing previously undocumented defects on the paintings

The following diagrams should be read in conjunction with those contained in the reports below, and record newly observed defects only:

- *1.024 Record of Condition and Recommendations for Manchester Town Hall Murals* by Ford Madox Brown', Hirst Conservation, (unpublished report, February 2019).
- *Conservation Report for the Manchester Town Hall Murals by Ford Madox Brown*, David Everingham Conservation Ltd., (unpublished report, 2015).



1. The Romans building a Fort at Mancenion AD 80 (dated 1880)



2. The Baptism of Edwin (dated 1879)



3. The Expulsion of the Danes from Manchester (dated 1881)



4. The Establishment of Flemish Weavers in Manchester AD 1363 (dated 1882)



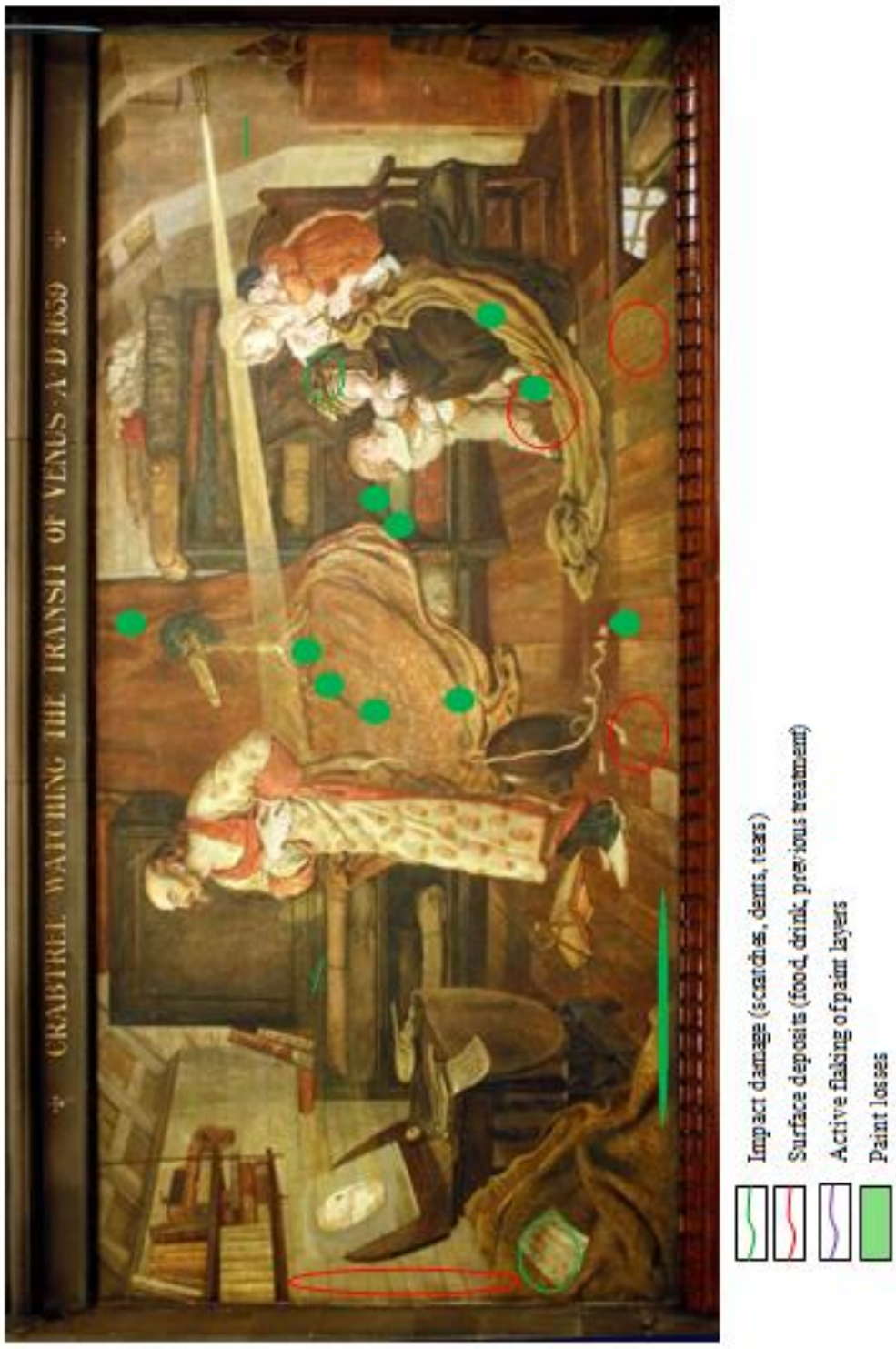
5. The Trial of Wyclif (dated 1880)



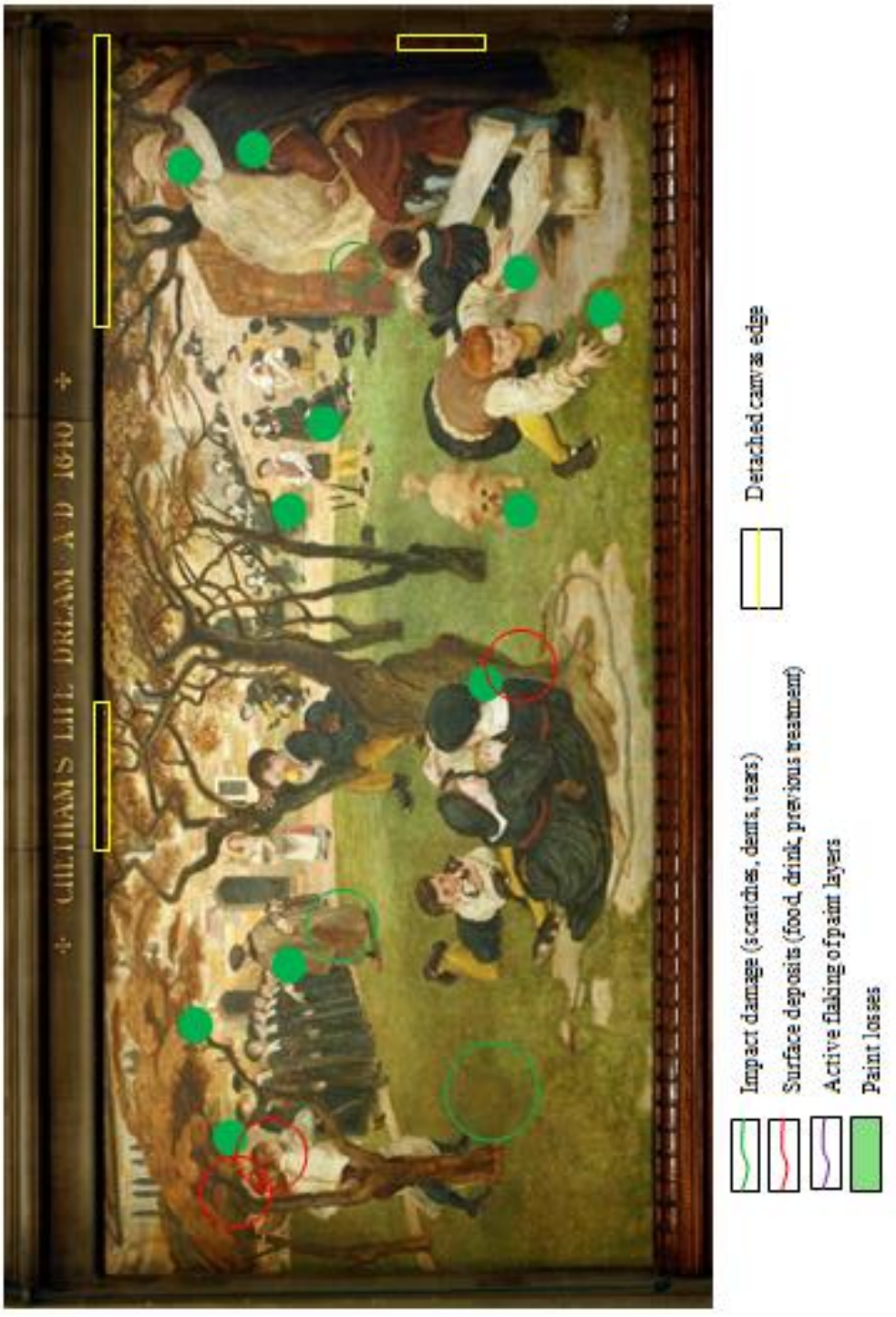
6. The Proclamation regarding weights and measures AD 1556 (dated 1880)



7. Crabtree watching the Transit of Venus (dated 1883)



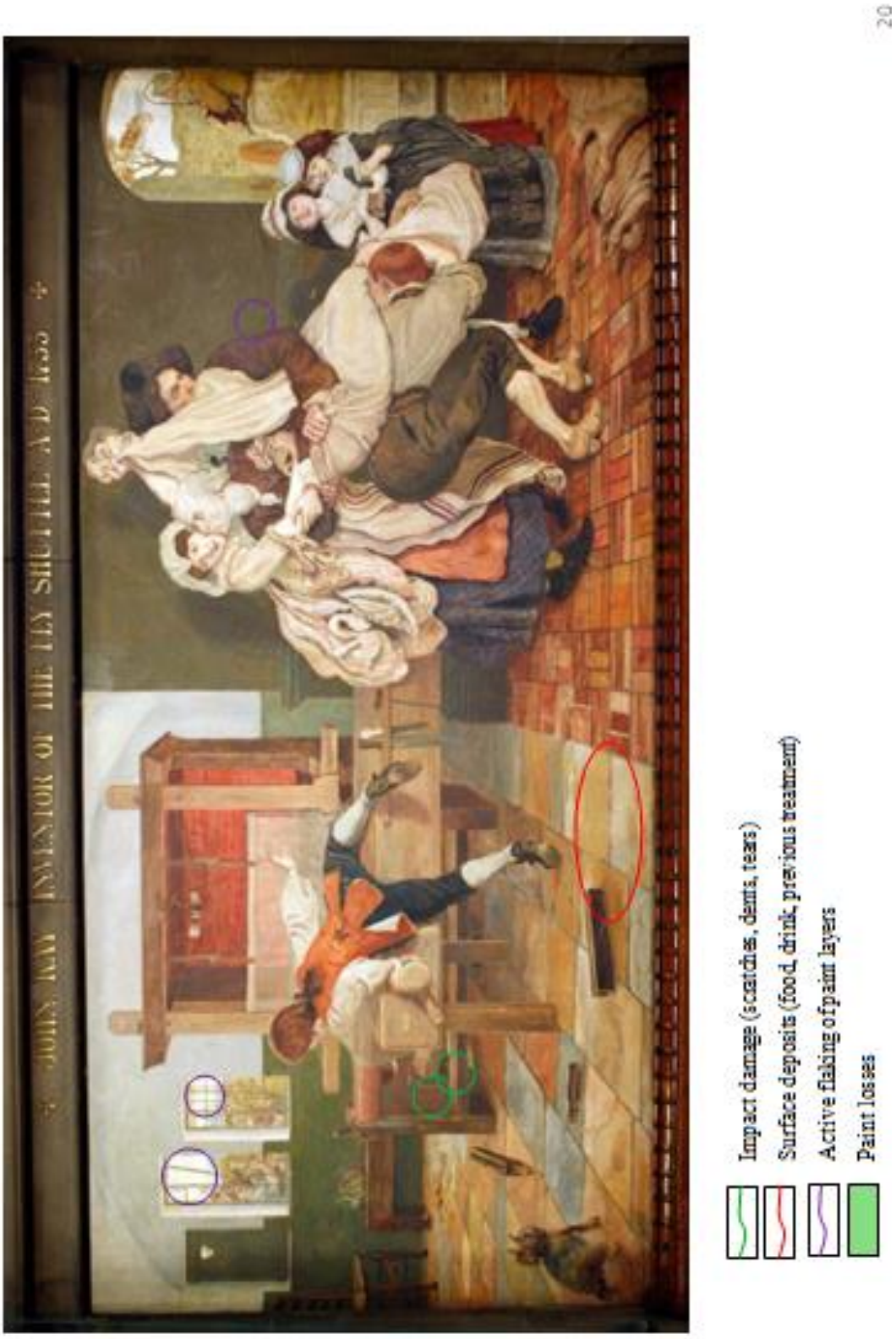
8. Chetham's Life Dream (dated 1886)



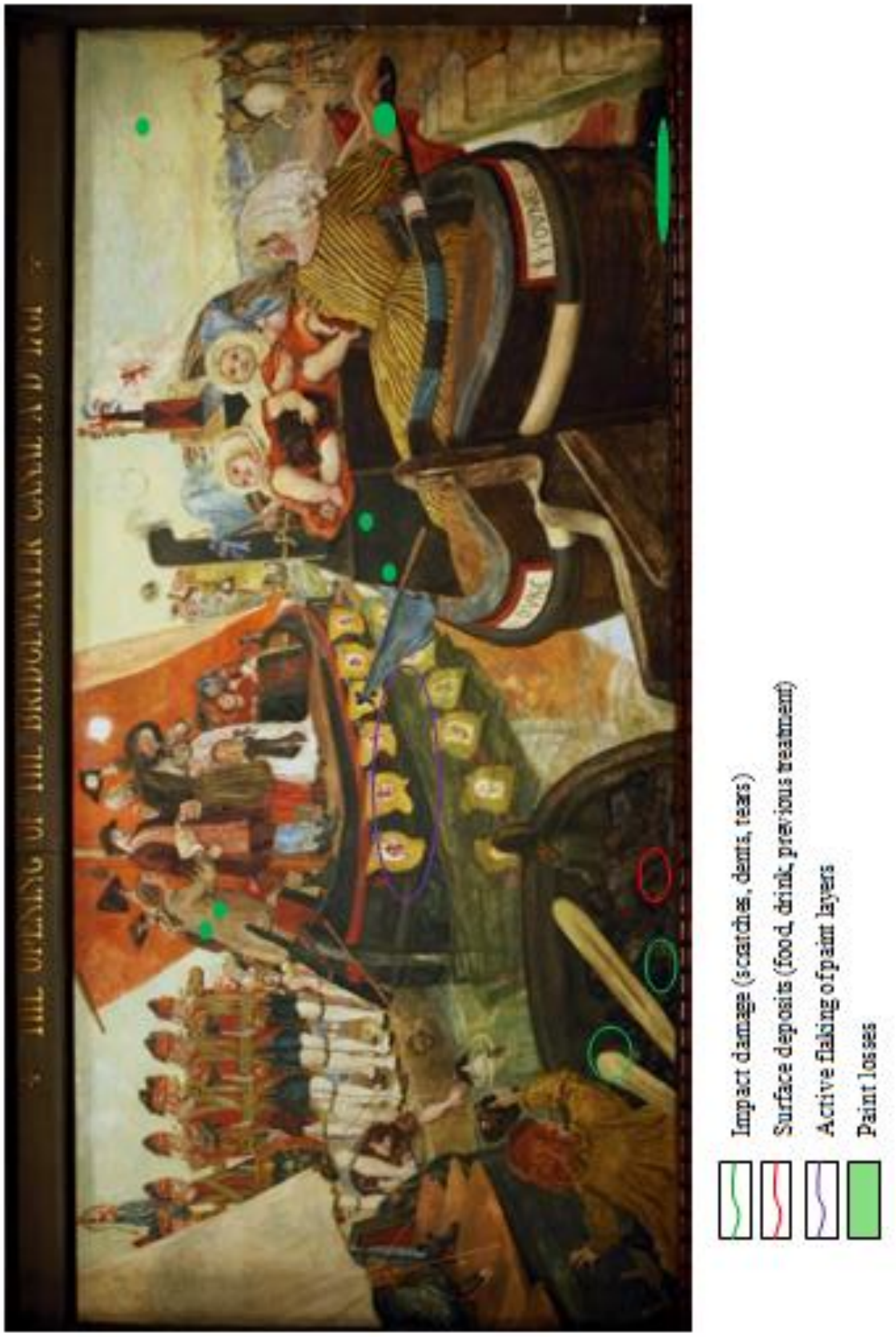
9. Bradshaw's Defence of Manchester (dated 1893)



10. John Kay Inventor of the Fly Shuttle AD 1753 (dated 1890)



11. The Opening of the Bridgewater Canal AD 1761 (dated 1892)



12. Dalton Collecting Marsh Gas Fire (dated 1887)



Section 5: Phase 1 Testing and Treatment Record

A series of tests were undertaken to establish the most appropriate conservation methods and materials for the Phase 1 Emergency Consolidation Works. The paintings were accessed from a mobile tower scaffold.

The following paintings were selected for the testing programme as examples of works on both canvas and plaster supports which displayed the range of defects requiring conservation treatment during Phase 1:

Number	Title	Support	Identified deterioration
11	*The Opening of the Bridgewater Canal*	Canvas	Dust; food deposits; wrinkling paint; active flaking paint; powdering paint; cupping paint; paint losses; delaminated canvas edges; section of delaminated canvas; requires facing
1	*The Romans Building a Fort at Mancenion A.D 80*	Plaster	Food deposits; active flaking paint; requires facing
2	*The Baptism of Edwin*	Plaster	Food deposits; hollow plaster substrate; active flaking paint; paint losses; requires facing
8	*Chatham's Life Dream*	Canvas	Requires facing

5.1 Pre-treatment tests

Several pre-treatment tests were made to establish the sensitivity of the painted surface and supports to water, selected solvents, and heat, the results of which dictated both the methods and materials that could be used for the localised cleaning, consolidation, stabilisation and facing of the paintings.

The paint layers and passages of retouching in various media on both plaster and canvas substrates proved stable to the controlled swab application of de-ionised water. They were also stable in white spirits and xylene.

Areas of retouching identified as being in Paraloid B72 medium (likely to have been applied by Brian Cardy, between 1995-98) proved slightly sensitive in acetone and toluene, as would be expected. The original paint did not appear to be sensitive to these solvents. The lighter passages of the painting were insensitive to acetone, but the darker/black passages display some sensitivity. Several matte areas of non-original paint were tested with water as previous conservation reports have stated that retouching have been made in watercolour. However, no water sensitive overpaint was found; it is likely that any watercolour retouchings were removed in the 1998 or the 2009 campaigns of cleaning when aqueous methods were used for the removal of surface dirt. The retouchings applied in acrylic paint in 2009 were not sensitive to de-ionised water.

The heat sensitivity of the original paint layers and various passages of retouching were tested using a thermostatically controlled spatula, with the degree of heat (applied to the paint surface through silicone release paper) gradually increased during testing. The use of heat can be required for the plasticisation of paint layers to lay them flat during the consolidation process, and for the activation of heat-seal adhesives such as BEVA 371 gel and film. The paint film and retouching proved tolerant to temperatures up 65°C.

5.2 Stabilisation of plaster substrate

The areas of 'hollow' plaster previously identified in Painting 2 ('Baptism of Edwin') and Painting 5 ('The Trial of Wycliff')[2] were re-assessed to establish the need for stabilisation in the form of grouting. The conclusion at this time is that none of the hollow sections of plaster within these areas appear to be unstable, and the slight vibration noted in isolated sections does not pose imminent danger of failure. Therefore, introduction of grouting materials at this stage was not required. However, extra protection was given to those areas exhibiting 'slight vibration' through the application of an additional, localised facing using the following procedure (Appendix A, photograph 8):

Strips of Japanese tissue were cut to size and adhered over the larger cracks and hollow areas prior to the application of the general facing to all the paintings. The process and recommended adhesive to be used is as for that described in Section 5.8.

5.3 Removal of loose surface dirt

Removal of loosely bound particulate surface dirt and food splatters was essential prior to the re-adhering of delaminated paint and the application of a protective facing. Failure to remove such deposits could see them further consolidated into the paint layer. Both food and dust deposits might have become feed for an organic growth in the event of elevated relative humidity during the building works. The following procedure was used:

- Loose surface dirt was cleaned from the paintings using a soft bristle brush in conjunction with vacuum extraction at source. Dusting brushes with timber or plastic handles were used to avoid accidental scratching of the painted surface.
- Food deposits were safely removed using de-ionised water applied with cotton swabs. The area was thoroughly dried using cotton wool after treatment.

5.4 Consolidation of loose and flaking paint:

All areas of paint recorded as flaking or lost on the condition surveys by Everingham (2009), Hirst (February 2019) and Hirst (November 2019) were consolidated.

To reduce the risk of further failure, all areas flaking, cupping, powdering, and historic loss in the paint layer were consolidated prior to the re-adhering of the delaminated canvas and the application of a protective facing. The chosen consolidant is required to be stable, reversible, and slightly weaker than the existing alternative forces within the object to which it is applied. It is also important that the consolidant does not result in excessive saturation of the paint layers, and that any excess adhesive can be safely cleared from the surface without affecting the paint layers.

[2] '1.024 Record of Condition and Recommendations for Manchester Town Hall Murals by Ford Maddox Brown' (Hirst Conservation, Section 7.1.4, February 2019)

Pre-treatment tests established the paintings' potential sensitivity to any carrier solvents that may be in a consolidant, and to the solvents required to clear an excess adhesive from the paint surface following consolidation.

A number of synthetic adhesives compatible with spirit fresco and oil paint layers were tested:

- These included Paraloid B72 (5% in xylene),
- Lascaux 4176 Medium for Consolidation (7-10% in de-ionised water)
- Plextol B500 (10% in de-ionised water).

Small consolidation tests using each of the adhesives were undertaken on Painting 11. For areas of cupping and powdering paint, and to stabilise the edges of existing areas of paint loss, the consolidant was applied to the affected area using a small brush, ensuring that it was fully absorbed behind the lifted paint. The paint surface was then protected with silicone release paper, and a thermostatically controlled heated spatula used to gently lay flat the lifted paint through the use of heat and pressure. In areas of severe powdering, the adhesive was applied through acid-free tissue paper to avoid disruption of the painted surface. Following full consolidation, residues of adhesive were safely cleared from the surrounding paint surface using de-ionised water or an appropriate solvent applied with cotton swabs.

Although all of the adhesives performed well, Lascaux 4176 Medium for Consolidation (7-10% in de-ionised water) was selected for the consolidation of the paint. Lascaux 4176 (an aqueous dispersion of an acrylic co-polymer) is non-hazardous to use, dries to a clear and flexible film, is light resistant, has excellent penetrating properties for underbound paint, and does not yellow with age; these properties were considered to be the most advantageous for the consolidation of the murals.

Excess adhesive was removed from the surrounding paint surface using xylene applied with a cotton swab.

5.5 Treatment of delaminated sections of canvas along the edges of the paintings:

The objective of this treatment was re-fix the canvas along the edges where it has delaminated from plaster support. Historic Condition Surveys and Treatment Reports confirm that lifting at the edges of the canvas has been an ongoing problem, which has been addressed on several occasions, but which is clearly an area of ongoing weakness. Delaminated canvas has a tendency to deformation along the edges where impact of moisture may be more significant. This may impact upon the condition of the ground and paint layers and lead to loss. Such processes can be accelerated by fluctuating environmental conditions such as may occur during the scheduled building works.

Tests identified that sections of delaminated canvas along the edges of the paintings could be stabilised and re-adhered to the plaster substrate using the following methods and materials, following the removal of all loose lying particulate dirt and the consolidation of flaking or damaged paint:

A localised facing was applied to the area being treated to provide increased rigidity for the paint layers, thereby reducing the potential for damage or loss of paint during the reattachment of the canvas to the plaster substrate. A facing of Japanese tissue was cut to

size and adhered to the paint surface using Klucel G, a water-based hydroxypropyl cellulose adhesive (7% in de-ionised water).

The needle of a hypodermic syringe was bent using pliers in order to create an angle suitable to accessing the reverse of the painting through the restricted entrance points along the edge of the canvas adjacent to the stone surround. Plextol B500 was injected behind the canvas and allowed to dry, re-adhering the canvas to the plaster substrate.

Plextol B500 is a water dispersion of a pure thermoplastic acrylic resin, commonly used as an adhesive for canvas lining and consolidation treatments. It has high chemical stability, and does not require heat to be activated. It is non-penetrating and capable of firming a nap bond. De-ionised water can be used to adjust the concentration to the required strength.

The protective facing was easily removable following treatment by dampening the tissue with deionised water and peeling back. Remnants of the adhesive were removed using dry cotton wool and de-ionised water applied with cotton swabs.

5.6 Treatment of a section of delaminated canvas on the Painting 11 ('The Opening of the Bridgewater Canal').

A large area of canvas support had become detached from the plaster substrate on the right side of Painting 11 due to the water ingress and movement of moisture through the adjacent stone leading to salt efflorescence. The delaminated canvas was noted in the Condition Survey produced by David Everingham Conservation in October 2015 and in Tom Organ's report of 2009, but was not noted in Brian Cardy's survey and treatment documentation dated to 1995-1998. This suggests that the water ingress responsible occurred at some point between those dates.

Active salts behind the canvas, powdering paint and heavy retouching are evident. Reference to Hirst Conservation's Condition survey carried out in February 2019 suggest that further small areas of flaking paint have occurred in the area since 2015. Observations in November 2019 suggest that the flaking is active and ongoing.

Moisture readings carried out to the surface of the painting using a Protimeter in February 2019, and during the trials in November 2019, suggest that the painting is dry. However, the likely source, an external downpipe, is not known to have been addressed, meaning that moisture ingress might still pose a risk to this area and to the painting. The fault in the downpipe should be identified and corrected during the forthcoming restoration works to the exterior of the building. Once the source of the ingress is fixed, a period of time will be required to allow the full drying of the salts behind the painting.

Discussions were held with the Town Hall Conservation Officer as to whether the re-adhesion of the canvas to the plaster, and the potential sealing of active salts and moisture behind the support, might be detrimental to the condition of the canvas and paint layers during this phase of works. Whilst the salts are potentially active, difficulties are also posed in the selection of the adhesive that could be used to re-adhere the support to the plaster. Ideally, a non-aqueous adhesive such as BEVA 371 would be selected so as not to add to the moisture problem and potentially cause more salts to crystallise. However, the temperatures needed to activate this adhesive (injected via the front of the painting to coat the reverse of the canvas) would be prohibitively high, as the heat would need to be applied through the front of the painting, passing through intervening layers of silicone release

paper, Japanese tissue facing, the wax containing paint layer, the ground, size layer and canvas. The recommended activation temperature of BEVA 371 is 68°C. Another 10°C would need to be added to activiate the adhesive through the many intervening layers. This temperature would have the potential to plasticise the paint layer, potentially causing damage and permanent deformations formed around the raised lumps of salts trapped behind the painting.

The use of an aqueous, non heat-activated adhesive also poses potential problems at this time when it is not know whether more moisture may occur behind the painting with the mobilisation of potentially more salts.

It is therefore recommended that the area of delaminated canvas is temporarily fixed in place at this time to prevent any further paint loss, but that the reverse is not fully sealed, therefore allowing the area to fully dry out before eventual full re-adhesion in Phase 2 of works, once the building envelope is fully sealed.

The following measures were therefore implemented to stabilise the delaminated canvas as part of Phase 1 Emergency Consolidation Works, and for the duration of the Town Hall refurbishment. The delaminated canvas should be treated and fully fixed during during Phase 2 of conservation works to the murals.

Where possible salt efflorescence was removed from the stone work that forms the recess to the right of the painting. After consultation with then Conservation Officer, a small piece of delaminating stone fragment at imminent danger of detachment was removed from the area and stored for future possible reattachment. The salt efflorescence was carefully brushed from the stone, collected and stored for potential future analysis.

All areas are flaking paint were consolidated and the painting faced with Japanese tissue and Klucel G (8% in de-ionised water). Small 0.5 cm anchor points around the edge of the canvas to be fixed in place using Plextol B500, so as to prevent the canvas from fully detaching from the plaster. The locations of these anchor points are identified with small squares of tissue.

Following the application of tissue facing of the painting a temporary prop was designed to support the canvas should further detachment occur:

stone recess at the top and wooden dado ledge at the bottom

A strip of Hexlite® 620[3] honeycomb sandwich panel was cut to size and secured into the stone recess using Plastazote[4] foam. Pieces of Plastazote were attached to the reverse of the hexlite strip to act as cushions, and the structure placed a few millimetres from the faced surface of the painting (Appendix A, photograph 9).

It is important to ensure the dado ledge is not moved or compromised during the main works in the Great Hall

5.7 Treatment of flat air pockets

Only one of the flat air pockets noted in David Everingham's 2015 report could be identified ('Bradshaw's Defence of Manchester A.D. 1642). This air pocket was found to be stable, and was not affecting the stability of the paint layers. No treatment was deemed necessary at this time.

Was this confirmed in 2019 condition surveys?

[3] Hexlite 620 has skins of woven glass fibre impregnated with epoxy resin and a lightweight Aluminium honeycomb core.
[4] Plastazote foam is an inert closed cell polyethylene foam.

5.8 Application of facing paper

Taking into account the long period of refurbishment works at the Town Hall, and possible difficulties to access the murals as frequently as desired, the complete facing of the surface of the murals was undertaken. The tissue facing will serve to protect the paintings from dust, and to provide support to the paint layers if any flaking occurs during works.

Any materials applied over the surface of the paintings should stay readily reversible using methods safe to any constituents of the paintings (and non-original materials). Following a programme of testing in areas consisting of both original paint, excessively waxy coatings, and non-original paint, the following methods and material was undertaken:

- A lightweight, acid free Japanese tissue was cut into squares measuring approximately 40cm (using water applied with a small brush to produce a feathered edge).
- A water-based hydroxypropyl cellulose adhesive, Klucel G, was mixed to form an 8% solution in de-ionised water.
- The tissue was positioned on the painted surface and the adhesive applied through the tissue with a brush (Appendix A, photograph 10).

KlucelG is an non-ionic cellulose ether which can be dissolved in water or alcohol. It is a versatile and stable product. It does not have strong adhesive properties, which makes it good for facings. It is removable with water.

5.9 Environmental monitoring in the Great Hall during works

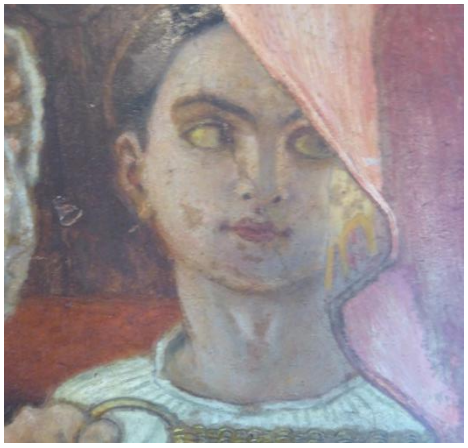
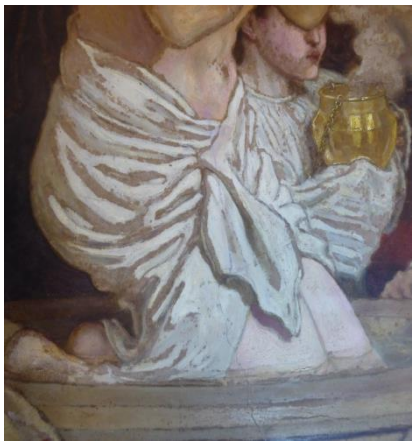
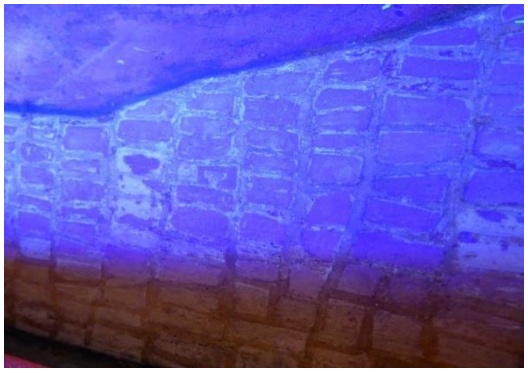
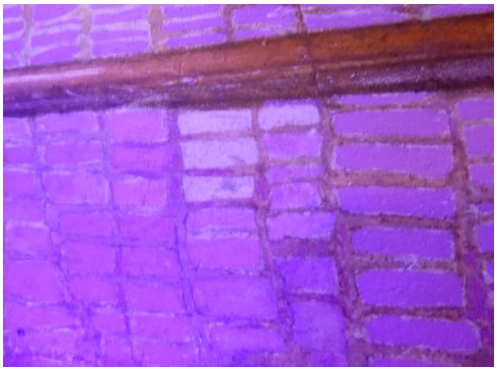
Environmental readings were taken with an electronic Protimeter in a hygrometer mode inside the Great Hall in the morning and afternoon throughout the three weeks of Phase 1 works to allow a snapshot of the temperature and relative humidity (RH) within the room. From 22nd November to 10th December 2019, the background temperature in the Great Hall was found to be a mostly 17-18°C, with a single low reading of 14°C (when the corresponding Relative humidity dipped to a period low of 29%), and a high of 19°C. This rage of temperatures is acceptable for the preservation of the fabric, and relatively stable probably due to the constant heating and the high level of thermal buffering provided by the building envelope. However, relative humidity levels during this short period were found to be fairly unstable, ranging from 29% to 53.1%, a difference of 20% possibly due to the high level of air leakage and exchange via the large external glazed windows.

The data obtained from such a short period of environmental monitoring has limited value regarding the general or average conditions at the site throughout the year. The negative impact of an adverse environment on these significant paintings cannot be understated. It is strongly recommended that environmental monitoring is undertaken in the Hall during the forthcoming period of refurbishment works when the usual conditions within the Hall are likely to be disturbed. This should include:

Monitoring of internal and external temperature and relative humidity, surface probes to measure temperature and relative humidity at the surface of each painting (within the protective casing) and vibration monitoring.

If at least one environmental monitor is required within the protective casting (i. e. moisture movement affected mural 11), this needs to be coordinated with temporary protection installation program or be mounted in place before the screen is fixed;

Appendix A: Selected photographs

<table>
<tr><td></td><td></td></tr>
<tr><td>1. Brown spots in face/lighter paint</td><td>2. Brown patches in white paint</td></tr>
<tr><td></td><td></td></tr>
<tr><td>3. Lower half of photo shows tiles in normal light. Upper half is in UV light; note the dark overpaint over the more fluorescent earlier paint layer</td><td>4. UV light reveals some of the tiles those that appear white) have not been overpainted.</td></tr>
<tr><td></td><td></td></tr>
<tr><td>5. Dark areas indicate targeted retouching by conservators.</td><td>6. Dark strip on lower edges of paintings</td></tr>
</table>

	
7. Markings on stone surround and painting edge suggestive of a frame	**8**. Localised facing applied to support areas of cracking and 'hollow' sounding plaster.
	
9.Supporting strip of Hexlite, painting 11	**10.** The paintings after the application of facing paper protection