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Manchester Town Hall

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HIRST Conservation

Manchester Town Hall
01-033 Great Hall Organ Chamber, Validation Survey

29/06/2022

Rev 00: For Approval

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1. Scope of validation survey

The intention of the survey is to confirm the scope of works set out in the tender and identify and additional requirements.

Scope of work in accordance with the tender (Purcell, 2022):

> *3.01.01 General Cleaning and Assessment of the painted plaster surfaces:*
>
> *Carry out a general clean to all the existing painted plaster wall and ceiling surfaces in the Organ Chamber (not including areas of defective plaster and flaking paint already identified to be removed and renewed). A chemical sponge dampened with de-ionised water will be effective in removing dirt from these areas and they are to be thoroughly dried with cotton wool after treatment.*
>
> *3.01.02 Validation Inspection:*
>
> *The areas of oil alkyd overpaint on the vaulting panels and some areas of the rear loft are not generally as compatible with the original paints, as they have a glossy sheen and have a tendency to peel in the areas of condition concern identified due to their surface tension and lack of permeability. Consequently, following the general clean it will be essential that the conservators carry out a full visual inspection of the painted surfaces, prior to the other recommended conservation works on the walls and starry night vault panels, to determine that the condition is unchanged from those recorded in October 2021 and to validate the scope of the required action. The full extent of defective overpainting to be removed may therefore require further assessment by the conservator, however, it must be assumed until this has been done that the areas not identified on the drawings are sound. A more detailed understanding of the overpaint will inevitably be achieved during the actual works, from increased familiarity of the painted surface and the impact of the general cleaning. All areas that are identified to be removed should be fully recorded in detail (photographically and with gridded tracings) to enable faithful reinstatement.*
>
> *3.01.03 Cleaning Areas of Stencilled Gilding on the Starry Night:*
>
> *These features can be additionally cleaned with a solution of tri-ammonium citrate (3% in deionised water) applied with cotton swabs, cleared with deionised water, and dried with cotton wool. This process effectively removes the dirt coating on the gilding and greatly improves the reflectance properties. This is considered to be beneficial to all the gilding and is included in the scope required. Any significant losses of gilding are to be in-filled to match with equivalent quality and colour of gold leaf on oil size (refer to section 2.04).*
>
> *2.02.01 Plaster Consolidation:*
>
> *Areas of defective plaster to be removed and renewed, and holes to be filled where plaster is missing are mainly on the walls and are shown on the drawings. These areas are to be renewed in traditional lime plasterwork as specified.*

2.02.02 Fractures

There are a significant number of small fractures in the finish plaster of the organ chamber walls, but they are all assessed as stable and should be repaired as specified. At present there are no areas identified (other than the areas for renewal) that will require additional support due to delamination of the backing coats.

2.02.03 Hollow Plaster

The areas of 'hollow plaster' are generally minor delamination of the finish coat related to scheduled small fractures and these should all be consolidated by injection of lime putty and finest silver sand grout as a void filler and adhesive as part of the crack repairs.

2.03.01 Flaking Paint

The vast majority of areas identified as flaking or peeling relate to the modern oil-alkyd overpaint. The required approach to these areas (once the detail is recorded) is to remove the flaking areas and the identified extent of surrounding compromised overpaint, which is at risk of further flaking or peeling due to identified deterioration or condition issues, back to sound paint by suitable methods including careful scraping. Trials and samples are to be carried out by the conservator to establish the most effective method to remove the modern overpaint whilst retaining as much of the original paint underneath as practicable. The paint could be softened with the heated spatula or hot air pen before removal with nylon scrapers. In general, the overpaint removal will also remove the original paint underneath, but any areas of original paint exposed will be cleaned and treated as described in section 2.01 above. The resultant edges of any surrounding sound overpaint and areas of less severe cupping in the non-original paint should be consolidated prior to the patches of bare plaster being in-painted as described in section below. The process of consolidation described here should be adopted. A 10% solution of Paraloid B72 in acetone was applied behind the flake using a small brush or hypodermic syringe. The paint surface was then protected with silicone release paper and a thermostatically controlled heated spatula set at 70°C used to gently lay flat the lifted paint through the use of heat and pressure. Excess adhesive could be effectively removed from the paint surface following consolidation using acetone applied with a cotton swab. The conservator will then reinstate any loss with sensitive in-painting and re-stencilling.

2.04.06 Gilding

Following cleaning the gilding as in section 2.01 above any significant losses of gilding are to be in-filled to match with equivalent quality and colour of gold leaf on oil size.

2.04.07 Paint Loss

Following cleaning and plaster consolidation any areas of bare plaster or areas of significant depletion of the paint detail should be in-painted

Retouching should as a minimum integrate areas of new filling material and exposed plaster. Detailed retouching of losses in the design is not recommended unless there is firm evidence or record of the last previous scheme in line with the preferred approach of low intervention, and with consideration of the distance at which the panels are viewed. Retouching of exposed areas and the selective enhancement of the scheme, where there is firm evidence and appreciable damage or disfiguring blanching, are considered necessary to maintain the unity and presentation of the scheme when viewed from the ground.

Retouching and integration of a filled loss or an area of consolidated missing paint that exposed the plaster substrate matched to the surrounding surface on the Starry Night can be undertaken using acrylic paints, but the use of dry natural pigments in Paraloid may also be considered an appropriate option depending upon the type of surrounding paint, subject to further trials and samples being provided by the conservator within this scope. Care should be taken to keep the retouching within the area of loss, and not to encroach upon the surface of the surrounding paint.

Areas of the disfiguring white overpaint on the rear walls of the organ chamber that are soundly adhered should be sanded down to break the paint surface and overpainted with porous paint in a colour scheme to match the cleaned surrounding original paint as in the specification.

2. Part 1 assessment of condition

2.1. Method and limitations

Visual assessment undertaken from scaffold platform in advance of main works and included tactile assessment to all but the rear organ loft ceiling[1]. Inspection was undertaken in visible diffuse and raking light, together with UV light inspection. Each panel was given an individual reference number (Figure 1 and Figure 2).

Paint samples were removed for cross section analysis from the starry night ceiling and rear loft walls.

Salt samples were taken from the starry night ceiling.

2.2. Tender documents:

Purcell, 2020. OTH-PUR-TH-ZZ-SPE-A-5906. In: *Our Town Hall M60 NBS Specification Painting/ Clear Finishing.*

Purcell, 2021. OTH-PUR-TH-ZZ-SPE-A-5901. In: *Out Town Hall VHS Rooms & Room Type Repairs Inc. Methodology Specification*

Purcell, 2021. SK:211020_01. In: *Stage 4: Great Hall – Organ Chamber Repair Schedule .*

Purcell, 2022. OTH-PUR-TH-ZZ-RPT-A-0168. In: *Our Town Hall Manchester City Council: Scoping Schedule and Specification Report For Conservation Work to Decorative Finishes.*

2.3. Tender Drawings:

OTH-PUR-TH-01-DWG-A-8333

OTH-PUR-TH-01-DWG-A-8334

OTH-PUR-TH-01-DWG-A-8335

OTH-PUR-TH-01-DWG-A-8336

[1] Pending higher level access on scaffold deck.

3. Starry Night

3.1. Location

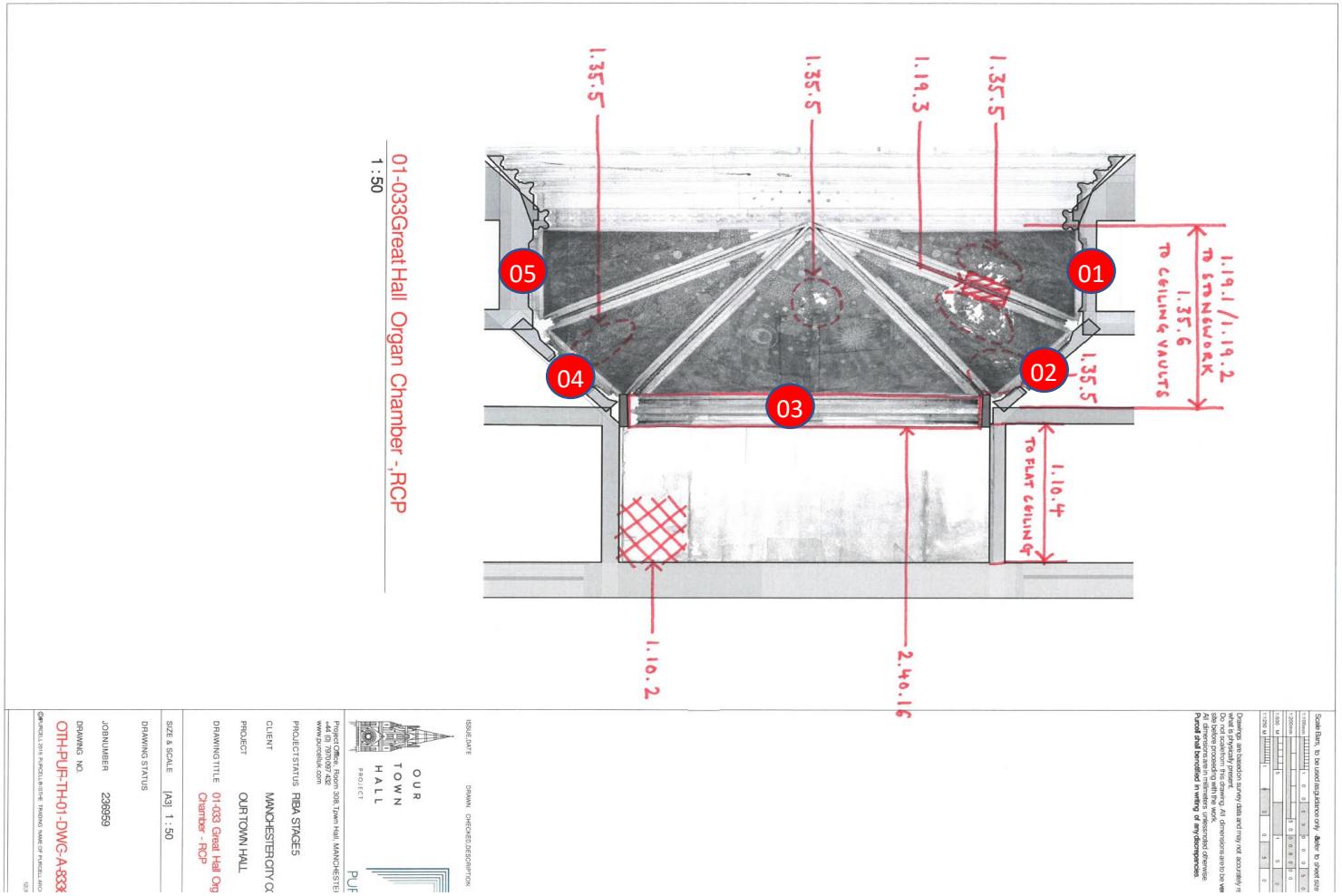


Figure 1: Drawing 8336 (OTH-PUR-TH01-DRG-A-8336) showing labelling of panels

3.2. Scope

1.35.6 Clean existing decorative scheme

1.35.5: Remove exiting paint layers, prepare and restore decorative scheme by conservator (to extent of areas shown on drawing, 5sq M)

Additional works agreed:

- Moisture and salt survey
- Paint analysis to ceiling

Provisional sums:

- Reduction of salts (to be agreed following completion of moisture and salt analysis)

3.3. Overview of condition

3.3.1. Plaster

The plaster support is applied onto the stone vaulted ceiling. The plaster is generally sound condition, no hollows were noted during tactile survey although the cleaning process will allow a more detailed assessment to be made. It was not possible to deduce the thickness or number of coats as part of the assessment.

Where water ingress has occurred, heavy salt deposits are extant (Figure 3, page 14). Analysis of these salts indicates that the main composition is magnesium sulphate (Appendix 2 Salt analysis). The initial results suggest that the plaster is likely to contain dolomitic lime and/or dolomitic limestone fragments, which is quite consistent with the Manchester area.

The extent of failure has not extended beyond that recorded on Purcell drawing 8336. However, additional remedial works to salt laden plasterwork will require review following the non-invasive moisture profiling, which will be undertaken post dry cleaning to allow review of any latent moisture movement. This may include

- Conversion (see Appendix 3: Stabilising Sulphates, adaptions of the Ferroni-Dini Method)
- Desalination
- Removal of localised plaster and reinstatement in an appropriate mix, such as dispersed lime to reduce introduction of water.

3.3.2.Painted decoration

General

In raking light, there is evidence of the earlier underlying scheme of decoration. Generally, the current scheme appears to closely tally with the underlying, however on panel 04, a wavy line was visible under raking light, suggesting there is some deviation between the current scheme and the original design (Figure 5, page 18).

Three samples were taken from the ceiling for analysis and the results of cross section assessment indicate that there are three schemes extant on the ceiling (see Appendix 1 paint analysis). The first

scheme was found only in the location with the wavy line to panel 04, and appears to be a scheme of gold and blue, possibly with applied decoration.

Scheme two appears to tally with the earliest scheme on the panels to the Great Hall ceiling, although the preparation layers are not the same.

The current painted decoration is believed to date to the second half of the 20th century. Cross section analysis of samples from the ceiling indicate that it is a synthetic resin paint which corroborates the timeline. The ribs are lined out with red and black, with the central fillet moulding gilded.

Drying cracks and previous losses were noted in the surface topography, suggesting that deterioration of the paint film contributed to redecoration in the current scheme.

Surface lying dust and dirt

There is a thin veil of surface lying accretions.

Moisture and salt damage

Flaking and loss of decoration is apparent across the ceiling, both on the starry night sections, beige borders and decoration to the rib between panels 1 and 2. This appears to be primarily attributable to water ingress and salt activity.

3.4. Recommendations

3.4.1.Works in addition to the agreed scope

Plaster

Analysis

initial testing of obvious salt efflorescence has indicated that this is mainly magnesium sulphate. This was found in one localised area only to panel 02. Other areas of failing paint have revealed a sound plaster surface. Micro core drilling to these areas of paint failure to establish the salts present would allow better anticipation of any latent issues with stability.

Treatment of salt-laden areas

Dependant on the results of the moisture survey and further salt assessment, various treatment options can be reviewed.

Conversion of salts: initial analysis inicatest that the salts are largely magnesium sulphate, which is extremently soluble and active at 'normal;' RH values. Barium hydroxide applied in solution converts the magnesium sulphate into stable, water insoluble barium sulphate and also produces magnesium hydroxide and calcium hydroxide, both of which will eventually carbonate, by reaction with carbon dioxide in the air, to their respective carbonates. See the process details given below:

$$Ba(OH)2 + MgSO4 \rightarrow BaSO4 + Mg(OH)2$$

Barium Hydroxide + Magnesium sulphate → Barium sulphate + Magnesium hydroxide

The barium sulphate is insoluble so cannot cause salt problems, and the magnesium hydroxide carbonates to insoluble magnesium carbonate, which cannot cause salt problems and additionally will help to consolidate the plaster if this is disrupted. Replacement: If replacement of the salt laden section of plaster is proposed, then plaster analysis should also be conducted to allow appropriate repair mixes to be considered against the risk of salt activation.

Desalination: Magnesium sulphate is highly soluble and it may be possible to remove the salts with clay and acid free tissue poultices. However, introduction of moisture may also push salts around.

Replacement: If replacement of the salt laden section of plaster is proposed, then plaster analysis should also be conducted to allow appropriate repair mixes to be considered against the risk of salt activation.

Paint

Analysis

Initial analysis has indicated the presence of a potentially significant early scheme to panel 04 (Scheme 1). Further sampling to areas of failure to identify if there is any trace of scheme 1 where paint will be removed should be considered essential.

Further investigation of scheme 1 on panel 04 would be beneficial to allow interpretation and recording of this scheme whilst access is available. This would add to understanding of the decorative history of this VHS room.

3.5. Proposed sequence of works

- Record stencil decoration in area of loss by photography and tracing
- Progress cleaning
- Undertake additional analysis and uncovering trials
- Undertake non-intrusive moisture survey
- Undertake additional micro-core sampling in areas of failure for salt analysis
- Hold point: review results of analysis and any variation to scope of work with Purcell and MCC in advance of further works
- If plaster removal is to be undertaken, allow for collection and analysis of plaster samples for reinstatement
- Remove flaking paint as per scope set out in drawing 8336
- Progress consolidation and retouching of base colours.
- Hold point: Purcell to sign off consolidation and retouching
- Reinstate gilded stencils

3.6. Panel 01

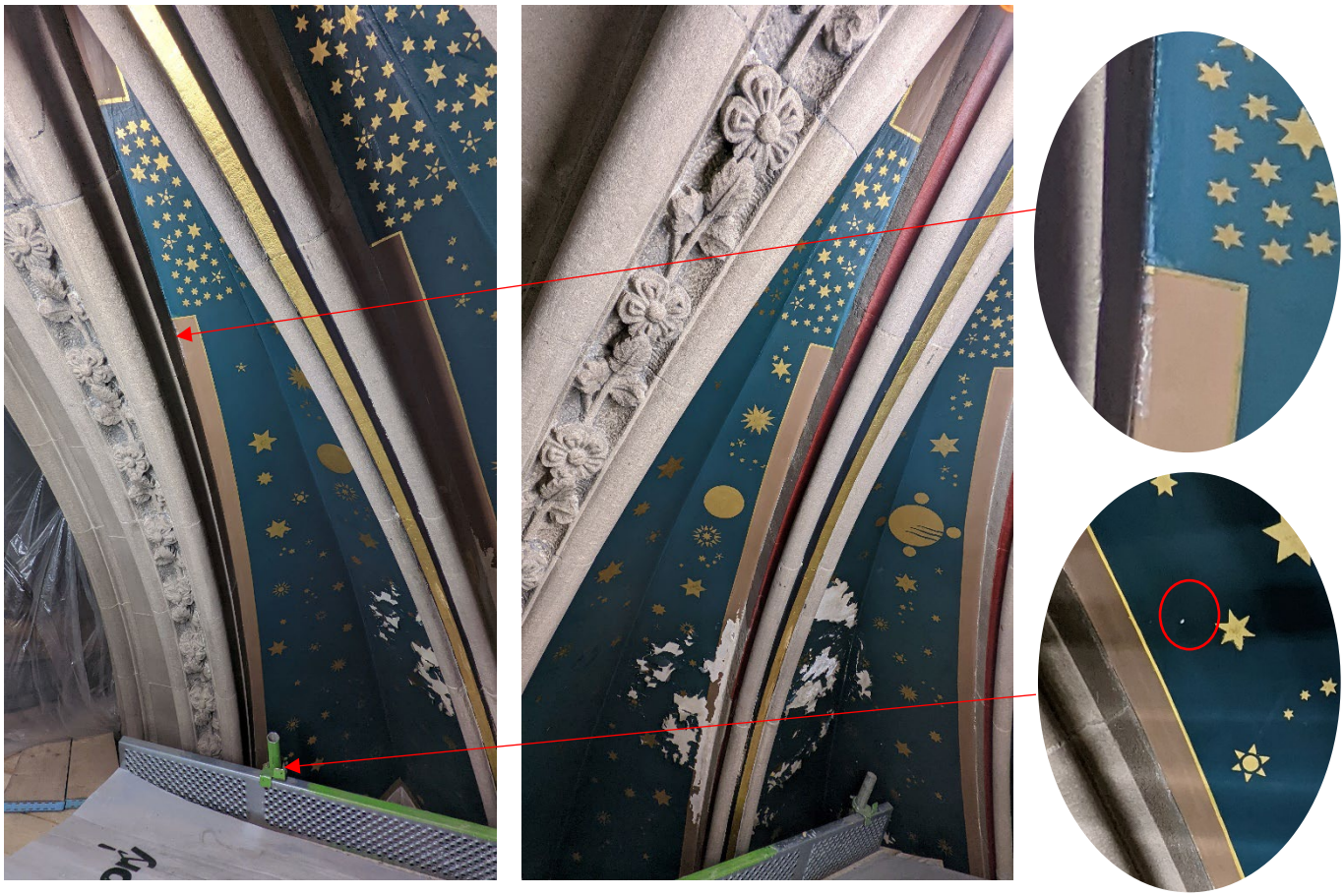


Figure 2: Left, panel 1, west side; right, panel 1, east side; inset top, detail of loss to west side; inset, bottom, minor loss to west side.

Plaster substrate	Tactile and visual inspection indicates that the plaster is largely sound. The east side of the panel has been affected by water ingress, with significant paint loss in the mid area of the panel although the plaster appears stable.
Painted decoration	West side is generally in sound condition, although some losses at the junction of the panel and rib were noted (see inset image) and one very small loss at lower level. To the east side, some additional loss was noted between March and May 2022, which relates to active deterioration and inevitable small losses during cleaning of the stonework. There is little evidence of underlying decoration to this area. The area of deterioration remains largely the same as that recorded on drawing 8336, including to the red and black banding to the rib.
Additional works	Confirm additional works to flaking paint to west side as shown in inset image above (very localised area).
	Following the moisture survey and salt profiling, additional remedial works to the moisture damaged plaster may be required.
Proposed sequence of works	Record stencil decoration in area of loss by photography and tracing.
	Progress cleaning in accordance with specification.
	Undertake non-intrusive moisture survey
	Remove flaking paint as per scope set out in drawing 8336 plus any additional works to the west side.

	Progress consolidation and retouching of ground colours.
	Reinstate gilded stencils

3.7. Panel 02



Figure 4:from left, Upper section of panel w, west side; upper section of panel 2, east side; lower section of panel 2, west side. May 2022



Figure 4: Left, Panel 2, east side, Mar 2022; Right, Panel 2, east side, May 2022 showing increased loss to beige border above window . Inset: detail of salt efflorescence.

Plaster substrate	Tactile and visual inspection indicates that the plaster is largely sound. The west side of the panel has been affected by water ingress, with significant paint loss in the mid area of the panel and associated salt efflorescence. Analysis of salts indicated that these are magnesium sulphate.
Painted decoration	Generally in sound condition, although significant flaking and loss to the east side. Traces of potentially early paint. Lower sections have localised areas of salt damage related loss as noted on drawing 8336, including to the red and black banding to the rib. Losses to the beige border are considerably greater than those recorded in March 2022.
Works in addition to agreed scope	Following the moisture survey, review and agree requirements for salt removal/ mitigation with Purcell Undertake remedial works to salt-laden areas as agreed with Purcell.
Proposed sequence of works	Record stencil decoration in area of loss by photography and tracing.
	Progress cleaning.
	Undertake non-intrusive moisture survey
	Remove flaking paint as per scope set out in drawing 8336
	Progress consolidation and retouching of base colours.
	Reinstate gilded stencils

3.8. Panel 03



Figure 5: Left, Panel 3, north side; Right, Panel 3, south side, May 2022

Plaster substrate	Salts noted to stonework to the north side of the panel. Tactile and visual inspection indicates that the plaster is largely sound. The central area has been affected by water ingress, with significant paint loss in the mid area of the panel and associated salt efflorescence. Analysis of salts indicated that these are magnesium sulphate (see Appendix 2 Salt analysis).
Painted decoration	Evidence of original decoration in raking light indicates that the current scheme largely appears to follow the original, although the register of the designs is slightly off. appear to largely Generally in sound condition, although significant flaking and loss to the east side. Traces of potentially early paint. Lower sections have localised areas of salt damage related loss as noted on drawing 8336. Losses to the beige border are considerably greater than those recorded in March 2022.
Works in addition to agreed scope	Following the moisture survey and salt profile, additional remedial works to the moisture damaged plaster may be required.
Proposed sequence of works	Record stencil decoration in area of loss by photography and tracing.
	Progress cleaning.
	Undertake non-intrusive moisture survey
	Remove flaking paint as per scope set out in drawing 8336

	Progress consolidation and retouching of base colours.
	Reinstate gilded stencils

3.9. Panel 04

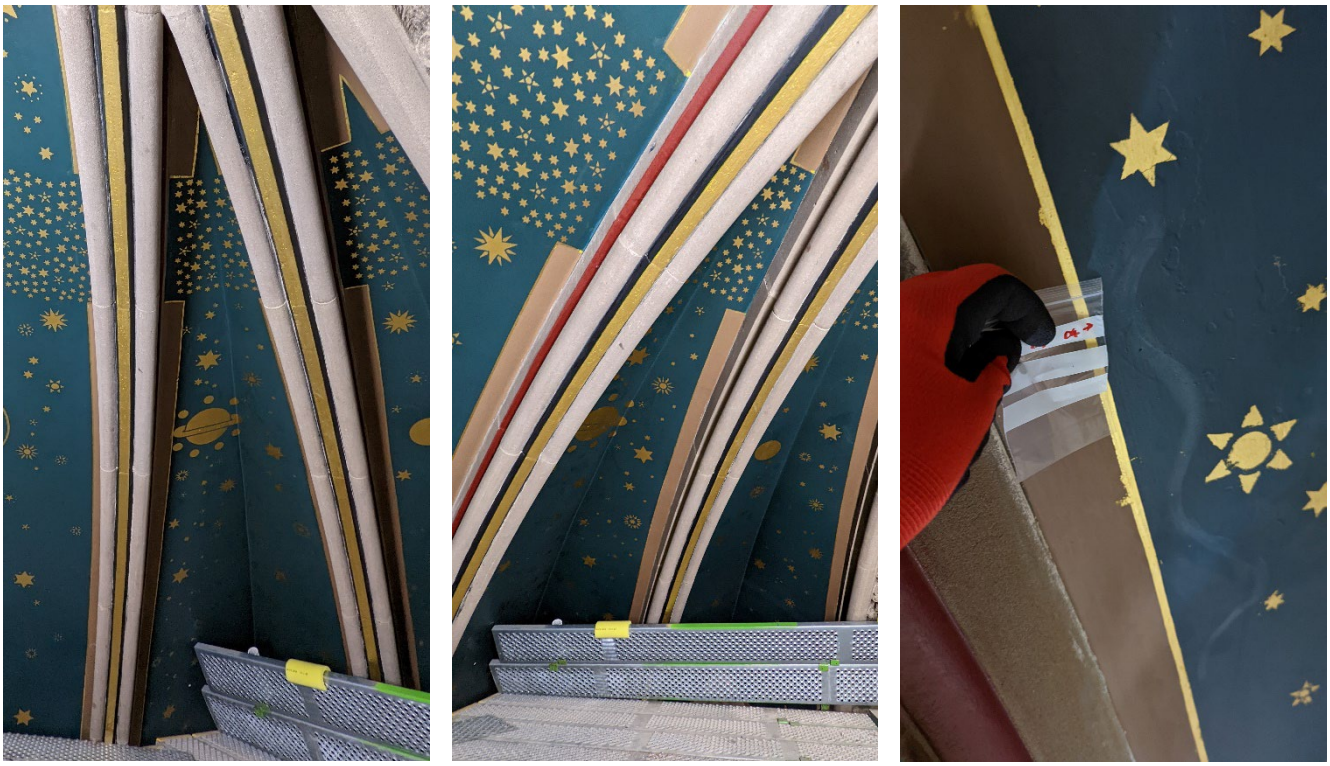


Figure 7: Left, Upper section of panel 4, west side; Centre, upper section of panel 4, west side; Right, detail of underlying decoration (possibly showing comet tail?) and also showing previous paint losses below the existing paint film. May 2022.



Figure 6:Lleft, lower section of panel 4, west side; Centre, lower section of panel 4, west side, both; May 2022; Right, lower section of panel 4, west side, March 2022

Plaster substrate	Tactile and visual inspection indicates that the plaster is generally sound. The west side of the panel has been affected by water ingress, with paint loss flaking to the lower area; the area does not appear to have extended past that shown on drawing 8336.
Painted decoration	Generally in sound condition, although flaking and loss to the west side. There is evidence of the underlying decorative scheme. The topography of drying cracks and previous losses in the underlying scheme was noted, and the applied astral decoration appears to differ slightly to the current format. Paint removal in the areas of failure may lead to loss of earlier, underlying decoration. Losses to the beige border have increased since in March 2022, which appears to be attributable to flaking paint becoming detached.
Works in addition to agreed scope	Following the moisture survey and salt profiile, additional remedial works to the moisture damaged plaster may be required.
Proposed sequence of works	Record stencil decoration in area of loss by photography and tracing.
	Progress cleaning.
	Undertake non-intrusive moisture survey
	Remove flaking paint as per scope set out in drawing 8336
	Progress consolidation and retouching of base colours.
	Reinstate gilded stencils

3.10. Panel 05



Figure 8: Left, Panel 05, east side; Right, Panel 05, west side, May 2022

Plaster substrate	Tactile and visual inspection indicates that the plaster is sound.
Painted decoration	Generally in sound condition
Works in addition to agreed scope	
Proposed sequence of works	Record stencil decoration in area of loss by photography and tracing.
	Progress cleaning.
	Undertake non-intrusive moisture survey
	Remove flaking paint as per scope set out in drawing 8336
	Progress consolidation and retouching of base colours.
	Reinstate gilded stencils

4. Organ Loft Ceiling

4.1. Scope of works

1.10.2: Refix lath and plaster from below, make good with tradition lath and plaster (1m^2)

1.10.4 Repair cracks in lath and plaster 15 l m

4.2. Overview of condition

4.2.1. Plaster



Figure 9: Left, organ loft ceiling looking south; right, organ loft ceiling looking north; organ loft ceiling SE corner. May 2022

There is no access to this area of ceiling from above due to the configuration of the roof space.

The ceiling has suffered from water ingress to the southeast corner, which has resulted in extreme deterioration to approximately 1 sq m in this area. In addition, numerous cracks running transversely across the ceiling, and also diagonally. Localised areas of water damage are present in the south section of the ceiling, occurring towards the east side, and suggesting that multiple, smaller water ingresses have occurred historically.

4.2.2.Paint decoration

The ceiling is currently painted off-white , which is badly discoloured. The discolouration highlights the joists and lath of the ceiling structure. Where water ingress and salt action have occurred, this has led to staining, flaking and failure of the paint films.

4.3. Recommendations

4.3.1.Works in addition to agreed scope

No works are proposed in addition to the agreed scope

4.3.2.Alternative proposed works

Current proposals are to remove the plasterwork to the the SE corner, review lath, reinstate with new where needed and replaster. Additional allowance for crack repairs is included.

Additional tactile survey will be undertaken from access, however visual inspection identified additional points of water and salt damage, together with the cracking to the ceiling.

The ceiling sits over the organ and is usually completely inaccessible. It is likely to be subjected to extremes of vibration, particularly when the lower register of the organ is played. As a minimum, screw and washer fixings to stabilise the ceiling should be employed if the plaster is suitable to accept fixings (subject to additional assessment) and undertaken in accordance with M20 220a of the specification.

Given the location of this ceiling and required resilience to vibration, this is rare instance where over boarding could be considered. Installation of over boarding would retain the original ceiling, but act as a fall arrest for the plasterwork, protecting the organ from any potential falls.

4.4. Proposed sequence of works

Hold point: Review condition of the ceiling with Purcell and MCC to agree scope of works.

5. Walls to Organ Gallery

5.1. Scope of works

2.01.01: General Clean (melamine sponge and deionised water)

2.4.5 Conduct paint analysis to establish paint archology Following analysis, removal all modern 'plastic' paints back to the latest historic paint layer beneath.

Provisional sums:

- Paint removal trials (subject to results of APR)
- Paint Removal (Subject to tests)

5.2. Overview of condition



Figure 10: left, north side flanking wall; right, south side flanking wall.

5.2.1. Plaster

North side flanking wall: cracks apparent within paint film but plaster generally appears stable, where accessible. The ceiling and cornice were also noted to show cracking (no access during this survey)

South side flanking wall: Cracked but appears stable. No high-level access during this survey.

5.2.2.Paint decoration

North side flanking wall: The paint is extremely discoloured by a veil of dirt. Cross section analysis indicates that this is an early scheme of decoration and therefore of high significance (see Appendix 1). Small areas of flaking and loss were noted, particularly to the lower sections. Note: assessment was made while the stone cleaner's masking tape was in situ, additional losses may have presented following removal.

South side flanking wall: One section of the early paint scheme is extant, with the remaining areas overpainted. Initial solubility tests indicate that this paint is a synthetic resin paint. The lower south side is flaking and much of the paint is lost.

5.3. Recommendations

5.3.1.Works in addition to the agreed scope

Access

There is no allowance for works to the ceiling in these areas. The scaffold configuration in this area limits the amount of access and will require amending to allow hop-up access.

Further analysis

Given that the current scheme to the north ceiling appears to relate to the early scheme on the walls, it is recommended that a minimum of 3 paint samples are collected for analysis to inform treatment options.

Further surveys

A tactile survey of the ceiling and currently inaccessible plaster should be undertaken at the same time as paint sampling.

Cleaning of original paint

Cleaning trials to the north flanking wall and ceiling should be undertaken by a conservator to establish the most suitable method in addition to assumption of cleaning with deionised water and swabs/ melamine sponges. Additional trials will include dry cleaning with adsorbent silicone sponges and art gum erasers, cleaning with tri-ammonium citrate at various strengths. Additional cleaning methods may include gels and poultices to achieve an even clean. At this stage, no varnish removal is anticipated.

Consolidation of flaking paint

Areas of flaking paint should be secured in advance of recreation. This will require trials to establish the most suitable material for consolidation and will also be dependent on the results of moisture and salt assessment.

Reintegration of area of loss

Areas of loss will require a conservator to undertake retouching, matching by eye to integrate plaster with the patinated early finish.

5.3.1.Alternative proposed works

Paint removal

Removal of the synthetic resin paint will require trials to establish the most effective method (trials are allowed in current costings). Initial assessment indicates that the paint is readily soluble in acetone, however removal was noted to leave a white bloom on the painted surface. It is likely that paint softeners will affect the underlying paint in this instance and further solvent trials are required to establish a suitable method for safe removal.

Following trials, timings and costs for paint removal may require revision.

5.4. Proposed sequence of works

- Agree options for access with LendLease
- Removal of 3 paint samples from cornice and ceiling bed to north doorway
- Undertake a tactile survey of the ceiling and wall plaster
- Moisture and salt profile to areas of failure
- Cleaning trials to the north flanking wall and ceiling
- Paint removal trials to the south doorway

- Consolidation trials to flaking paint
- Hold point: Review results of cleaning and consolidation trials with Purcell and MCC
- Cleaning to painted decoration
- Consolidation of flaking paint
- Removal of white overpaint
- Reintegration of area of loss

6. Walls to Organ Loft

6.1. Scope of works

2.4.1: removal of defective/ missing area of plaster, renew with two coat plaster

2.4.3 Repair cracks in plaster

2.4.4. Remove peeling paint areas from plaster, prepare and decorate (part area).

2.4.11: Fill hole in plaster (up to 25mm) and make good finishing coat.

Provisional Sums:

- Repainting of organ chamber in one colour, 2 coats, suitable modern acrylic system

6.2. Overview of condition

See

6.2.1. Plaster

The plaster to the walls has suffered deterioration to all elevations. Most defects appear to relate to water ingress and salt activity, including extreme deterioration of plaster to the north wall and south side of the east wall.

In addition, salt pustules and were noted in numerous locations, particularly to the north and south walls. Blown inclusion, overpainted in both the red/ brown paint and white paint, were noted on the east wall and were generally stable. The same pattern of eruptions was noted on the west wall.

Localised areas of hollow plaster were noted to all elevations, often in association with wall mounted metal fixings. This may relate to vibration from the organ in addition to localised condensation forming on the metal surface.

Various losses have been overpainted, indicating that these are historic.

6.2.2.Paint decoration

Cross section assessment of the painted decoration indicates that the exposed red/ brown may be an early finish. The white overpaint is likely to date from the second half of the twentieth century (synthetic resin paint, soluble in acetone).

The painted surface is heavily soiled. Flaking of the paint films down to the substrate is present on all elevations, and often in conjunction with salt pustules.

6.3. Recommendations

Works should progress largely in line with the schedule however the extent of the works requires final agreement on site.

6.4. Proposed sequence of works:

- Hold point: Site meeting to confirm scope and measure of works with Purcell and MCC
- Installation of air scrubber and protection
- Dry clean plaster surface where retained and remove salt pustules
- Removal of salt laden plaster and flaking paint
- Record substrate photographically
- Reinstatement of two coat plaster system
- Crack repairs
- Grouting as agreed
- Hole repairs
- Carbonation period
- Cleaning/ Redecoration/ Integration

7. Proposed changes in scope arising from validation survey

Drawing reference	Item	Proposal	Further additional works which may arise.
8336 – starry night vault	Evidence of potentially significant early scheme found to the south side of the ceiling. This scheme does not appear to reflect the starry night design. Further assessment is recommended to ensure that removal of flaking paint will not lead to loss of key areas of an unrecorded scheme. if this scheme is not extant in the areas to be removed, then removal of flaking paint can progress. Uncovering test to panel 4 to record and understand the early scheme. This is a one-off opportunity before the organ is reinstalled	Site assessment to include visual inspection with hand-held microscope and incision with a scalpel. Collection of up to nine additional samples, targeted to areas of failure (to total two from each area of flaking including sample 02 already taken).	Uncovering tests may require retouching on completion to reintegrate with the current scheme. An alternative approach to the flaking paint may be required if this early scheme is extant in areas of flaking and is of substantial significance.
8336 – starry night vault	Where paint loss is occurring, there is evidence of salt efflorescence, although the plasterwork is generally stable. The moisture survey will be undertaken following dry cleaning, this will allow a suitable treatment to be reviewed with Purcell and MCC. TBC.	A provisional sum for treatment of salts was included under additional costs and will be reviewed and confirmed following moisture survey.	Where plaster is found to be salt laden, options for replacement, reduction of salts or conversion of salts should be considered, along with any considerations for selection of new coatings.TBC
8336- organ loft	The ceiling is plaster on lath, with little access from above. In addition to the very visible damaged caused by water ingress, there is cracking running across this ceiling. The ceiling is directly over the organ and is therefore likely to be subject to high levels of vibration of various frequencies. Whilst the ceiling could be	Purcell and MCC to review options for stabilisation to the ceiling. If over boarding is undertaken, it would be better if this was undertaken by the contract plasterers and outside the scope of Hirst Conservation.	

	secured with screw and washer fixings, given its location and function, in this instance over boarding offer a more secure long-term option for preservation of the organ. Usually recommended for historic ceilings, however, once the organ is reinstalled, there will be no access to this area to undertake any repairs in future.		
Organ Gallery: North and South Flanking wall	There is currently no allowance for works to the ceiling in this location. The decoration may be coeval with the early scheme on the wall.	Undertake condition assessment of the ceiling (note access required, not possible from current configuration of scaffold). Allow for assessment of 3 number paint samples.	
		Allow for potential stabilisation of the plaster in this area following survey.	
	The painted decoration may require additional/ alternatives methods to sympathetically clean other than those specified in the schedule	Cleaning trials to painted decoration	Additional cleaning works to early decorative schemes
	Flaking of the early paint scheme was noted.	Consolidation trials to north doorway	Consolidation works to significant painted decoration
	Retouching of loss is currently not included under item 2.4.5	Allow for retouching following removal of overpaint and consolidation.	
Organ Loft Walls	Assessment on site indicates that there may be additional works/ variation in scope to the organ loft walls.	Scope of work to be reviewed with Purcell and MCC	TBC

Appendix 1: Paint Analysis

1. Methodology

1.1. Collection of Paint samples

Samples were taken using mechanical means using a small chisel and hammer or scalpel, given individual reference codes and the sample sites recorded photographically and diagrammatically. The majority of samples were taken using a scalpel in order to reach the small areas in which earlier paint layers were likely to survive. Sample locations are recorded within the body of the report.

1.2. Microscopic Assessment of Samples

The samples were mounted in clear casting resin and polished to provide a cross section through the paint layers. Assessment at 100x or 200x magnification in incidental light allowed the layer structure to be assessed. In addition, fluorescence microscopy was employed to identify the basic stratigraphy of paint schemes and to establish basic composition of paint films. Assessment of samples in incidental light and UV fluorescence allows each scheme to be identified though dirt films, 'oiling out' layers, fading of upper surfaces of films and variations in fluorescence properties.

1.3. Microchemical Analysis of Paint Films

Further investigation of key layers was achieved by a microchemical tests (Plesters, 1956). Assessment for lead content was undertaken on selected samples in the laboratory was undertaken using dilute sodium sulphide (Na2S). The presence of zinc was tested using a solution of dithizone.

2. Results: Starry Night

2.1. Sample locations

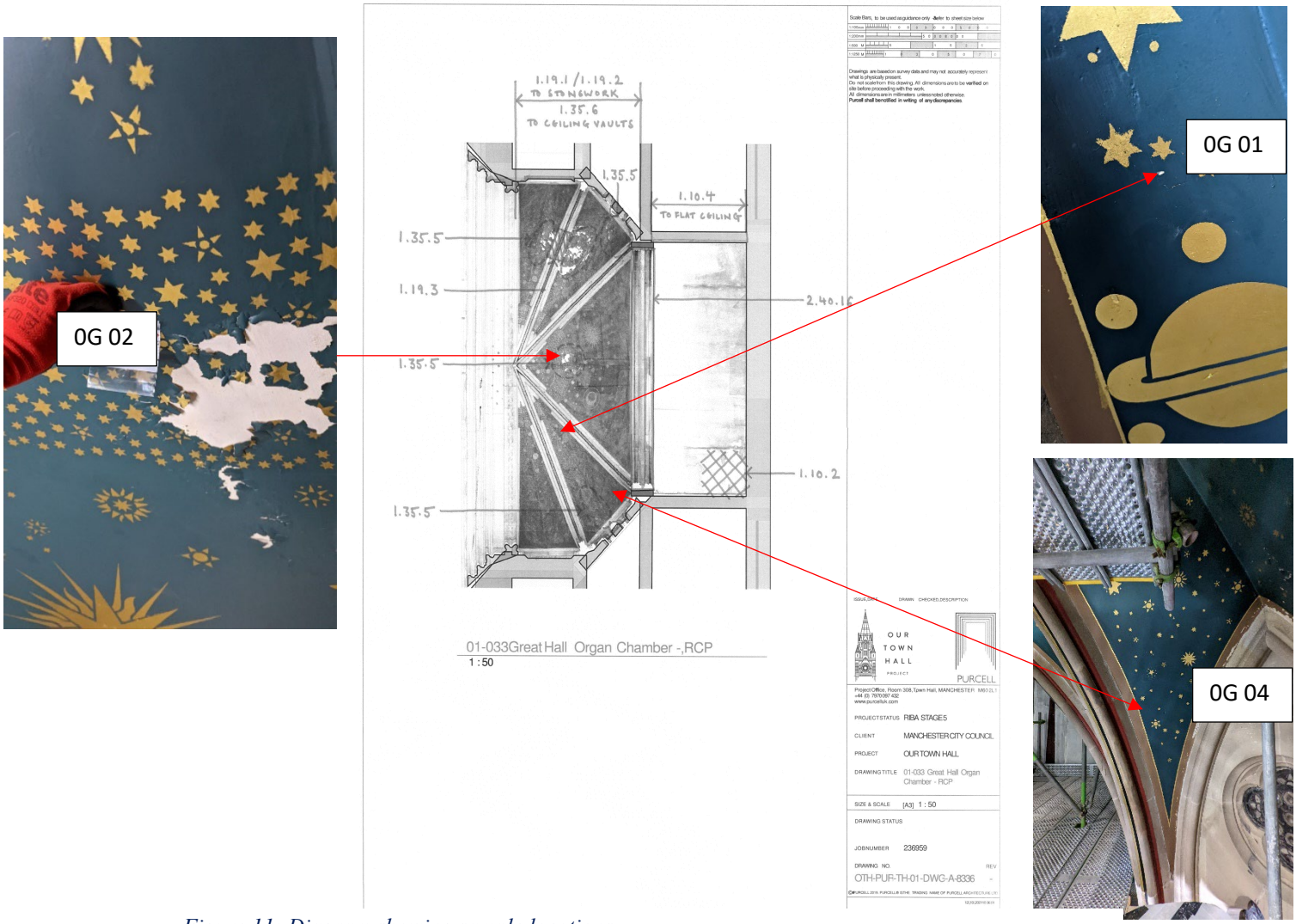
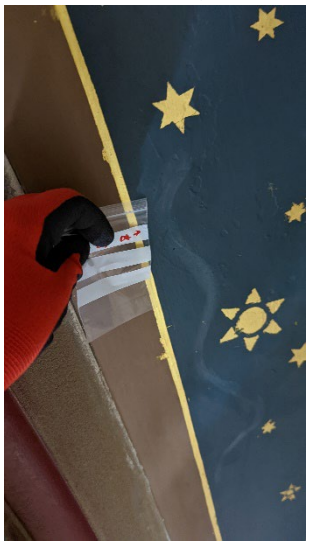


Figure 11: Diagram showing sample locations.

2.2. Assessment of paint strata

2.2.1.Key sample: 04 (panel 4)

Selection of sample site



During site inspections in raking light, a wavy line was noted on the LHS of the panel and did not reflect the current placement of stars, suggesting a variance in application of decoration. Sample OG 04 was collected from this site to better understand why this variation may have occurred. Comparison with other samples from the ceiling (samples 01 and 02) indicate that there is an additional, early paint scheme in location 04 that is not present in the other locations.

The line was enhanced on site by movement of surface lying dust, this can be seen in the sample location photograph.

Figure 12: Sample 04 location, showing location of wavy line.

2.2.2.Results of assessment

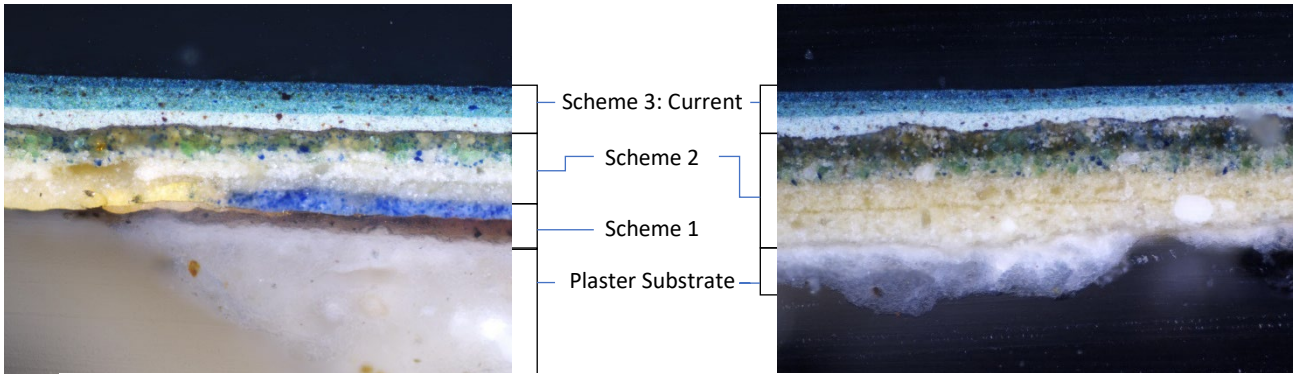


Figure 13: Sample 04, left in visible light, right Sample 01, left in visible light, images taken at 200x magnification. Magnification to print not calculated.

Assessment of sample OG 04 indicates that there are three paint schemes:

- Scheme 1, the earliest scheme, utilised gold and ultramarine blue (scheme 1). This is only found in sample OG 04. .
- Scheme 2 is similar to the blue/ green background found on the panels to the great hall, although preparation layers vary.
- Scheme 3 is the current scheme of green/ blue synthetic resin paint.

2.2.3.Scheme 1

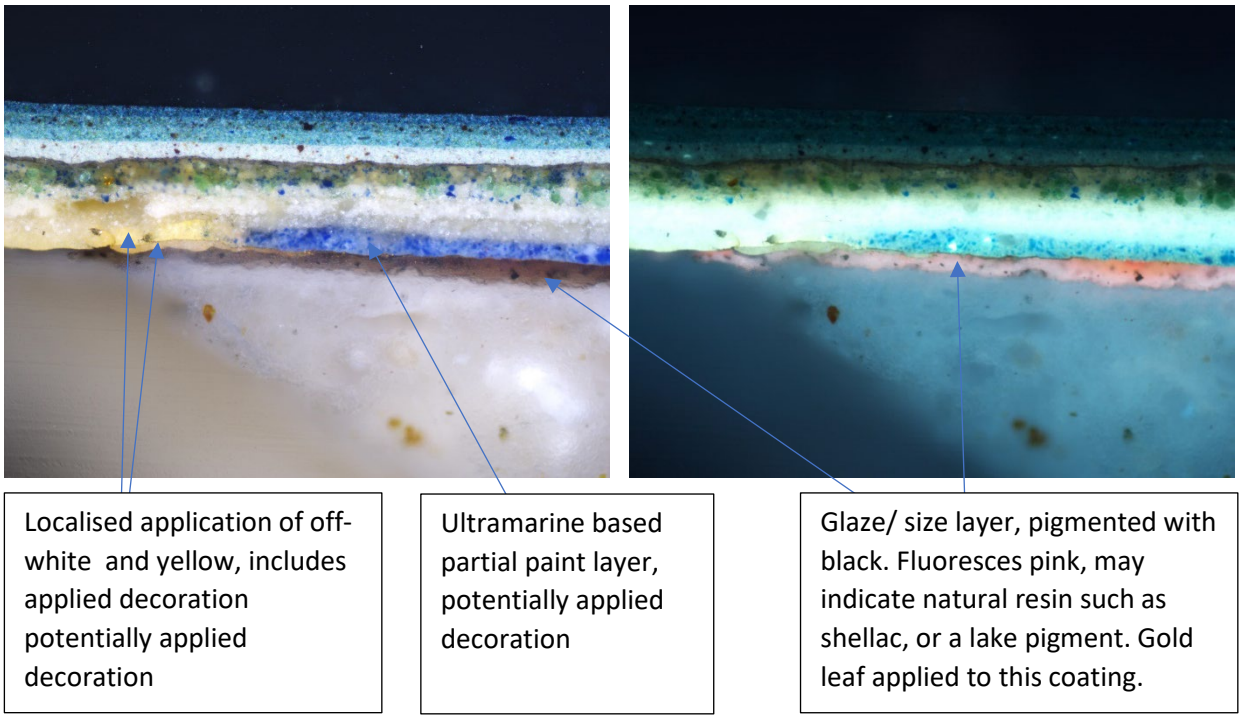


Figure 14: Sample 04, left in visible light, right under UV illumination, images taken at 200x magnification. Magnification to print not calculated.

Evidence indicates that this is the remains of an ornate scheme of decoration. Further sampling, analysis and on-site investigation is required to better understand the nature of this scheme, which included gilding and the potential use of applied decoration. The irregular particle size of the ultramarine could indicate that this is natural ultramarine and therefore an expensive finish, however this would require further analysis to confirm.

2.2.4.Scheme 2

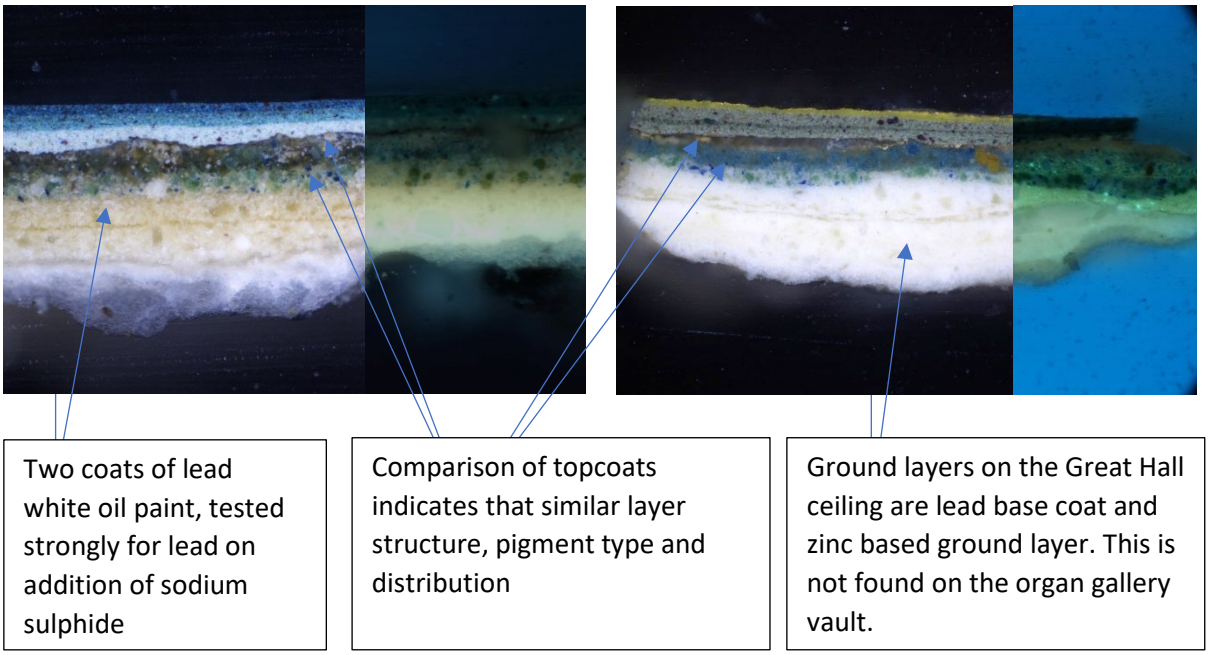


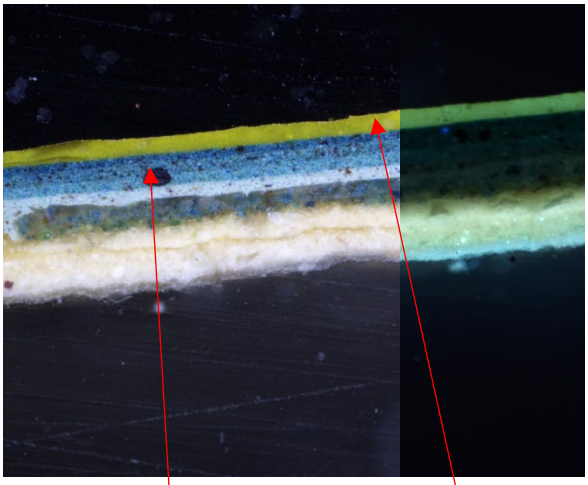
Figure 15: Left: Sample 01, left in visible light, right under UV illumination; right, sample 06, Great Hall ceiling, panel 04, Canada (April 2021). Images taken at 200x magnification. Magnification to print not calculated.

Assessment of scheme 2 shows strong similarities with the background colour to the Great Hall Ceiling Panels. The build-up of the colour in two coats is very similar, as it pigment distribution and pigment type. Microchemical testing of these paint films indicates that the blue pigment is ultramarine (stable on addition of sodium sulphide, blanched on application of dilute hydrochloric acid). The pigment morphology of the green pigment suggests that this is copper arsenate emerald green. Additional analysis is required to confirm.

Like the Great Hall panels, the ground to the blue green is made up of two coats of paint. However, in the organ gallery these are lead white based paints, there is no evidence of the zinc ground layer found on the Great Hall panels.

Additional sampling is required to identify gilding in this scheme.

2.2.5.Scheme 3



Blue colour is built up with four applications, starting with a light grey/ blue undercoat	Gilding is applied with yellow pigmented oil size.

Figure 16: Left: Sample 02, left in visible light, right under UV illumination. Images taken at 200x magnification. Magnification to print not calculated.

The current scheme is a synthetic resin paint. The colour is built up over four coats of paint, starting with a light grey undercoat, and followed by progressively deeper blue/ green paints.

The gilding was applied by stencil over a yellow oil size.

2.3. Conclusions

Assessment of the three samples from the ceiling indicate that there are three paint schemes. The earliest scheme was only found in panel 4, and may represent a significant, early scheme.

Scheme 2 is closely allied to the decoration identified on the ceiling panels. This could be attributable to works undertaken in 1894 to the great hall ceiling, and as part of the enlargement of the organ at that time.

Scheme 3 is a synthetic resin paint, more likely to date to the latter half of the 20th century. The surface topography suggests that the earlier paints have been partially lost in several areas.

3. Results: Organ Gallery flanking walls

3.1. Sample locations



Figure 17: Sample locations, south flanking wall

Four samples were collected from the flanking wall:

- OG 05: Upper wall colour (current drab colour)
- OG 06: Black dado line. In raking lightly, there appears to be overlapping coatings.
- OG 07: Dado, brown.
- OG 08: White overpaint to dado.

3.2. Results of assessment

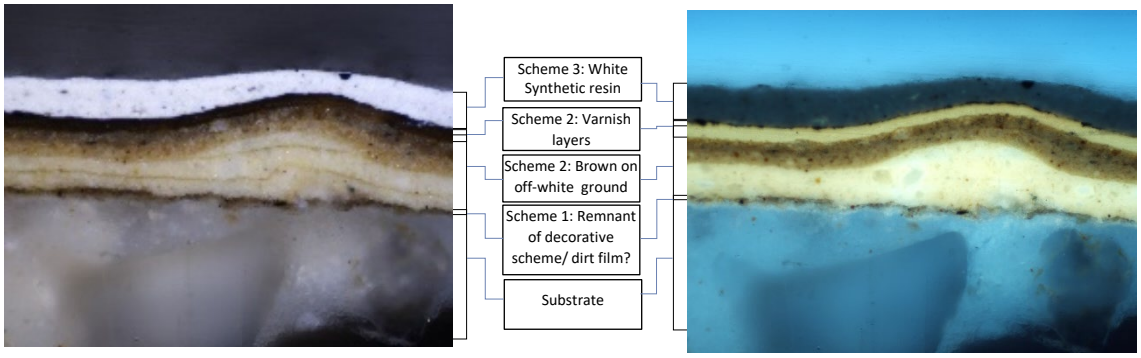


Figure 18: Sample OG 08, left in visible light, right under UV illumination at 200x magnification.

There are three schemes on the flanking walls.

Scheme 1: Potential traces of an early scheme of decoration, observed in all four samples.

Scheme 2: The current scheme seen to the north flank and still partially extant on the south flank. The lower wall has been twice varnished.

Scheme 3: Partial overpaint to the north flank with white synthetic resin paint.

3.2.1.Scheme 1

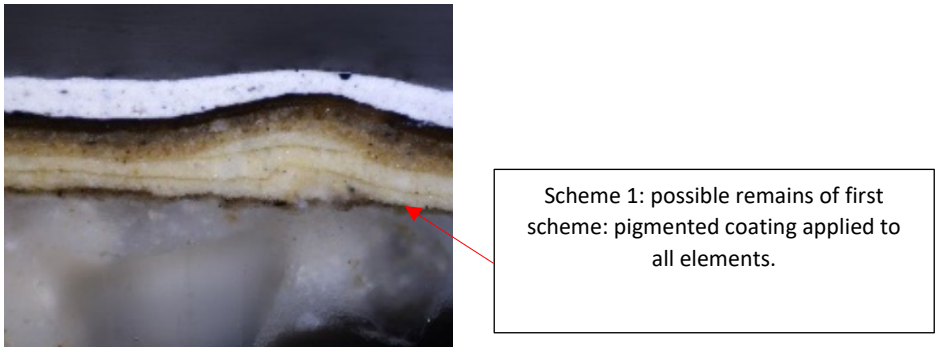


Figure 19: Sample OG 08, left in visible light at 200x magnification.

All samples show evidence of a thin coating applied directly to the plaster substrate. This is pigment (in the case of OG 08, red and black pigmentation was observed). This may represent a builder's finish, or may be remnants of the first decorative scheme.

3.2.2.Scheme 2

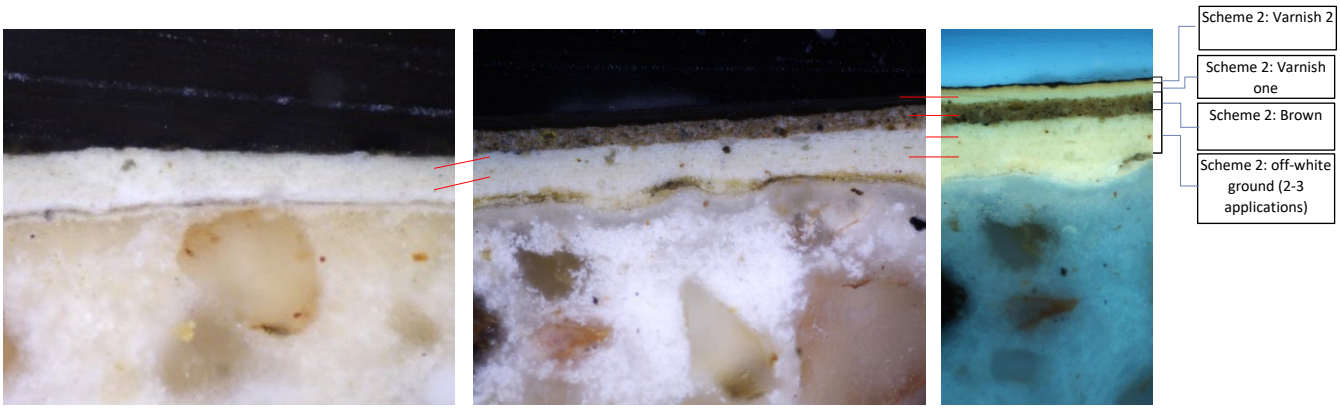


Figure 20: From left: Sample 05, upper wall, visible light, centre, 06, dado, visible light, right, 06, UV illumination.

Scheme 2 is the first complete finish on the walls, and is still extant on the upper wall area of the north flanking wall, and partially exposed on the opposite south wall.

The upper wall was painted with an off-white lead oil paint, which has become heavily discoloured with dirt. This is not varnished.

The lower wall was painted with the same off-white ground, with the brown colour applied over. The dado was defined by four parallel black lines.

The lower wall received two coats of varnish, to create a more resilient finish. This may account for the slight variation in colour on the dado border.

3.2.3.Scheme 3

Whilst scheme 2 has been retained on the north flanking wall, sections of the south wall have been overpainted with a white, synthetic resin paint which is readily soluble in acetone.

3.3. Conclusions

Assessment of the three samples from the flanking walls indicate that there are three paint schemes.

Scheme 1 appears to be remnants of an early film, pigmented with red and black.

Scheme 2 has the same base coats as the starry night ceiling, and may be coeval. This scheme is still extant on the north flanking wall.

Scheme 3 is a synthetic resin paint, more likely to date to the latter half of the 20th century.

4. Results : Organ Loft

4.1. Sample locations



Figure 21: Sample locations, south flanking wall

Two samples were collected from the east (rear) wall of the organ gallery:

- OG 09: Lift 2, area of white overpaint
- OG 10: lift 2, earlier red/ brown coating

4.2. Results of assessment

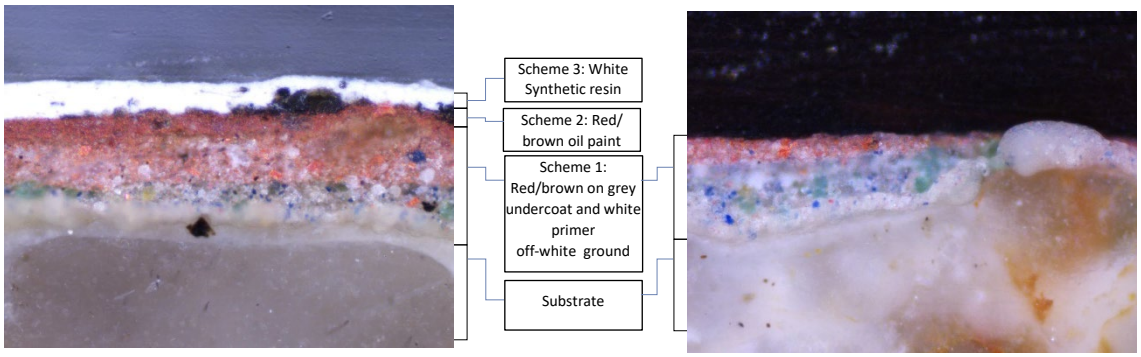


Figure 22: Left, Sample OG 09; Right, sample OG10. Both images 200x magnification in visible light, magnification to print not calculated.

There are three schemes on the organ loft walls.

Scheme 1: (based on current evidence) White primer, grey primer composed of blue green from the ceiling with additional red and black pigmentation, red topcoat. On site investigation required to confirm. Applied to all wall surfaces, suggesting that this predates organ installation in 1877.

Scheme 2: Red topcoat, applied selectively, indicating that this postdates the organ installation and was colour matched to the existing. This may relate to organ works in 1893 or 1912.

Scheme 3: Partial white synthetic resin paint applied around organ mechanism.

Scheme 1

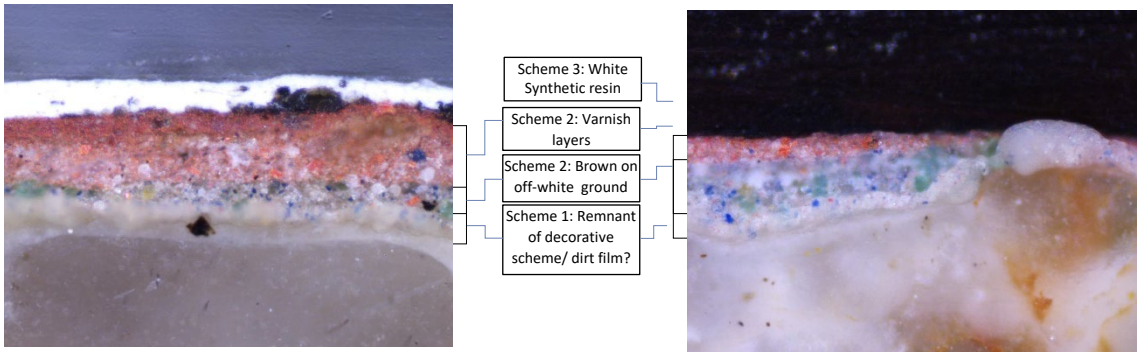


Figure 23: Left, Sample OG 09; Right, sample OG10. Both images 200x magnification in visible light, magnification to print not calculated.

The exposed red/ brown coating to the rear wall may be the original paint scheme. Cross section assessment shows three paint coatings: a white/ off-white primer, with grey undercoat and red topcoat. The grey is composed of blue and green used on the ceiling, plus black, red and yellow. Historically, decorators reused waste paint to form undercoats, which is the most probable explanation for this coat. It was common to use a grey undercoat for dark colours such as red. Further on site assessment is required to confirm. Applied over the grey undercoat is a red topcoat, which is still extant where not overpainted with white.

Scheme 2

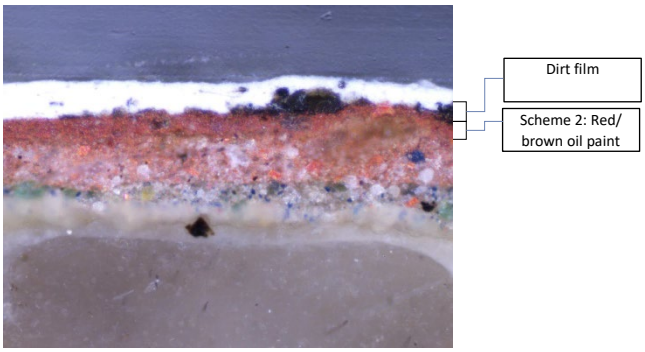


Figure 24: Sample OG 09; 200x magnification in visible light, magnification to print not calculated.

Scheme 2 was not found in sample 09, suggesting that many areas were inaccessible for repainting due to the organ mechanism. The paint applied was a red/ brown oil paint, which would have closely matched the earlier finish. A heavy dirt film was noted in cross section.

4.2.1.Scheme 3

Sections of the organ loft walls have been roughly overpainted with a white, synthetic resin paint, which is readily soluble in acetone.

4.3. Conclusions

Assessment of the three samples from the organ loft walls indicate that there are three paint schemes.

Scheme 1: dark red applied over grey undercoat on white primer.

Scheme 2: Partial red/ brown applied where accessible around organ mechanism. May relate to later works to the organ in 1893 or 19112.

Scheme 3: Synthetic resin paint, applied around organ mechanism, more likely to date to the latter half of the 20th century.

Appendix 2: Salt Analysis

Water Soluble Salt Analysis for Sample MTH OG 03 25/06/22

Location



Description

The sample is a fine white powder intermixed with green paint and gold leaf fragments

Figure 25: Location of sample, panel 02

Method

To determine the soluble salt content within the sample material a measured mass of the sample was dispersed in a measured volume of de-ionised water. The solution was gently heated and agitated to dissolve all water soluble components.

On cooling the final volume of the 'solution' was measured and Merckoquant® universal indicator strips were used to determine the ppm or mg/l of each component in the solution, which were then calculated as % of the relevant sample.

Results

pH	%Sulphates	%Nitrates	%Chlorides
7	100%	Negligible	Negligible

- Flame tests were negative for calcium, sodium, potassium and other relevant cations.
- A test with alkaline Magneson reagent gave a blue colouration indicating a high concentration of magnesium

Conclusions

The tests indicate the salts are essentially Magnesium Sulphate.

Appendix 3: Stabilising Sulphates, adaptions of the Ferroni-Dini Method

Introduction

If a plaster or mortar is dolomitic then magnesium sulphate may become the main problematic salt which disrupts the material particularly if water ingress is or has been an issue.

Magnesium sulphate causes damage, because it is hygroscopically active at 'normal' RH values. It disrupts the fabric of the painting in its several hydration states due to the variable pressures it exerts during hydration phase changes within the pores of the painting.

Desalination poultices may extract soluble magnesium sulphate, however it may also move salts around in the plasterwork.

In general, when barium hydroxide treatment is carried out on wall paintings, the main problem salt is calcium sulphate on the surfaces (usually from the reaction of calcium carbonate in damp lime plasters with sulphurous atmospheric pollutants). Consequently, an ammonium carbonate poultice is first applied, for some protracted period, to convert the quite insoluble calcium sulphate to very soluble ammonium sulphate, which then will convert much more readily to barium sulphate and calcium carbonate:

$(NH4)_2CO_3$ + $CaSO_42H_2O$ → $(NH4)_2SO_4$ + $CaCO_3$ + $2H_2O$
Ammonium carbonate Gypsum ammonium sulphate Calcium Carbonate water

$Ba(OH)_2$ + $(NH4)_2SO_4$ → $BaSO_4$ + $2NH_4OH$

Barium Hydroxide + ammonium sulphate → Barium Sulphate Ammonium Hydroxide

NH_4OH → NH_3 + H_2O

Ammonium Hydroxide ammonia water

However, given the very soluble nature of magnesium sulphate (about 35% in water, the same as table salt), if magnesium sulphate is the main problem salt, ammonium carbonate poultice conversion of any errant 'insoluble' gypsum (calcium sulphate) to soluble ammonium sulphate is note required, and salt stabilization can be undertaken with barium hydroxide.

Method for Dolomitic Plasters:

Barium hydroxide applied in solution will not only convert the magnesium sulphate into stable, water **insoluble** barium sulphate (and similarly any other soluble sulphates present, but probably little if any gypsum) but also produce magnesium hydroxide and calcium hydroxide, both of which will eventually carbonate, by reaction with carbon dioxide in the air, to their respective carbonates. See the process details given below:

$Ba(OH)_2$ + $MgSO_4$ → $BaSO_4$ + $Mg(OH)_2$

Barium Hydroxide + Magnesium sulphate → Barium sulphate + Magnesium hydroxide

The barium sulphate is insoluble so cannot cause salt problems, and the magnesium hydroxide carbonates to insoluble magnesium carbonate, which cannot cause salt problems and additionally will help to consolidate the plaster if this is disrupted.

Sometimes a slight bloom of salts from the magnesium hydroxide/carbonate might form but this can be removed.

Therefore, this method renders harmless any damaging effects of soluble magnesium sulphates (and other salts).

Ideally analysis of the substrate/support plasters is required to determine its composition and the percentage of soluble salts contained within it e.g. (magnesium/calcium sulphates, nitrates etc.).

Process Details showing how stabilization and consolidation reactions also occur:

Note: the reactions shown are for stabilisation of magnesium sulphate, but **similar reactions occur for any other soluble sulphates in solution (and some calcium sulphate as well).**

1. **Precipitation of the insoluble salts (conversion of magnesium sulphate to stable barium sulphate):**

$$MgSO_4 + Ba(OH)_2 \rightarrow BaSO_4\downarrow + Mg(OH)_2$$

The magnesium hydroxide carbonates to insoluble magnesium carbonate, thereby consolidating the plaster, in the same manner as lime (Calcium hydroxide) in lime water:

$$Mg(OH)_2 + CO_2 \rightarrow MgCO_3 + H_20$$

2. **Any excess barium hydroxide will carbonate to barium carbonate which will also help consolidate the plaster:**

$$Ba(OH)_2 + CO_2 \rightarrow BaCO_3\downarrow + H_2O$$

There may be an exchange reaction between any existing calcite or magnesite/dolomite grains in the plaster and the barium hydroxide, where the outer surface of these grains turn into their respective hydroxide gels while barium carbonate may also accrue on other crystals:

$$Ba(OH)_2 + CaCO_3 \rightarrow BaCO_3\downarrow + Ca(OH)_2$$

$$Ba(OH)_2 + MgCO_3 \rightarrow BaCO_3\downarrow + Mg(OH)_2$$

Any magnesium hydroxide formed will re-carbonate increasing the consolidating effect:

$$Mg(OH)_2 + CO_2 \rightarrow MgCO_3\downarrow + H_2O$$

IMPORTANT NOTE: The method should not be used in the presence of a high concentration of nitrates or organic binders.

Nitrates will result in the formation of barium nitrate, which is slightly soluble leading to its visible crystallization on the surface. The organic binders in tempera or oil paintings do not tolerate the high alkalinity of barium hydroxide in high concentrations in water, resulting in their hydrolysis or saponification. In old paintings, these organic binders have largely transformed into inorganic compounds such as calcium oxalate and the above reactions will not necessarily take place, the use of this method can therefore be justified.

Appendix 4: Organ Loft Walls, Record of Condition May 2022



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