



Examination of condition
of Glyde mural in
University of Alberta
Library

for

University of Alberta, Museums and
Collections Services
Edmonton, Alberta (AB), Canada

January 16, 2019

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Fine arts

Report No.
131594



Canadian
Conservation Institute

Institut canadien
de conservation

Canada

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CCI advances and promotes the conservation of Canada's heritage collections through its expertise in conservation science, treatment and preventive conservation. CCI works with heritage institutions and professionals to ensure these heritage collections are preserved and accessible to Canadians now and in the future.

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Condition Report and Treatment Proposal

CCI Number: 131594

Division/section Reference Number:

Artifact name: Mural
Artifact title: Alberta History
Accession No.: 1965.34
Attribution: Henry George Glyde
Artifact Date(s): 1950-1951
Institution/Owner: University of Alberta Art Collection
Artifact description: Casein paint on plaster depicting Fort Edmonton in the background and clusters of people in the foreground; indigenous peoples, settlers and priests.
The mural is a composite of scenes and events in Alberta history from the mid-nineteenth century.

Dimensions * measured approximate

height: 93 ½" (237.5 cm)

length: 256.75" (652.15 cm)

Condition Summary (Optional): Poor: extensive cracking, heavy in certain locations (lower half of the painting), lifting, cupping, flaking paint and heavy losses in specific areas, especially in lower portions of the painting.

Artifact examined by: laboratory museum storeroom gallery

Examined by: Wendy Baker, Marie-Hélène Nadeau

Proposed treatment reviewed by (N/A):

Date: January 9-10, 2019





Introduction

The Canadian Conservation Institute was invited to examine the Glyde mural, *Alberta History*, at the beginning of 2019 to determine its condition and to advise on possible treatment options. This mural has been of concern to the client for a number of years. A series of examinations beginning in the early 1980s by different conservation professionals and University of Alberta staff has deemed the casein-based mural to be in a precarious condition with significant treatment challenges. Condition issues likely began shortly after execution of the painting and may be due to a confluence of factors such as chemical changes due to hydration of components in the finishing coat of plaster, application of the finishing coat of plaster on a too-dry plaster wall and/or high tension contraction of the paint medium as this dried. Environmental factors such as fluctuating humidity, low humidity during the winter months and high temperatures during the summer months may also be contributing agents.

This report will detail the artist's technique, as this is documented by various sources, and by visual examination. As much of the failure of the paint is confined to certain regions of colour and texture, this might help to focus on a specific cause of deterioration. Results from an Analytical Report prepared by the CCI in 1983 will be reviewed, as well as observations made by a number of conservators and University of Alberta staff beginning in 1980. These observations make apparent that the paint failure was clearly critical at that time, and has continued to worsen.

Artist's technique

Glyde was a skilled painter in egg tempera which is a fast drying medium applied in short strokes of the brush. This mural, planned as an exercise for his art students at the University of Alberta, was executed in Prisma colour pencils and casein which he used in an egg-tempera like style of cross-hatched and parallel lines. It is possible that he combined egg-tempera in the composition, but this has not been confirmed.

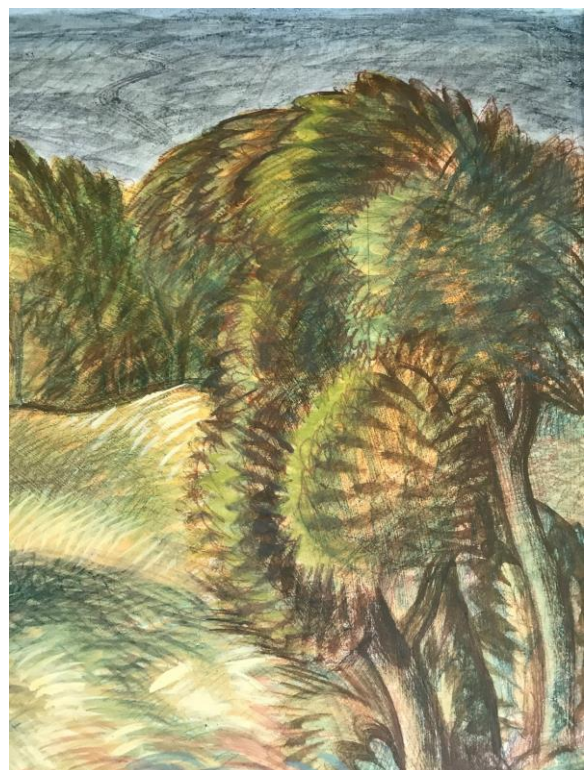
The plaster wall onto which the painting was executed is composed of a gypsum-lime plaster. There is a fine finishing layer of plaster over a smooth undercoat. It has been suggested that a sizing layer of some kind may have been applied to the fine coat of plaster to seal this. This layer has yet to be detected. It is most probable that a coating of thinned and coloured casein was applied to the plaster to provide a base coat and working surface for subsequent paint layers. The colour, where it can be seen, is a yellow-ochre (see background toning in **Figure 1**). The image was projected onto plaster wall which was squared off in 6" x 6" graphite pencil grids which were further bisected with diagonally placed lines. The image was traced out using graphite pencils and Prisma colour pencils. The painting appears to have been carried out using an ammonium-based casein paint. This was combined with highlighting and building up of form using the Prisma colour pencils which make up a considerable amount of the design application. The artist was also known to use egg tempera, and it is unclear whether this medium may have





been used in part for the composition. The paint and coloured pencil lines are applied in strokes which very much resemble egg tempera painting (**Figure 2**). The paint application varies between the top half to 1/3rd of the painting which is executed mostly above the very thin application of yellow-toned casein that penetrated into the plaster. This is supplemented in the top sections by thinly-applied strokes of colour and linear drawing and cross hatching with the Prisma coloured pencils (see **Figures 1 and 2**). This technique continues to be use into the lower half of the painting, however, the artist chose to apply heavier brush strokes of casein or casein-like paints to execute the composition (see **Figures 3 and 4**). In areas of high decoration, such as clothing and jewelry, there may be up to three layers of paint.

Although the materials purportedly used by the artist- casein, (egg-tempera?) and Prisma coloured pencils are not water-sensitive, some of the paint found on the mural- most specifically the white detailing and highlights, proved to be very soluble in water (**Figure 5**). The application of this paint appears to be part of the original design, however, much of the reconstruction of areas of damage to the mural have also been carried out in a highly water-sensitive paint- likely distemper.



Figures 1 and 2: Prisma colour pencils form much of the design in top portion of the mural (left), and are incorporated into elements of casein painting (right). In right image, prisma colours and casein are applied in fine strokes reminiscent of egg-tempera technique.





Figures 3 and 4: casein and or egg-tempera combine with prisma colours in lower sections of composition where layering of paints and pencil is common.

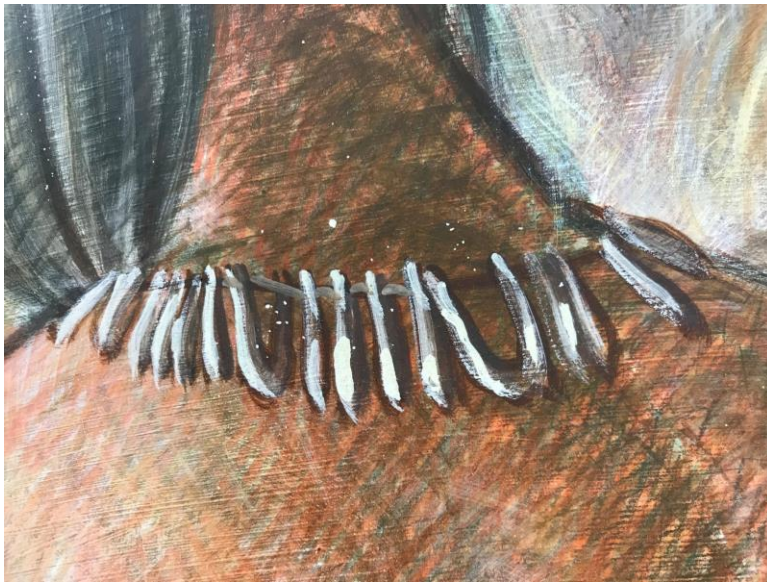


Figure 5: Heavy application of white paint on details such as clothing and jewelry may be rendered in a water-soluble tempera paint, either by the artist, or as a later addition





Concerns with casein-based paintings

Casein is a highly brittle material when dry and can contract sufficiently, especially if exposed to unfavorable environmental conditions, to cause cracking and delamination from the supporting structure. If this structure has little tooth (no keying ability), the paint can easily flake, peel back on itself and fall away. The artist likely prepared the plaster wall with a thinned out casein wash (as suggested above), however, the layering of the casein supplied sufficient contractive force to pull this away from the plaster surface. Many of the samples of flaked paint that were retrieved over the years from along the bottom edge of the frame indicated that the paint had pulled a thin layer (intonaco) or fine layer of plaster with it. This suggested a weakness in the plaster layer which could have allowed the paint contract and peel away. There are areas of the painting, however, that still retain the fine coat of plaster along with Prisma colours and some lightly applied design elements (presumably casein). It may be an unfortunate coincidence that the finish coat of plaster was unable to withstand the contractive forces of heavy layers of a casein or casein-like paint.

Analyses of paint flakes and plaster by CCI (taken from ARS Report, 2105, 1983)

Six paint with plaster samples were analyzed by CCI, 1983. These samples were collected both by Ian Hodkinson, Professor MAC program at Queen's University, Kingston in 1981 and two years later by Leslie Carlyle, Fine Art Conservator, CCI. Findings indicated multiple paint layers over a thick (50 micron) layer of plaster. The plaster adhered to the verso of the paint flakes contained BaSO_4 (blanc fixe) + ZnS (=lithopone), $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ (gypsum), CaCO_3 (calcium carbonate), and CaSO_4 (anhydride) as well as traces of magnesium, aluminum silicon and iron. These are all typical findings for a lime putty gaged with plaster of Paris or a lime-gypsum plaster. Scrapings from the plaster wall (below the finishing plaster layer) did not show gypsum- only CaCO_3 and lithopone. It is possible that the underlying plaster wall is a lime plaster.

The failure was found, in all cases, to be between the finishing plaster layer and the underlying plaster base.

Speculations for failure of adhesion (ARS Report 2105)

- One possible cause is the slow hydration of magnesium oxides in the plaster wall which could cause bulging and delamination.
- Another is the possibility of having applied the final coat of plaster to a too-dry plaster wall. Moisture would be absorbed by the underlying plaster wall, leaving the intonaco layer underbound, weak and crumbly.
- If the casein paint is overbound (too much medium) the contractive force of the paint can cause delamination due to high tension on drying.





Speculation for failure of adhesion based on previous observations, analysis and current observations

- Failure is localized- this suggests that the action causing delamination is not necessarily related to chemical changes in the plaster layer (e.g. hydration of magnesium oxides), nor to the dryness of the underlying plaster when the intonaco plaster was applied.
- Failure of adhesion is largely found in areas where the paint is more heavily applied or layered.
- Losses appear to be greatest in certain colours (dark browns, blacks and dark greens). It is possible that these colours cause additional shrinkage of the medium. This is known to happen with inorganic pigments where overloading of the pigment to medium can cause embrittlement of the ensuing paint layer.
- Areas where there is only a thin wash of casein colour with graphite and Prisma colour pencils, the decorative surface is very intact (top third of the painting).
- It is plausible that the layering of the casein (and possibly egg tempera) have caused very large tension stresses during drying which were sufficient to compromise the underlying intonaco layer which is the weakest point in the compositional layers.
- Fluctuating humidity has likely also created an environment which would induce further movement in the paint layers. Long periods of low humidity will cause curling of delaminating paint layers, lifting and eventual loss.

Previous Examinations

A listing of previous examinations indicates that starting in 1980, lifting, cracking, cupping, crumbling and loss in specific regions (lower 2/3's of the painting, and in certain, darker colours) are characteristic of the behavior of the mural painting. No notations occur previous to the 1980s, however, it is clear that significant damage had occurred earlier given the extent of reconstruction noted in the January 2019 examination. There was a suggestion by one of the examiners, Helen Collinson, curator, that there may have been damage to the mural as early as the mid-1950s which was touched up either by the artist or students. This repair or reconstruction of missing areas appears to be concentrated in regions where the paint was applied more heavily (along the lower edges). Losses and reconstruction of original material in these areas appears to be extensive.





Date	Examiners	Conditions Noted
16/10/2015	J. Bowser, J Tofflemire, Conservators	Accretions, soling (overall), shrinkage of paint (overall), cleavage, cupping (overall) flaking (overall), scratch
10/6/2013	S.T. Kraichy	Poor overall condition, no obvious change from previous report of 2012 (notes abrasion, soiling, embrittlement, flaking, loss)
18/7/2012	M. Hecht	Poor overall condition, abrasion, soiling, flaking, embrittlement, loss. Notes that condition issues have worsened since 1984 in areas of dark paint (hair, clothing, barrel of gun, eyes of oxen). New area of flaking noted in horse's ear
29/9/1993	J Chlopicki, Conservator	Lists condition issues as soiling (dust), flaking. Proposes treatment.
9/10/12/83	S. Lawrence, Conservator	Cites increases in paint loss since the last examination, even in areas of overpaint such as the wagon wheel and backs of seated figures
1981-83	I Hodkinson and L. Carlyle (CCI)	Ian Hodkinson carries out tests and removes loose flakes (1981) and L. Carlyle removes loose flakes (1983) for analyses by CCI. CCI Analytical report ARS 2105 (1983)
18/07/1980	H. Collinson, Curator, Art Collections, Museums and Collections	Notes that some areas of the mural were losing large amounts of paint. On close examination states that paint is flaking and friable. Loss





	Services, U of A. S. Heth	noted on areas of heavier applied paint- flesh on backs of figures, cupping of paint on gun stock, some faces disintegrating. Notes that edges of the painting are alright. Mentions that wall paint applied in 1979 and that some paint has dripped onto surface of the painting. Notes that a ceiling leak had occurred east of the mural- not clear whether this might be related to damage. Also notes that the room was very hot in the month of May. States that the painting condition has deteriorated since S. Heth inventoried in April (1980), and when H. Collinson has last seen the work (date not given).
1980	Lisa Mibach, (conservator) H. Collinson (curator)	Notation on file of an examination of the mural by H. Collinson and L. Mibach where it is stated”.....the painting began flaking about 5 years after it was painted, and was touched up at that time (whether by the artist or by university students is not known....”

Testing materials from past interventions

Several conservators were called in to test possible solutions to address the flaking and loss of paint. Sandra Lawrence, in December 1983, tested a number of adhesives. These adhesives were used in conjunction with [REDACTED], a powerful solvent used to soften paint. Softening and relaxing down the concave paint was considered a





necessary step in achieving a successful re-adhesion to the plaster substrate. Casein, is however, a paint medium which is impervious to most solvents, and softens slowly-taking days to respond to solvent treatment.

██████████ was added to the following adhesives in ██████████% by volume.

Ian Hodkinson, in 1981, tested, according to the report prepared by S. Lawrence in 1983:

Results of consolidation tests

S. Lawrence points out that nothing could be touched without a facing tissue, otherwise paint would simply fall away. Even with facing tissue, some loss was inevitable given the brittleness and cupped profile of paint and plaster flakes. The ██████████ helped to soften the paint, but did not appear to enhance adhesion of the paint and fine plaster layer back down to the underlying plaster. Readhesion remained tenuous even after repeated applications of adhesive.

The ██████████ appeared to be the most effective consolidant, however, removal of the facing tissue caused paint to peel away.

S. Lawrence reports that tests carried out by Ian Hodkinson (presumably in conversation with the latter) showed that both the ██████████ and the ██████████ appeared to hold the flakes in place. On examination by S. Lawrence, in 1983 it was noted that these areas were still crumbling.

Further testing by S. Lawrence produced the following findings:

- Casein paint layers are impervious to water and other solvents;
- Red and green Prisma pencil marks are somewhat affected by ██████████;
- Some sensitivity of the Prisma pencils to ██████████;
- Sensitivity of thin underlayer of plaster to moisture;
- Base plaster is dense, non-absorbant, and not affected by moisture

S. Lawrence concluded that although seemingly possible in the short term, the treatment of the mural would not survive the test of time, and that flaking would return.

Treatment Proposal by J. Chlopicki (September, 1993)





J. Chlopicki proposed localized consolidation first with a low viscosity resin ([REDACTED]), [REDACTED], followed by a low molecular resin, [REDACTED].

There is no indication that testing of this proposed treatment was undertaken.

Further treatment options were presented by J. Chlopicki in 1994 during a discussion on the Glyde Mural (November 23, 1994). At this time three options were presented. All included a treatment of the plaster wall, through the paint layer, in order to stabilize the plaster:

1. Consolidation using a mixture of [REDACTED]. [REDACTED]. Drying time is long, and the treatment irreversible.
2. [REDACTED] combined with [REDACTED]. [REDACTED]. Actual adhesion would be carried out using [REDACTED]. Drawbacks to this treatment are darkening, uncontrolled precipitation of the [REDACTED] mixtures and unknown adhesion potential over this sealant with the [REDACTED].
3. [REDACTED] to cause a recrystallization of the plaster at subsurface level followed by consolidation with an unspecified adhesive. Drawbacks include complexity of treatment, whitening of the surface and partial solubility of copper pigments.

None of these treatments appear to have been endorsed, at this time.

Conclusions from past examinations with respect to treatment options

No treatment option appears to have been accepted, possibly due to the fact that those adhesives tested either did not appear to be successful in the short-term, or were suspected of failure in the long-term. Other treatments, untried, had significant drawbacks due, in part, to their irreversible outcomes, as well as possible disfiguring changes (darkening, or whitening of the surface). All treatments would involve the use of toxic chemicals over prolonged periods of time.

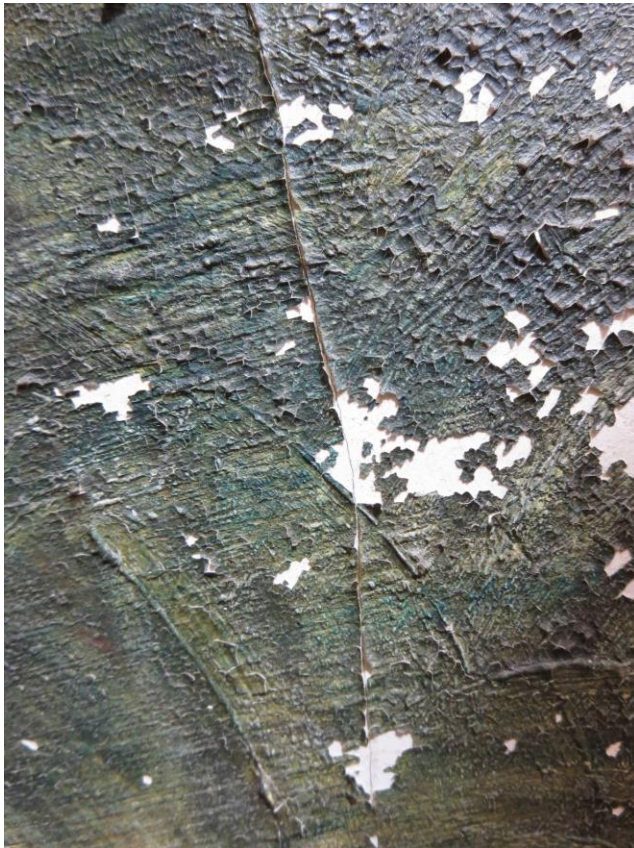
The mechanical action of consolidation: [REDACTED] [REDACTED], also proved to be extremely precarious with resulting loss to underlying paint. Both the means of achieving the outcome and the overall long-term success of this outcome were doubtful.





Examination, January 2019

The mural was examined by 2 CCI staff members, Wendy Baker and Marie-Hélène Nadeau over two days (January 9th and 19th, 2019). Condition issues such as cracking, cleavage, lifting, curling of paint, paint loss were noted. These conditions were identical to those previously noted, with the exception that paint loss has increased over time. There are also large zones of reconstruction, presumably due to earlier paint loss, that have not been previously noted. There are three primary types of paint loss which were noted. The first of these as seen in **Figure 6**. The paint failure in this case appears to be between the final coat of fine plaster and the



underlying plaster. It is most probable that this is due to the intense contractive force caused by the reactive casein paint rather than to an inherent flaw in the plaster. It is also possible that the final coat of plaster was applied when the underlying layer was too dry. This may have caused a weakness in the top layer as moisture would have been leached away causing a compromised setting of the fine coat. This kind of delamination and cracking followed by curling and cupping is primarily located in areas of heavier paint application or where more than one layer of paint has been laid down. The exposed, underlying plaster is smooth and water-insoluble.

Figure 6: cracking, delamination, cupping and loss of casein paint from contraction within the paint layer. Delamination has occurred between coats of plaster.





The second form of paint failure is between original paint layers and layers of original casein or reconstructions. It is assumed, in some areas, that that these reconstructions of significant paint loss and were carried out pre 1980 as no mention of them appears in the record since that time. **Figure 7** shows just such a paint failure. There is clearly an artist-applied colour wash of yellow casein paint, followed by application of design elements in brown casein brush strokes. Above these layers is located another paint which may or may not be original. The failure here is between the top paint layers and the underlying paint. It is presumed that if the overlying paint is highly water-soluble, it is a later application of distemper, if not, it is likely artist-applied.

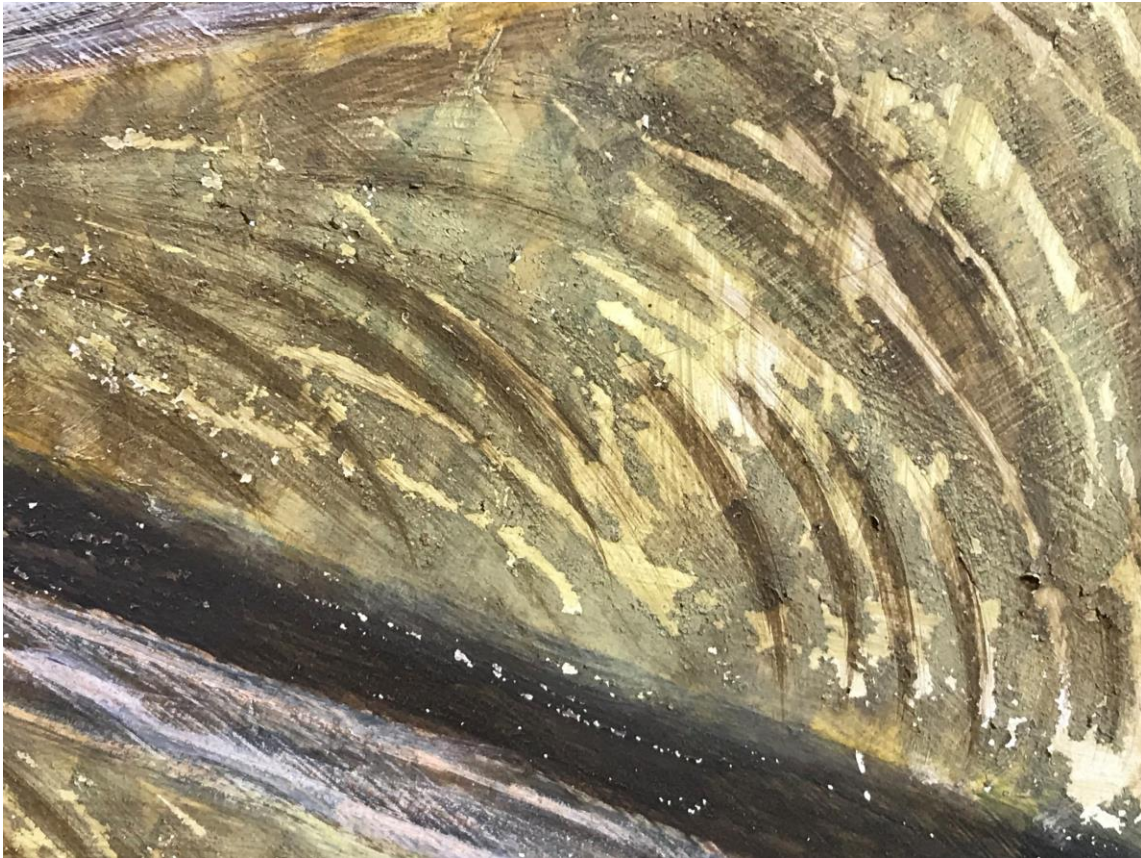
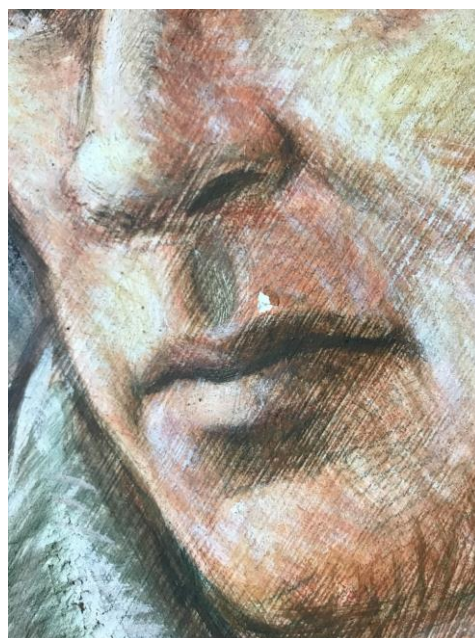


Figure 7: flaking tempera paint over a layer of coloured casein wash and brown casein paint brush strokes. Lower half of painting





The third form of paint failure is due to a possible chemical conversion of salts into different hydration states within the plaster layer (s). This paint failure is highly contained, and affects only very few spots on the painting. It is not confined to one area, but often appears in parts of the composition where the paint is applied thinly. It is possible that changing environments (rise in RH) could have a more pronounced effect on the underlying plaster in these regions, allowing more easily for changes in hydration states of salts found in the plaster. The damage can be seen as a single flake under which the plaster has become powdery. If the paint flake has fallen away, then a pit develops in the plaster surface as the degraded plaster dust eventually disappears. **Figures 8 and 9** show two examples of this phenomenon.



Figures 8 and 9 show damage to the paint layer from disruption in the underlying Plaster due to possible changes of hydration states of salts contained in the plaster.

Finally, it has been noted by all observers and examiners that the darker colours such as black, dark brown (burnt umber, raw umber) lighter browns (burnt sienna) and dark greens are susceptible to cracking and flaking. The mineral pigments can contain elements which cause shrinkage on drying and may have exacerbated the





contraction of the casein paint on drying. **Figure 10** shows a typical example of flaking of paint which is contained almost exclusively to one colour.



Figure 10: flaking and loss confined to dark coloured paints may be the result of shrinkage characteristics of particular mineral pigments used in the casein paint.

The following damage tables indicate specific condition issues in each of four quarters (arbitrarily divided) of the mural beginning from the left side of the work of art. Schematics of each of the four sections are presented with locator information.

Damages

Refer to attached schematics

The mural has been divided into four sections. The “X” axis has been given numbers from 1 to 43 (from left to right of the mural). The spacing is based on the 6-inch graphite pencil grid





utilized by Glyde and his assistants to lay out the underdrawing. The Y” axis is likewise subdivided into 6-inch spacings, as per the original gridwork. The Y axis is labelled alphabetically beginning at “A” at the bottom edge and ending at “P” along the top. Glyde’s grid layout starts inside the edges of the mural, and the overall size of the mural is slightly larger than a multiple of 6 in both height and width. Colours in each of the four schematics denote different damages or conditions.

Coloured areas on the schematics are as follows: **red= flaking**, **blue dots= losses to paint and superficial layer of plaster/gouges to plaster** (the more closely spaced, the heavier the losses), **yellow= reconstruction or overpaint**, red lines with no cross hatching= cracks to plaster, red lines with cross hatching= cracks with heavy lifting and flaking of paint along the crack, **green with cross hatching= area of previous consolidation**.

Condition: General Comments (first quarter of painting sectors 0 to 11).

For details of specific damages see the schematics at the end of each of the four sections.

Condition issues in this sector include cracking cupping and flaking of the paint layer (s) (ranging from light to severe), flaking and lifting of paint has taken a thin layer of plaster so that, as previously reported, there is no cohesive loss between paint layers or of the paint to the plaster, rather the fine coat of plaster has disengaged from the underlying plaster layers in these regions. Losses are primarily associated with the cracking and flaking and losses range from light to severe. There are several areas of individual flaking where underlying plaster has pitted as well. This is atypical of the far more common widespread cracking with flaking which takes a layer of intonaco or finishing plaster and leaves a smooth, hard surface of underlying plaster. There is also cracking to the plaster itself. Paint has lifted and curled along the edges of some of these cracks, especially when these are slightly heavier.

As is obvious from the diagram, much of the damage has occurred in the lower half of the painting. This is most likely due to the fact that these regions have received, in many areas, more than one layer of paint. The heavier the paint application, the more likely this is to crack. Also, as has been noted by previous examiners, the darker colours appear to be most prone to cracking (dark browns, blacks, dark greens). This is the case here where hair and clothing painted out in darker tones appears to have cracked preferentially to other colours. Often the cracking, lifting and flaking is confined to a design area of a particular colour.

Additionally noted in this first quarter of the painting are areas of overpaint or reconstruction where losses have been disguised with the application of a paint, largely having a different character from that of the original paint. This overpaint is highly water-sensitive. A large zone





of reconstruction is located in the first seated figure (reference to zones 9, 10 and 11 in table 1 below). The jacket of this figure has been heavily restored in regions mostly associated with the yellow (yellow ochre-coloured paint) as well as some orange and blue patterning. It is likely that this area suffered significant loss and was largely repainted in a glue-tempera. We shall see this pattern repeated across the length of the painting.

Table 1 Condition: General Comments (1st quarter of painting sectors 0-11)

Location	ID	Damage	Colour	Additional
H-I/0	1	Flaking and losses	Green-brown	Overpainted or reconstructed
G-H/0	2	Flaking and losses	Green-brown	Overpainted or reconstructed
K-L/0	3a	Small compound cracks in plaster	NA	No associated flaking
M-P/2	3b	Vertical crack	NA	No associated flaking
N-P/2-3	3c	Diagonal crack	NA	No associated flaking
N-O/2-4	3d,e	Two short diagonal cracks	NA	No associated flaking
B-I/3-4	3f	Vertical crack	NA	No associated flaking
M-O/5-6	3g	Diagonal single crack	NA	No associated flaking
N-P/9-10	3h	Two diagonal intersecting cracks	NA	No associated flaking
L-M/10-11	3i	Vertical crack	NA	No associated flaking
G-J/9-10	3j	Curved crack	NA	No associated flaking
H-J	3k	Diagonal crack	NA	No associated flaking
H-J/1-2	4b	Two areas of flaking and losses	Brown, Venetian red, green	
H-I/1-2	5	Flaking and losses	orange	reconstructed, water sensitive
J/3-4	6	Flaking and minor loss	Black, green	Hair
G-I/2-3	7	Old losses repaired	Flesh tone	Several zones of reconstruction in face
H-I/2-4	8	Flaking and minor	Black, green	Area unstable with





		loss		incipient flaking
G-H/0-3	9	Old losses repaired	Yellow	Zone (banding on collar) reconstructed, water- sensitive
E-F/1-2	10	Old losses repaired	Yellow	Zone (part of jacket) reconstructed, water-sensitive
E-G/2-3	11	Old losses repaired	Red and white	Zone (sleeve) reconstructed, water-sensitive
J-K/1-2 Figure 11	12a	Flaking and losses	Pale green, dark brown	Slightly shiny surface, possibly previous consolidation testing
J-K/2-3	12b	Cracking, flaking and localized losses	Mid-tone green with red scumble	Matte surface (as opposed to 12a)
J-K/1-2	13	Cracking, flaking and localized losses	Dark brown, green	Matte surface (as opposed to 12a)
I-J/2-3	14a	Cracking, flaking and localized losses	Dark brown, black	Flaking follows brush strokes and confined to areas of design
J-K/3-4	14b	Cracking, flaking and localized losses	Dark brown, black	Flaking follows brush strokes and confined to areas of design
J-K/4-5 Figure 12	14c	Cracking, flaking and localized losses	Dark brown black (black or van Dyke brown)	Flaking follows brush strokes and confined to areas of design
J-K/5-6	14d	Cracking, flaking and localized losses	Dark brown (burnt umber), black	Flaking follows brush strokes and confined to areas of design
I-M/3-5	15a	Upper portion of crack 3f now with flaking and paint loss	NA	Crack with paint lifting along both sides
D/5-6	15b	Horizontal crack with flaking and paint loss	NA	Crack with paint lifting along both sides
C-J/6-11	15c	Vertical and diagonal 5-branched crack	NA	Heavy main crack with lifting along all branches





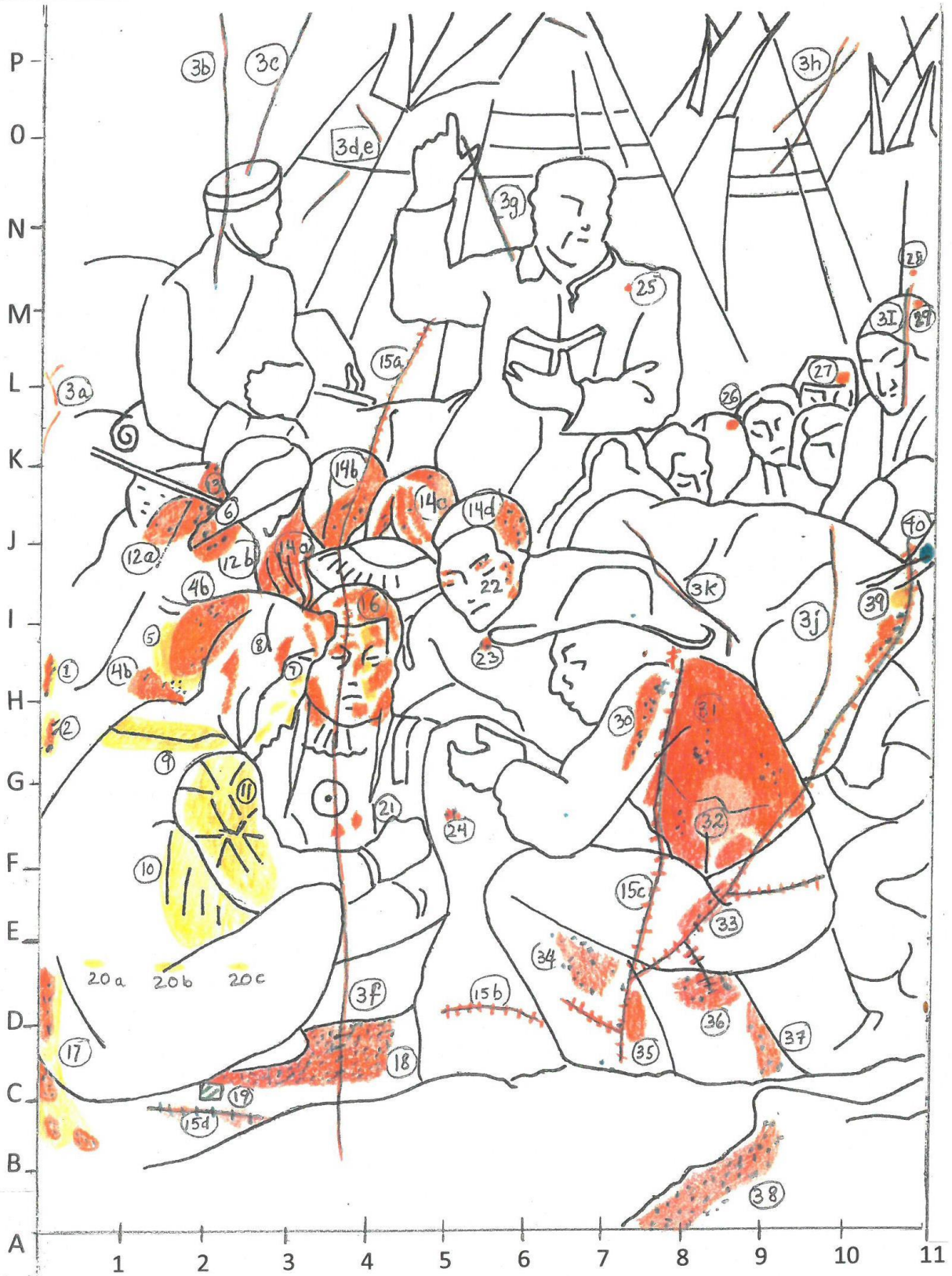
		with cracking and paint loss		
B-C/1-3	15d	Horizontal crack with flaking paint	NA	Short crack with lifting paint at edges
H-I/3-4 Figures 13, 14, 15	16	Cracking, flaking, loss and areas of reconstruction	Dark brown (burnt umber), green, flesh tones	Flaking and lifting in dark-coloured hair (some consolidants may be present. Portions of flesh tone in face also flaking with areas of reconstruction or overpaint.
B-E/0-1	17	Flaking, loss, reconstruction	Mostly yellow and pale green	Old repairs may be reconstruction rather than overpaint
C-D/3-5 Figure 16	18	Heavy cracking, serious flaking and loss	Green paint	Significant flaking and losses, very localized to green paint
C/2 Figure 17	19	Area of consolidation	Green paint	Small area, appears saturated and has wax residues from previous consolidation testing (I. Hodkinson). Note that the paint appears stable under the wax.
D-E/0-3	20 a,b,c	Scrapes through to plaster	NA	These damages appear retouched
F-G/3-4	21	Flaking with pitting	Pale yellow	Two individual flakes with pitting of the underlying plaster (plaster highly powdery)
I-J/5-6	22	Flaking and loss	Flesh tone	Localized flaking on face
H-I/5-6	23	Flaking and loss	Venetian red	localized
F-G/5-6	24	Flaking with some loss	Dark brown, black	localized





M/7	25	Flake with pitting	brown	One flake with pitting and powdery plaster
K-L/8-9	26	Flake with pitting	brown	One flake with pitting and powdery plaster
L/9-10	27	Flake with pitting	brown	One flake with pitting and powdery plaster
M-N/10-11	28	Flake with pitting	brown	One flake with pitting and powdery plaster
M/10/11	29	Flake with pitting	brown	One flake with pitting and powdery plaster
G-I/7	30	Heavy flaking with loss, intense cracking, cupping	Brown (raw umber) and green wash	Area very unstable
G-I/7 Figures 18, 19	31	Small-scale cracking, flaking, some loss	Brown (burnt sienna), dark green	Area unstable with much incipient loss
F-G/7-10	32	Small-scale cracking, flaking, some loss	Brown (burnt umber scumbles)	Cracking and incipient loss, not as severe as 30 and 31
E-F/8-9	33	Cracking, flaking, peeling, loss	Dark green	Localized, severe
D-E/6-7	34	Fine cracking, some flaking and loss	Dark green, Venetian red	Localized, less severe than 33
D/7-8	35	Fine cracking, minor flaking	Dark green, Venetian red	Localized, less severe than 33
D/8-9	36	Fine cracking, incipient flaking, loss	Dark green, yellow	Localized, minor losses
C-D/9	37	Fine cracking, incipient flaking	Dark green, yellow	Localized, minor losses to thinly applied paint
A-C/7-9	38	Cracking, lifting, losses	Dark green, yellow	Localized, heavy cracking and significant losses to thinly applied paint
I/10-11	39	Cracking, flaking, reconstruction	brown	Flaking and loss with one zone of reconstruction
J/11	40	Gouge out of plaster	NA	Likely due to percussive action





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Condition: General Comments (2nd quarter of painting sectors 11-22)

As with the 1st quarter of the painting, the second quarter has sustained most of the damage to the paint layer in the lower 1/3 of the painting. This damage includes cracking, flaking, crumbling and loss. Unlike most of the losses to the 1st quarter of the painting, we note that a number of areas of loss occur between a coloured intonaco layer of plaster and the overlying paint. The paint applied above the colour wash on the plaster is lifting away from this. Much of this friable paint has crumbled and lifted away. It is presumed that this paint is the original casein applied above a casein wash on the plaster. These losses are significant in several areas. In the 2nd and 3rd quarters we begin to see evidence of clear overpainting where these kinds of losses have occurred, and the overpainting is likely in a distemper-type paint which is highly water soluble.

Location	ID	Damage	Colour	Additional
I-J/12	41	Flaking	Black, grey, brown	2 separate areas of flaking
M-P/12	42a	Crack to plaster	NA	Vertical crack, no associated flaking
K-M/12-13	42b	Crack to plaster	NA	diagonal crack, no associated flaking
M-N/12	42c	Crack to plaster	NA	Compound crack, no associated flaking
M-O/14	42d	Crack to plaster	NA	Vertical crack, no associated flaking
L/13-15	42e	Crack to plaster	NA	Horizontal crack, no associated flaking
D-E/11-12	42f	Crack to plaster	NA	Diagonal crack, no associated flaking
N-O/16-17	42g	Crack to plaster	NA	Vertical crack, no associated





				flaking
M-P/17-18	42h	Crack to plaster	NA	Vertical crack, no associated flaking- part of compound crack
P/20-21	42i	Crack to plaster	NA	Vertical crack, no associated flaking
N-P/20-22	42j	Crack to plaster	NA	Diagonal crack, no associated flaking
A-B/12-13	43	Cracking and losses	Dark brown above pink tone and yellow	Random losses
A-C/13-15	44	Cracking, losses	Dark brown and green washes	Paint very friable, cracking and crumbling
C-D/13-15 Figure 20	45	Cracking, flaking, loss	Green, yellow with burnt umber washes	Heavy cracking, flaking , cupping, losses
A-C/14-17	46	Cracking, flaking, loss	Green, yellow with burnt umber washes	Cracking, heavy flaking, losses
F/13-14	47	Flaking and loss	Yellow, green	Isolated flaking and loss with some pitting of plaster (not associated with cracking)
I/13-14 Figure 21 BT Figure 22 AT	48	Two areas of flaking	Grey wash and burnt umber scumbles	This appears to be new flaking, not associated with cracking. Likely plaster powdering and pitting below
E-F/17-19 Figure 23	49	Cracking, cupping	brown	Heavy craquelure with cupping, minimal loss at





				this time
I/16-17	50	Scratches	NA	Fine scratches, gouges to plaster
E-G/ 18-22 Figure 24	51-58	Heavy flaking, loss, overpaint and reconstruction	NA	Large area where damage likely occurred in the life of the painting and where extensive repairs were undertaken.
E-G/18-19 Figures 25 and 26	51	Heavy flaking and loss of paint, scratches	Olive green above yellow-toned plaster	Green paint which is flaking may be original casein. Yellow-toned plaster may be the preparation for other paint which may have flaked away, or may be original layer.
E-G/19-20 Figure 27	52	Loss and flaking of layer of olive-green casein-like paint.	Olive-green above yellow-toned plaster and dark brown paint above a layer of thinly-applied brown	Green paint which could be casein has largely flaked away revealing a yellow-toned plaster with light brown highlights. The spokes also appear to be overpainted in darker brown casein-like paint which is flaking away from an underlying wash





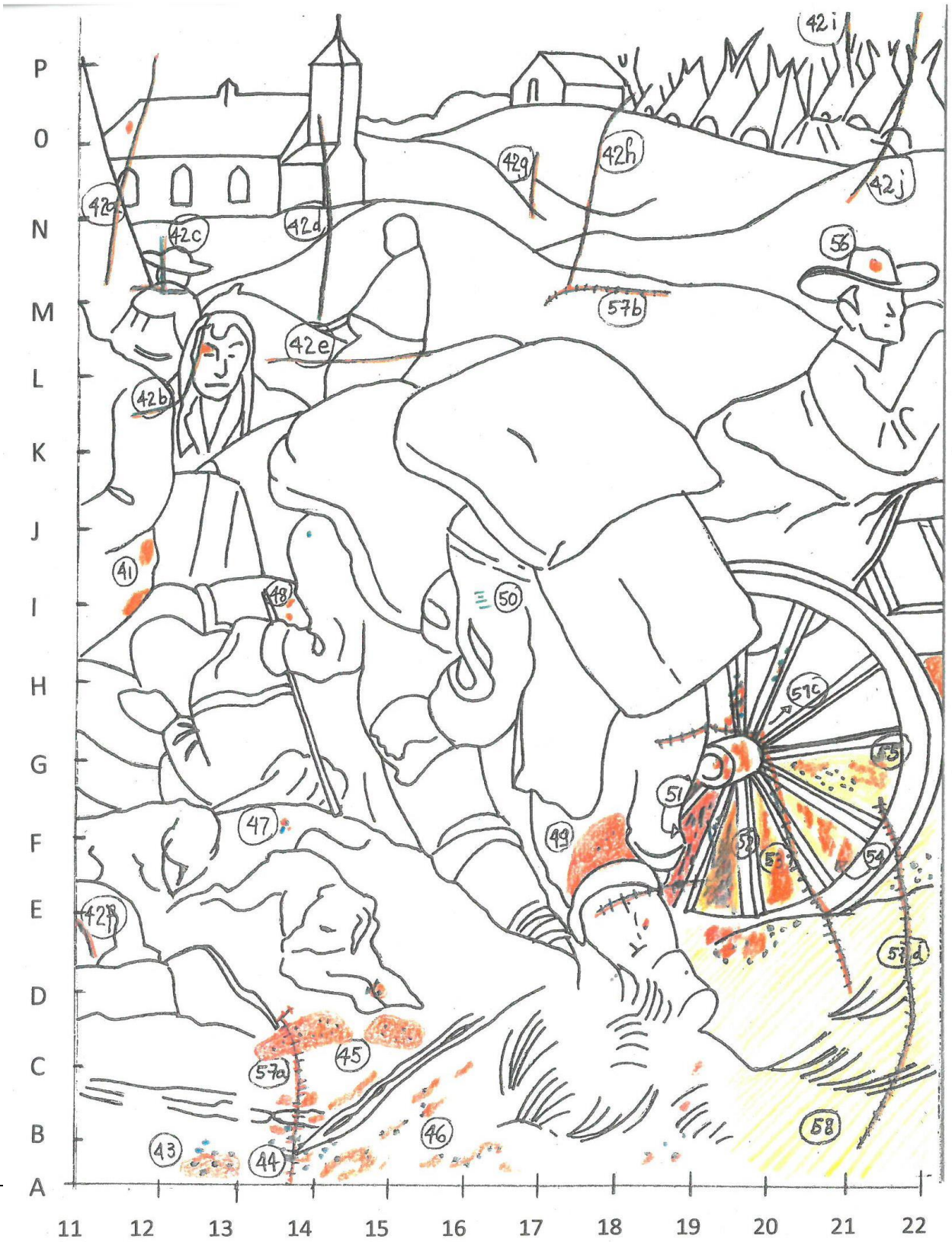
				of brown.
E-G/20-21 Figure 28	53	Loss and flaking of layer of olive-green casein-like paint, grey and brown casein-like paint flaking	Olive green casein above yellow-toned plaster, grey casein paint above yellow-toned plaster, dark brown casein above brown wash	As with location 52, it appears that this area has been painted above a more thinly-executed design. This “overpaint” has largely flaked away, sometimes taking underlying layers with it.
E-G/20-22 Figure 29	54	Loss and flaking of layer of olive-green casein-like paint, grey and brown casein-like paint also flaking	Olive green casein above yellow-toned plaster, grey casein paint above yellow-toned plaster, dark brown casein above brown wash	As with locations 52 and 53, it appears that this area has been painted above a more thinly-executed design. This “overpaint” has largely flaked away, sometimes taking underlying layers with it.
F-G 20-22 Figure 30	55	Loss and flaking of layer of olive-green casein-like paint, grey and brown casein-like paint also flaking	Olive green casein above yellow-toned plaster, grey casein paint above yellow-toned plaster, dark brown casein above brown wash	As with locations 52,53, and 54, it appears that this area has been painted above a more thinly-executed design. This “overpaint” has largely flaked away, sometimes





				taking underlying layers with it.
M-N/21	56	Flaking paint	Grey-black	Single flake with powdery pitted plaster
A-D/13-14	57a	Vertical crack	NA	Lifting and flaking at edges
M/16-18	57b	Horizontal crack	NA	Lifting and flaking at edges
D-G/18-21	57c	Bent crack	NA	Lifting and flaking at edges. This may be the crack that was noted as a “scrape or scratch” in previous reports
A-F/21	57d	Vertical crack	NA	Lifting and flaking at edges





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Condition: General Comments (3rd quarter of painting sectors 22-33)

This lower half of this painting is heavily damaged due to the application of heavier layers of paint above the coloured intonaco. Many areas, such as the grass below the seated figures has obviously flaked away and been largely reconstructed with a very water-sensitive paint, likely distemper. Certain decorative details such as necklaces, collars, loin cloths have been retouched or wholly repainted. Where there is flaking, this is highly unstable. Old adhesive tests using a synthetic resin have held down flaking in that areas, however, the ability of casein to absorb adhesive has meant that it is almost impossible to remove the residues which sit in and on the paint layer and show as shiny spots on the surface. Cracking to the plaster in this 3rd quarter of the painting is less and has not provoked lifting of the paint along the edges of cracks.

Location	ID	Damage	Colour	Additional
23-28/A-G Figures 31 and 32	58	Overpaint and loss with active flaking	Yellow-green	This entire zone of grass is heavily damaged and overpainted with streaks of grey, brown, white and green to replace the heavier casein-like paint which has crumbled away. This is likely all distemper reconstruction as it is highly water-sensitive
F-G/22-23	59	Area of complete paint loss down to coloured intonaco	Yellow-green	As above
F-G/23-24	60	Paint loss, flaking and reconstruction	Flesh tones	Loss of original paint layer and reconstruction





				with distemper paint which is very water-sensitive
H/24-25	61	Reconstructed	Necklace with multiple colours	Heavily applied paint has largely flaked away, and this decorative element has been reconstructed
E-H/24-25 Figure 33 BT Figure 34 DT Figure 35 AT	62	Partial reconstruction, flaking and loss	Flesh tones	Heavily applied paint is flaking and crumbling, many zones of reconstruction with water-sensitive distemper.
F-H/25-26	63	Flaking and loss	Flesh tone	Heavily applied paint is flaking, curling with some loss
E-F/25-26	64	Flaking and loss	Flesh tone	Heavily applied paint is flaking, curling with some loss
G-H/26-27 Figures 36 and 37	65	Flaking and loss	Dark brown	Losses are occurring along brush strokes where the paint is applied more heavily
H-I/28-29 Figure 38	66	Cracking, flaking with paint loss. Drip of grey paint from the wall is peeling away underlying original paint	Dark brown	Paint cracking and flaking along brush strokes where paint is thicker. Contraction of grey wall paint causing original





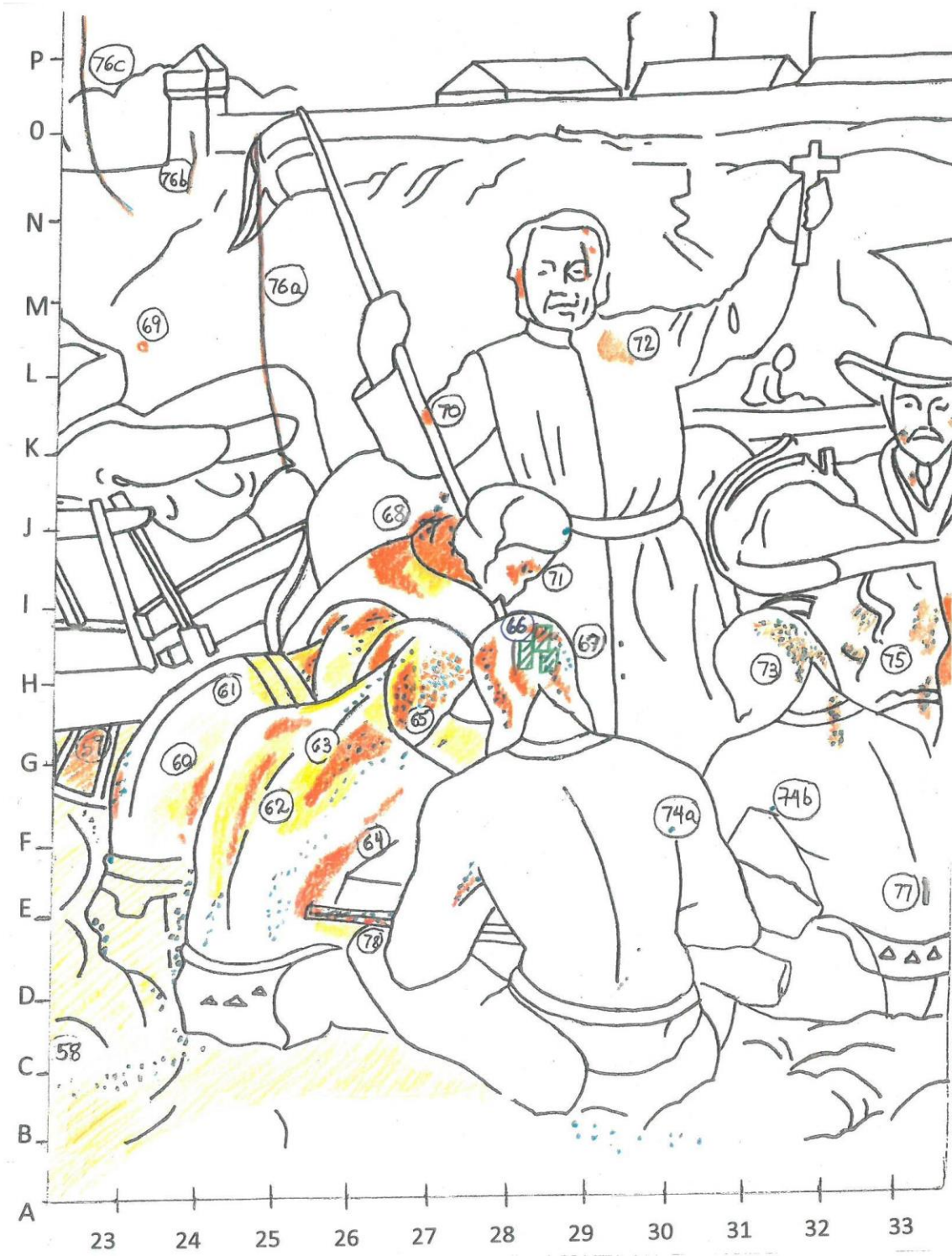
		layer.		layer to peel away from underlying plaster
G-H/28-29 Figure 39	67	Old adhesive testing	Dark brown, black	Four old adhesive tests using synthetic resin, [REDACTED] Consolidated flakes are holding, but the surface is noticeably shiny from adhesive residues which are difficult to remove.
I-J/26-27 Figure 40	68	Heavy cracking, lifting, flaking and loss with overpaint and reconstruction	Light brown, white, and light red.	Heavily applied paint is cracking, lifting, curling. At least one campaign of retouching and reconstruction to large area.
L/23-24	69	Flake	yellow	Single flake not associated with cracking, but with powdering and pitting of underlying plaster
K-L/27-28	70	flaking	Light brown	Single flake not associated with cracking, but with powdering and pitting of underlying plaster
I/28	71	Flaking with loss	Flesh tone	Heavy paint has





				cracked and is flaking
L/29-30	72	Flaking	Black	Isolated area of flaking
G-I/31-32	73	Flaking and losses	Dark brown, black	Small scale cracking with heavy cupping and flaking especially along raised edges of brush strokes
F/30 Figures 41, 42	74a	flake	Flesh tone	Isolated flake with pitting and powdery plaster
F/31 Figure 43	74b	flake	Flesh tone	Isolated flake with pitting and powdery plaster
G-I/33-34 Figure 44	75	Flaking and loss	brown	Small scale cracking with cupping, flaking and loss
I-O/25	76a	Vertical crack	NA	No associated cracking
N-O/23-24	76b	Vertical crack	NA	No associated cracking
N-P/23	76c	Vertical crack	NA	No associated cracking
E/33	77	Paint drip	NA	Grey-green paint drip from painting of the adjacent wall
E/25-27	78	Cracking, flaking, loss	Black, grey, white	Cracking and flaking is very confined to the barrel of the gun painted in darker colours







Condition: General Comments (4th quarter of painting sectors 33-43)

Damage to the paint layer in this 4th quarter is less extensive than in other regions of the painting, and is more localized. When it does occur, cracking, lifting, flaking are quite severe with some areas of significant paint loss. As with the other regions of the painting, the damage is largely centered on the lower half of the painting where the paint application is heaviest. No obvious areas of reconstruction were noted in this quadrant,

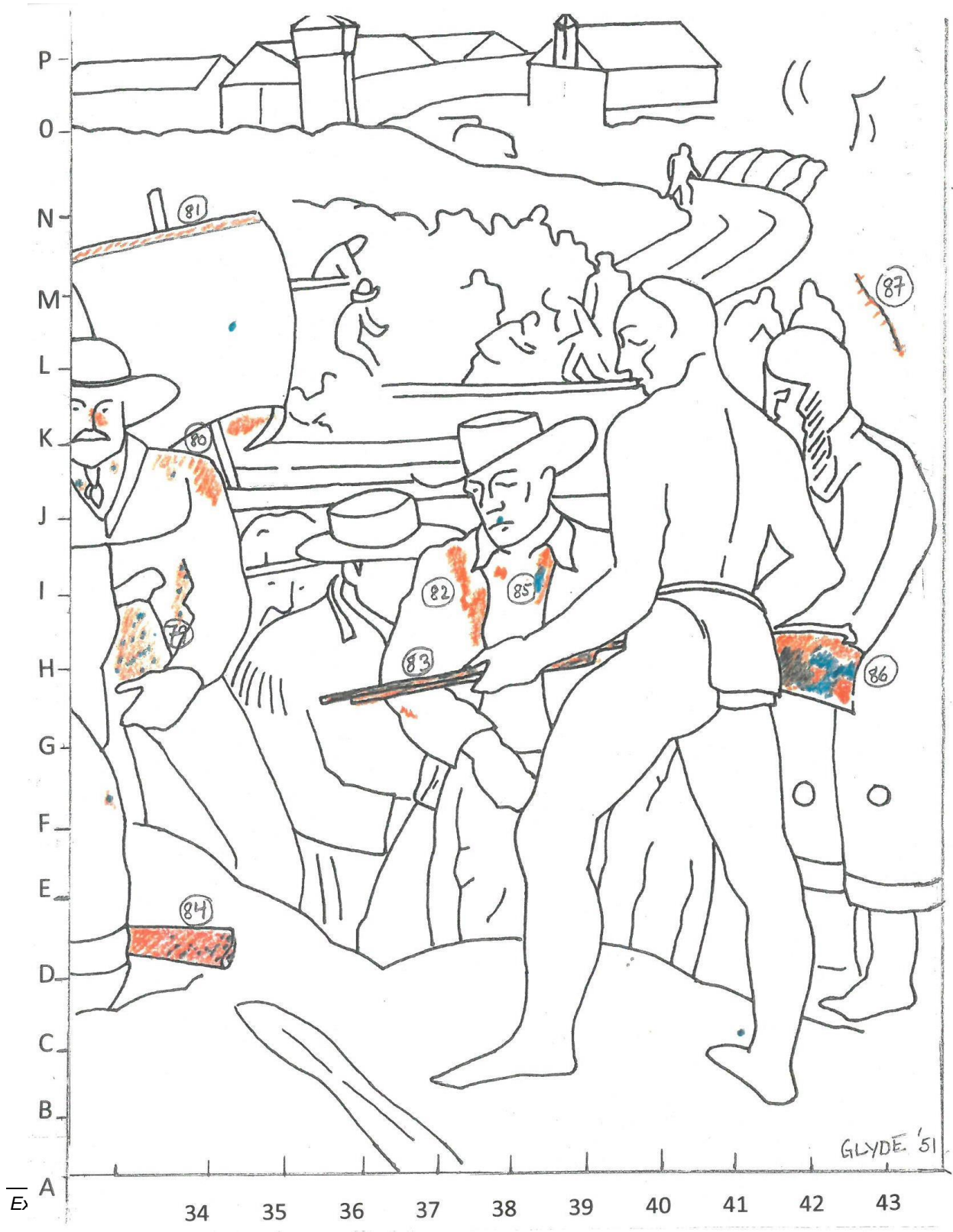
Location	ID	Damage	Colour	Additional
H-I/33-34	79	Cracking, flaking and loss	Venetian red and blue	Small-scale cracking with flaking, lifting and loss to original paint layers due to heavier paint application
J-K/33-34	80	Cracking, flaking and minor loss	Grey, black, brown	Small-scale flaking with minor loss
M-N/33-35	81	Cracking and flaking	brown	Confined to one design region
H-I/37-38 Figures 45 and 46	82	Cracking, flaking, lifting	Brown (burnt sienna), orange	Area of more heavily applied paint, flaking along with plaster layer
G-H/35-39 Figure 47	83	Cracking, flaking, lifting	Black, blue, white	Thicker black paint cracking, flaking, cupping
D-E/33-34 Figures 48 and 49	84	Cracking, flaking, lifting	Burnt umber, burnt sienna, black	Thickly applied paint is unstable, confined to this design area
I/38-39 Figure 50	85	Cracking, flaking, lifting	Brown (burnt sienna), orange	Area of more heavily applied paint, flaking along with





				plaster layer
G-I/41-43 Figure 51	86	Cracking, flaking, lifting and loss	black	Paint damage confined to design area
K-M/42-43	87	Crack to plaster	NA	Lifting of paint at edges of crack





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Testing for Treatment

A number of tests have been carried out in the past to stabilize and to reattach the paint flakes back to the wall. None have been very successful, largely due to the very brittle nature of the paint and paint flakes and the inability to introduce adhesive into areas where any kind of physical contact results in loss of paint. Additionally, the casein paint will absorb the consolidant and leave a highly reflective surface behind as residues are very difficult to remove. It has been suggested that [REDACTED] would assist in the relaxing of the paint flakes and would subsequently allow these to be relaxed down to the plaster wall. This is however not practical for a number of reasons, not the least of which is [REDACTED]. It would also require many days [REDACTED] to have any plasticizing effect, and very likely, if the paint were to relax out, contraction would re-occur over time and lifting and flaking might well re-occur. We opted to test with a water-soluble adhesive, [REDACTED]. This adhesive is both soluble in water and in other polar solvents (alcohols). [REDACTED] also allows for moisture to penetrate which would allow for moisture to move from inside the wall out and from outside the wall in without creating a vapour barrier which might result in further delamination of the paint. [REDACTED] was tested in a number of areas. [REDACTED] above the unstable paint layer was often sufficient for that flake to simply break away. The challenge was to secure the flake sufficiently prior to the application of the consolidant. It was suggested, by a past examiner, that [REDACTED] prior of adhesive might circumvent this problem. It may be that [REDACTED] of the flaked areas with an adhesive such as [REDACTED] which has very little gloss (in case residues remain) would be an effective first step in allowing a facing to be placed onto the paint surface. [REDACTED]. [REDACTED] It is highly unlikely that flattening of the paint will be successful, however, if adhesive can be introduced behind the flakes there is a chance that these will be more stable. **It is unlikely that this paint will ever be stable.**

1 [REDACTED]





Treatment Recommendations

The painting is dusty, however, little can be done to rectify this without causing paint loss. If possible, [REDACTED] to remove superficial dust could be done in areas deemed to be stable. For the rest, dust may have to be removed after consolidation. Given that there are a large number of highly water-sensitive areas on the painting (all of the white colours, much of the yellow/some of the greens), all areas will have to be checked before consolidation is undertaken. The white paint is slightly less sensitive than some of the yellow and greens (these latter two may be pure distemper). An adhesive should be selected that will not dissolve the medium and which will not cause discoloration. [REDACTED] in some cases, may be a good choice of adhesive where highly water-sensitive colours are concerned.

It will not be possible to expect that one campaign of consolidation will correct the flaking and delamination. It will take several repeated applications of adhesive to ensure that sufficient amounts of adhesive material is in place to effectively hold flakes in place and secure them to the underlying plaster.

Removal of mural from the wall

Although removal of paint layers (with some underlying plaster) is possible, it is highly inadvisable in this case. Part of the issue is that the overlying paint is only lightly, if at all adhered to the underlying plaster. The underlying plaster contains design elements- such as washes of colour, fine brush strokes, Prisma colour pencil marks. Most of this would be left behind with the flaking paint removed preferentially. In addition, most [REDACTED] work requires the use of highly contractive, and water soluble adhesives. Large portions of the mural would be highly damaged by the application of such adhesives. The mural cannot be safely removed without [REDACTED]. **This is not recommended. In-situ treatment is still the best option.**





Time estimates for treatment

A multi-step process will likely be required. Consolidation will likely have to be repeated once a year for a minimum of three years. Each subsequent treatment phase will repeat the consolidation to ensure that sufficient adhesive is in place to hold flakes securely to the wall. A single treatment would likely require [REDACTED] to complete one round of consolidation. The subsequent treatments should require less time, as presumably, the flaking would be far more secure.

Long-term care

The environment will play a major role in the long-term stability of this mural. Fluctuating or extremes of humidity, especially low humidity will cause further or ongoing deterioration. It will be necessary to either arrange for a more stable environment in the present location, or explore means by which the mural can be protected by means of a case. The building of a case would require a consultation with a building scientist to determine the possible risks of creating a sealed or semi-sealed container around the mural given that this is still linked to the building architecture which can dictate moisture content within the wall. It may be necessary to ensure some form of continual air circulation via a “black box” to provide environmental controls optimal for the preservation of the painting.

