Paint Analysis of Hinemihi's Historic Carvings

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"Painting Hinemihi by Numbers" courtesy of WHAT_Architecture 2010

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1 Introduction

This report presents the results of research project focusing on a cross section paint analysis of the surface of Hinemihi's historic carvings. This project was undertaken by Isabel Pombo Cardoso and Dean Sully with contributions from other post graduate students at UCL Institute of Archaeology from 2003-2010. This work was carried out as part of course work for the MSc Conservation for Archaeology and Museums (see Cardoso, I. P. 2003 "*Report on Paint analysis of Hinemihi*" Unpublished Institute of Archaeology UCL report 2003), further work took place during the completion of Cardoso's PhD research (see Sully, D. & Cardoso, I.P. 2007 "Conserving Hinemihi at Clandon Park, UK", in Decolonising *Conservation; Caring for Maori Meeting Houses Outside New Zealand,* D. Sully (ed.)). This project forms part of the information gathering process by the 'Hinemihi Project Group'. As an initial statement about Hinemihi's past painted decoration, it forms an important contribution to the debate about Hinemihi's future conservation.

2 Background

Analytical techniques are routinely used for the characterisation of materials and painting practices used on painted surfaces (Eastaugh 1989, Hackney *et al.* 1999, Mairinger and Schreiner 1986, Schoute and Verougstraete-Marcq 1986). These analytical studies allow supplementary understanding about the objects and people who made and used them. Moreover, they make an important contribution to informing the conservation of these objects, helping in decision making and in the design of strategies for their conservation.

The investigation of Hinemihi's painted surface aims to understand the changes in the perception and use of Hinemihi by identifying material evidence within the cross sections identified in paint samples removed from Hinemihi's surface. This includes aspects such as:

- the paint sequences used in the different phases of Hinemihi's life
- the materials used in the repainting
- the frequency of repainting
- the colour schemes selected by those who painted her

The key research questions of this study were:

- is it possible to find evidence of the first colours, materials, and patterns used on Hinemihi's carvings?
- is it possible to establish the changes in the painted decorative surface over time?
- is it possible to relate the different decorative schemes to the history of Hinemihi?

The project developed as a part of the information gathering process surrounding the current conservation project at Hinemihi (a key stage of which has been the submission of a first round application to the Heritage Lottery Fund in December 2010). The research process was adapted to the needs of the conservation project, available time, the resources of the researchers, the requirements of the National Trust and the communities that surround Hinemihi. This required a flexible approach to the work that enabled progress to be made when opportunities arose. An initial investigation took place as a result of the Physical fabric survey in 2003 (Sully, D. 2004. *Physical Fabric Survey of Hinemihi June 9-11 2003.* Unpublished UCL Institute of Archaeology/National Trust report 2004), when the first phase of sampling

took place. As a result of the analysis of these samples, a second targeted sampling took place that focused on areas that had been identified as important in completing information about the paint sequences. This has enabled a proposed chronological paint sequence from 1880-1995 that matches the currently available historic documentation.

The approach to cross sectional paint analysis research project involved the following stages:

3. Rationale for the first sampling
4. Analytical Methodology
5. Results from the first sampling
6. Rationale for second sampling
7. Results from the second sampling

The results of this project are presented in the following sections

8. Overall of results
9. Discussion Overall of results
10. Further Work
11. Conclusion

3 Rationale for the first sampling

Figure 1 Isabel Pombo Cardoso removing paint samples from Hinemihi's paepae carving (Dean Sully 2003).

The investigation of Hinemihi's paint structure primarily involved cross-section paint analysis. This method requires the physical removal of samples from the object (see figure 1). In addition to the ethical issues of the conservation profession, there are specific issues that relate to the significance of Hinemihi for the Maori community. This required the inclusion of Maori protocol associated with Meeting houses (tikanga, kawa, and kaupapa) in the analytical project (see Sully and Cardoso 2007; 199-219 for further information). The sampling of an object is controversial – a non reversible and invasive action where part of the object is permanently removed, so a strong rationale was needed (Eastaugh 1989). The case to remove paint samples from Hinemihi was justified by the integration of this research within a wider

multidisciplinary study, where specific questions remained unanswered. A study of the available information about Hinemihi (such as published and unpublished documents, photographs, physical examination and assessment) revealed significant information about Hinemihi's past structure (see table 1).

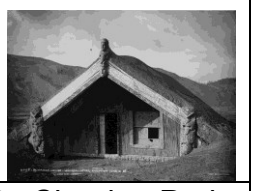
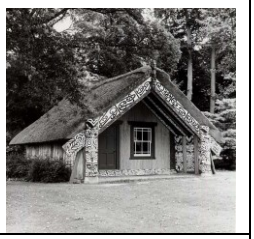
Date	Developments in Hinemihi's built structure over time
1880-1881	constructed in Te Wairoa, New Zealand by Ngäti Hinemihi 
1886	survived the Mount Tarawera volcanic eruption 
1892	purchased by fourth Earl of Onslow and relocated to Clandon Park 
1914-19?	restored by WW1 allied troops, particularly from New Zealand?
1925/34?	repaired and relocated, during which time her front wall, door and window carvings were removed
1960	restored by National Trust and provided with a new roof 
1980	restored by National Trust and provided with a front wall for the first time since 1925/34 
1995	repaired by Ngäti Hinemihi and additional carvings added (both new and re-discovered) 

Table 1 Developments in Hinemihi's built structure over time, which provides a general chronology for Hinemihi's paint sequence

The following factors provide justifications for sample removal:

- The sampling took place after a period of information gathering, after which clear objectives and questions for the paint analysis were defined. These questions could be addressed by the information provided by cross section analysis.
- Samples taken for cross sections were as small as possible and did not disturb the visual appearance of Hinemihi's surface. It was also apparent that there were significant areas of flaking paint on Hinemihi's historic carvings that could easily yield paint samples.
- Finally, the samples can be studied by a wide range of analytical techniques and potentially they can be kept for future studies (in this case however, it has been agreed that the sample material will be returned to be buried with Hinemihi at the end of the project).

During the first sampling phase, seven samples (less than $2mm^3$) were removed with a scalpel, from each of Hinemihi historic carvings. The samples were labelled A-Z, A2-J2 (see Appendix 2a for specific location information, an image of the exact location of each sample and cross section micrographs of each sample).

The aim of this first sampling and analysis process was to provide a general overview of the paint structure that could be compared with what was known from the available historical information. The number of samples taken was a compromise between the desire to obtain reliable results, capable of answering the research questions (the reliability of the results tends to increase with the number of tests, as well as with the consistency of the results of those tests) and the aim of minimal intervention (Eastaugh 1989). The importance of the integration of the paint analysis

within a broader interdisciplinary study is therefore critical in order to focus research questions and indicate appropriate sample locations. This provided an effective way of reducing the number of cross-sections needed to answer the research questions. Despite the rationale for the sampling, it is important to bear in mind that this study, whilst focussing on answering specific questions, would inevitably generate additional questions. Also, the analysis of very small samples (less than $2mm^3$) creates possible problems with the interpretation of the results that might not be representative of the whole object. Finally, it is important to remember that this methodology and the interpretation of the results require much time, resources and experience.

There are several factors that have helped with the paint analysis of Hinemihi.

- the existence of extensive historic documentation
- the existence of key marker layers within the paint sequence (for example volcanic ash remains from the volcanic eruption of Mount Tarawera in 1886)
- the preservation of an extensive paint sequence within specific sample cross sections
- the variable condition of the paint layers (as a possible indication of long exposure to environment).

There are several factors that make the paint analysis of Hinemihi particularly problematic:

- Most significant has been the past practice of stripping off old paint layers before each repainting event (a preparation strategy used to get a better paint adherence and to maintain the carving detail). Documentation is available

that indicated that this is the case for interventions in 1960, 1980, and 1995, but is also likely to have taken place each time Hinemihi was repainted before this.

- During the repainting events, different colour schemes have been used. This has led to variations the painting patterns over time and local variations in the areas repainted. In some cases it is apparent the only certain areas of the surface were repainted (probably the most damaged ones).
- As a relatively recent structure (130 years old) Hinemihi will have been painted with commercially produced paints. Modern commercial paints are often difficult to identify, as they are often composed of complex mixtures and great variety of pigments.

4. Analytical Methodology

4.1 Sample preparation

An indication of the potential value of the sample material was initially assessed with microscopic examination. Sample fragments were embedded in epoxy resin (Epotek 301) and polished until the edge-on layer structure was revealed using Micromesh abrasive sheets as the polisher (grade 4000, 6000, 8000 and 12000). The polishing process used no lubricant, in order to avoid interaction or to wash out of any material from the sample. The cross sections were then examined and photographed under the microscope in order to determine the potential value of each sample, i.e. the ones capable of providing useful information to answer the research questions.

4.2 Analysis

The choice of optical microscopy, μ-Raman Spectroscopy, and Scanning Electron Microscope with Energy Dispersive spectrometer (SEM-EDS), as the analytical techniques for the characterisation of these cross sections, was related to their ability to provide effective information, and also their ease of availability within UCL. These techniques provide complementary information about paint materials. Also, they were chosen because they are non-destructive for the samples.

4.2.1 Optical microscopy (OM)

The microscope used on the examination of these cross-sections at *Pigmentum* laboratory (http://pigmentum.org/) was a Leica DMRX, with a x10 ocular lens and x10 and x40 objective lens, using reflected light (both ordinary light and ultraviolet light). The examination of the cross-sections under the microscope with reflected light and ultraviolet (UV) light revealed the number and sequence of layers, the colours of the layers, the existence of mixtures in some layers, the condition of the layers, the thickness and the distribution of the fluorescent materials (e.g. some materials such as organic media or specific pigments fluoresce under UV). Photomicrographs were taken of each cross-section (see Appendix 2a for sample location, and photomicrographs in reflected light and UV light).
This was followed by analysis with the analytical technique that was considered the most relevant for the identification of the materials.

4.2.2 μ-Raman spectroscopy

The Raman instrument used at the Christopher Ingold Laboratories, University College London, was a Renishaw InVia Raman microscope, Diode laser operating at

785nm, x50 objective and the spatial resolution down to c. 1µm. The instrument was calibrated by Dr Steve Firth, everyday using silicon.

Raman Spectroscopy provides compositional information about the materials within the layers by producing spectra characteristic of the materials present that can be compared with known references. The Raman analysis of Hinemihi's cross-sections provided the identification of all the pigments used in the paints employed to decorate Hinemihi.

4.2.3. Scanning Electron Microscopy with Energy Dispersive spectrometer (SEM-EDS)

The SEM Hitachi S-570 (in the Wolfson Archaeological Science Laboratories at University College London, Institute of Archaeology) with energy dispersive x-rays was used to analyse specific layers within some samples that were not possible to identify with Raman spectroscopy. This technique provides the identification of the elements present in the analysed areas. Additionally, this technique is capable of providing compositional imaging[1] (i.e. an image based on the distribution of the different elements within the cross-section). This was used to examine the existence of layers that were not conclusively visible with OM. The cross-sections, prior to analysis, were carbon coated to avoid sample charging. This technique proved to be very efficient in detecting and analysing a particular important layer; the volcanic ash/mud layer.

5. Results from the first sampling

[1] 'back scatter electron' image (BSE)

The first results, from the examination and analysis of the cross sections, revealed that the cross sections comprised anything from only a few layers (two) contrasting with others that reveal a greater number (13) of layers (see figure 2).

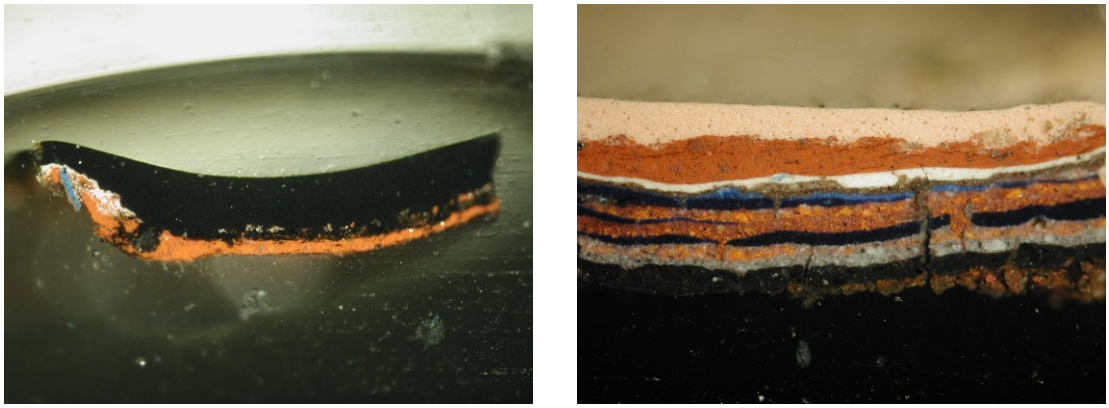


Figure 2 cross-section of Sample F (left) showing few layers and cross-section sample N (right) showing 13 paint layers. Both samples are from the first sampling phase

These very uneven results confirmed the difficulty of revealing the full story of the paint sequence. Therefore, it was clear that identifying the precise paint sequence related to different painting phases, would be a difficult task considering the extant samples and the sampling constrains.

The colours present in the cross sections were:

- orange/reddish layers in earlier paint layers that changed to reddish/pinkish in later interventions.
- white
- blue (which is one of the main colours in the first four interventions and loses this role in later interventions)
- black

Some layers showed a significant degree of deterioration, giving a possible indication of a long period of exposure to the environment. However, because it is

known that stripping off old paint was a method used in the repainting of Hinemihi, the deterioration of the layers could also be a result of the stripping action.

Common synthetic pigments were identified: Important was the identification by Raman spectroscopy of Pigment Red 112 (See Appendix 3, Raman spectrum from layer R2/R3), a commercial paint, which gave an indication of age, since this synthetic pigment was first produced in 1939 (Burgio & Clark 2001: 1504).

6. Rationale for second sampling

The comparison of the results from the examination of the cross sections, with the historical information and physical assessment, allowed the identification of two main areas of Hinemihi's historic carvings with the potential to reveal additional information. (See Appendix 2b for sample location, and photomicrographs in reflected light and UV light for samples from the second sampling).
These are the carvings around the window (waewae) and the carved area of the bargeboards (maihi). These two areas were considered relevant for different reasons. The carved area on the bargeboards is important because the examination of those specific samples revealed the largest number of layers, i.e. they seem to be the most complete samples. This is most probably due to its elevated position on the building, and because this element has areas of deeply carved relief. This means that it would be difficult to completely strip off all remains of the old paint during the past stripping operations. An additional important factor is that these bargeboards have always been a part of Hinemihi's structure and as external carvings are likely to have required frequent repainting. Therefore, their samples could contain, in theory, the complete paint sequence; 1880-1995.

The window carvings are relevant because it is known that they were removed from the building for a significant period of time, (removed sometime between 1925 and 1934 and replaced in 1995). Therefore, when comparing these two sets of samples (bargeboard & window) it was expected to find, in the set belonging to the window, a paint sequence with the gap corresponding to their absence (between 1925/34 and 1995). This would provide additional information for the sequence of the painting interventions that took place during this period and help with the chronology of the entire sequence.

7. Results from the second sampling

The results from the second sampling added significant detail to the results of the first set of samples. A lot of information resulted from a comparison of the paint sequence on the barge boards and the window carvings. A gap in the paint sequence was identified between the complete sequence of the bargeboards and truncated sequence of the window carvings. This suggested a sequence of 11 interventions, eight before the window's removal and three afterwards (interventions in 1960, 1980, and 1995). The gap in the sequence appears to represent two painting interventions that correspond to the 1960 and 1980 interventions.

A key factor was the detection of a layer that probably represents the remains of the volcanic mud that covered Hinemihi after the eruption in 1886. The identification of this layer provides a datum in the paint sequence, below it is the painted sequence applied at Te Wairoa, New Zealand, and above it is likely to be the paint sequence applied at Clandon Park, following Hinemihi's relocation in 1892.

The information gathered from the analysis allowed the formulation of a hypothesis for the painting sequence of Hinemihi.

8. Overall Results

The results from each cross section are recorded in Appendix 1. Each sample from the first sampling (A-Z, A2- J2) and second sampling (1-15) is grouped in relation to its location on Hinemihi's carvings. The presence of each identified paint layer is indicated for each cross section. The establishment of the sequence for each cross-section resulted from the cautious examination and comparison of the different photomicrographs (visible and UV light) as well as its confirmation under the microscope at high magnification (x40 objective lens). This methodology allowed the detection of similarities between the equivalent layers within different samples, through the examination of different aspects such as colour, fluorescence, existence of the same mixtures or same inclusions. Once the composition of a layer was identified in a sample, it was confirmed with the additional analysis of equivalent layers in other samples. This allowed a complete chronological sequence to be proposed.

The complete paint sequence can be seen in table 2 below.

Bl: Blue layer, Prussian Blue (spectrum from sample B2)
O1: Orange layer, Red lead (spectrum from sample 15)
P: Black layer, Carbon black, Calcite (spectrum from sample 2a)
V: Volcanic mud layer, Silica (spectrum from samples 2, T)
G: Grey layer, lead white, carbon black, synthetic iron oxide (spectrum from sample 2a)
O2: Orange layer, red lead, synthetic iron oxide, barium sulfate (spectrum from sample 2a)
Bl1: Blue layer, ultramarine, calcite, carbon black (spectrum from sample 2a)
O3: Orange layer, synthetic iron oxide, read lead (spectrum from sample 2)
Bl1a: Blue layer, ultramarine (spectrum from sample 2)
O3a: Orange layer, synthetic iron oxide, red lead (spectrum from sample 2)
Bl2: Blue layer, ultramarine (spectrum from sample 2)

W1a: White layer, lead white, calcite (spectrum from sample 2)

Bl2a: Blue layer, ultramarine (spectrum from sample 2a)

B: Beige layer, lead white, synthetic iron oxide (spectrum from sample 2a)

Bl3: Blue layer, Prussian Blue (spectrum from sample T)

R1a: Red layer, iron oxide, carbon black (spectrum from sample 2a)

W1: White layer, lead white (spectrum from sample 7)

Bl3a: Blue layer, Prussian Blue (spectrum from sample G2)

R1: Red layer, iron oxide, carbon black (spectrum from sample 2a)

W2: White layer, lead white, lead sulfate (spectrum from sample 7)

Bl4: Blue layer, Prussian Blue, carbon black (spectrum from sample G2)

Bl4a: Blue layer, Prussian blue, lead white (spectrum from sample G2, H2)

O4: Pink layer, iron oxide, barium sulfate (spectrum from sample 2a)

W3: white layer, lead white (spectrum from sample V)

Bl5: Light Blue layer: ultramarine, barium sulfate (spectrum from sample Z)

R2/R3: Pink Layer, Pigment red 112, iron oxide (spectrum from sample 7)

W4: White layer, rutile, calcite (spectrum from sample 7)

R4: Reddish layer, iron oxide, calcite (spectrum from sample 7)

W5: White layer, rutile, barium sulfate (spectrum from sample T)

Bl6: Blue layer, phthalocyanine blue (spectrum from sample Y)

W6: White layer, rutile, calcite (spectrum from sample W)

R5: Pink layer, rutile, iron oxide, calcite (spectrum from sample 7)

P1: Black sequence, carbon black (spectrum from sample Y)

Table 2 Showing the complete sequence of discrete paint layers identified in Hinemihi's cross section samples. Each layer has been analysed with Raman spectrometry (see Appendix 3 for an example of a Raman spectrum for each extant layer) and the composition is presented along with the sample in which this layer was analysed.

9. Discussion of Overall of Results

Historical records indicate that Hinemihi was repainted in 1880, 1960, 1980 and finally in 1995. In all, it is estimated that eleven different interventions are present in the cross sections. These interventions may represent seven different phases of

painted design. The pigments identified presented no surprise; they all appear to be synthetic pigments used in commercial paints. The white layers were initially painted with lead white, substituted after 1960 (i.e. in the last three interventions) with titanium white (rutile form[2]). This is not unexpected as, due to health and safety issues, the use lead based paints tended to be phased out in the UK by mid 20th century.

The majority of the blue layers, after the first use of Prussian blue, supposedly the original blue, are made of ultramarine[3], and the last blue (1980) consisted of phthaloayanine blue. The presence of the blue as one of the main colours in the patterns seemed to be reduced, after the fourth intervention, to blue detailing in a pinkish red-and-white colour scheme.

The orangey/reddish/pinkish layers, after the first use of red lead, are made of variable mixtures of red lead and iron oxide. This follows three interventions where iron oxide was the main pigment (mixed with carbon black or barium sulfate) and in 1960, 'Pigment Red 112' was used. The following two interventions consisted in iron oxide mixed with titanium white.

The materials used do not present any surprise in terms of temporal or spatial information, they correspond to the known evolution of pigment use.

Crucial for this study is the identification of what are probably the remains of the volcanic deposits (Rotomahana Mud) from the 1886 Mount Tarawera eruption. These remains, in some samples (T, 2, 5, 6, 7a, 8, 12, 14), form a clear but thin layer, in others it is possible to see just some vestiges of this layer. The SEM-EDS analysis of this layer identified the element; silicon. It is possible this represents the

[2] this form of titanium white started to be used in 1947 (Dr. Tracey Chaplin pers. Comm. 2003)

[3] in two samples (T and 11) Prussian blue is found in the 5th intervention (see appendix 1 and 3) and in one sample (G2) in the 6th intervention, the small number of samples where it is found seem to indicate that it was used for details, however this needs further study.

remains of Rotomahana ejecta from the Tarawera Eruption that buried the landscape with up to a metre of mud at Te Wairoa (Lowe 2006: 53). The main element in the composition of material ejected from volcanoes is commonly silicon. However, the composition of the Rotomahana ejecta is likely to vary significantly geographically. Therefore only an approximate composition can be determined from geological investigations (Nairn 2010 pers. comm.) The results of Rotomahana mud analysis are likely to vary between different locations, and between different samples from the same location. Further investigation is required to confirm the identification of this layer as evidence of the 1886 eruption. Samples of the volcanic deposit (Rotomahana mud) from Hinemihi's original site at Te Wairoa were collected by Dean Sully and Jim Schuster in December 2010 and are available for future comparative testing. Results from this analysis will help to refine the identification of this material within Hinemihi's paint sequence. However due to variations in composition, may not produce an exact match (Nairn 2010 pers. comm.)
An additional fact that seems to point to the layer being the remains of the volcano eruption is that silica is not known to be used as a pigment (Eastaugh 2004), therefore a layer made exclusively of silica could indicate that it is not a paint layer.

The first sequence identified in the paint samples is probably the original painting intervention from 1880 and consisted of blue (made with Prussian blue), orange (made with red lead) and black (made with carbon black). The white colour is missing from this sequence, it is not possible, so far, to say if it existed or not. According to historic photographs, there appears to be a white colour used in the painted design. There are however few samples that contain the original colours

and the white layers need further sampling and study in order to be more fully understood (as is also the case in later interventions).

The choices of colours that change during Hinemihi's life suggest some links to her past. The first interventions used brighter colours, a vivid reddish/orange (made of red lead in its orangey form, the lead (II, IV) oxide) contrasting with a strong blue (Prussian blue), and a white (which was not found in any sample, but appears to be present in the historical photographs). This represents the first colour scheme present in the samples. The use of these bright and strong colours could be related with one of the functions of Hinemihi when in New Zealand, a touristic attraction. It may also relate to contemporary meeting house design in the 1880s, influenced by the brightly coloured Ringatu faith meeting houses (Brown 2009:58). This is also suggested as Tene Waitere, the carver who completed Hinemihi, was a member of the Ringatu faith (pers. comm. James Schuster 2010). The following three interventions (likely to have taken place at Clandon Park) retained the brightness of the colours, which seems to indicate the wish to preserve the memory of the original colours. From then on (possibly after 1925/1934), the orangey colour was replaced with darker and dull reddish/pinkish colours, which seem to reflect a change in the perception of Hinemihi; possibly indicating loss of memory, or change in taste, or could just be related to the availability of paint materials. The 'importance' of the blue seemed to weaken during the 20th century, when the colour scheme consists essentially of the pinkish and white colours. The blue tends just to be used for some areas (barge boards) and for details, where before larger areas seemed to had been painted in blue. This is not unique to Hinemihi and similar changes in fashion can be seen in the repainting of meeting houses in New Zealand during this period (Brown 2009). One strand of this process represents the development of a monochrome

tradition using red ochre on all carvings (Barton 1985, Barton & Reynolds1985:10), the other strand is seen with Ringatu meeting houses that continue to utilise a wide contemporary palette of commercially available paints (Brown 2009).

The last intervention in 1995 used black paint to replace the areas of design previously painted with blue. The use of pink and white, especially seen in the last interventions, follows the idea that Hinemihi was thought to have been originally painted in these colours. These were the colours of the famous 'Pink and White Terraces' near Te Wairoa. It could reflect a strong wish by the people who painted her, to revive what they thought was the original perception of Hinemihi as a Meeting House.

It is likely that the decoration of Hinemihi did not conform to rigid rules in terms of patterns, as for example the last intervention in 1995 where just some areas were repainted. This specific event reflects the lack of time available at the time prior to the dedication ceremony of the new carvings. Also, it is evident that the colour scheme has been reversed during Hinemihi's time at Clandon. The 1960s colour scheme appears to have reversed the white and red areas of design present in 1880. The 1980 repainting reverted to the earlier colour scheme from 1880, when pink areas were painted white and white areas became pink. The red/pink colour was based on a sample of red ochre sent over from New Zealand by M.E. Camplin (unpublished letter from M.D. Drury 26 August 1980)

As a result of this work an initial chronology is proposed in table 3:

First phase (Prussian blue, red lead) 1880-1881

1. Bl: Blue layer, Prussian Blue/O1: Orange layer, Red lead/P: Black layer, Carbon black

1886 (Silica)

2. V: Volcanic mud layer, Silica

Second phase (ultramarine, iron oxide, red lead, barium sulfate, lead white) 1897?-1917?

3. 1897? G: Grey layer, lead white, carbon black, synthetic iron oxide/O2: Orange layer, red lead, synthetic iron oxide, barium sulfate/Bl1: Blue layer, ultramarine, calcite, carbon black

4.? O3: Orange layer, synthetic iron oxide, read lead /Bl1a: Blue layer, ultramarine

5. ? O3a : Orange layer, synthetic iron oxide, red lead / Bl2: Blue layer, ultramarine /W1a:White layer, lead white, calcite

6. ? Bl2a: Blue layer, ultramarine/B: Beige layer, lead white, synthetic iron oxide

Third phase (Prussian blue, iron oxide, lead white, lead sulfate) 1917?

4. ? Bl3: Blue layer, Prussian blue

5.? R1a: Red layer, iron oxide, carbon black /W1 White layer, lead white/ Bl3a: Blue layer, Prussian blue

6. ? R1: Red layer, iron oxide, carbon black/Bl4: Blue layer, Prussian blue, carbon black/W2: White layer, lead white, lead sulfate

7. ? Bl4a: Blue layer, Prussian blue, lead white

Fourth phase (ultramarine, iron oxide, lead white barium sulfate) 1925/1934?

8. O4: Pink layer, iron oxide, barium sulfate/W3: white layer, lead white/ Bl5: Light Blue layer: ultramarine, barium sulfate

Fifth phase (Pigment red 112, iron oxide, rutile, calcite) 1960

9. R2/R3: Pink Layer, Pigment red 112, iron oxide/W4: White layer, rutile, calcite

Sixth phase (phthalocyanine blue iron oxide, calcite, rutile, barium sulfate) 1980

10. R4: Reddish layer, iron oxide, calcite/W5: White layer, rutile, barium sulfate/Bl6: Blue layer, phthalocyanine blue

Seventh Phase (iron oxide, calcite, rutile) 1995

11. W6: White layer, rutile, calcite/R5: Pink layer, rutile, iron oxide, calcite/P1: Black sequence, carbon black

Table 3 showing 11 painting events and the proposed seven different phases of decoration 1880-1995

A digital reconstruction of the colours identified in the first layers of paint on Hinemihi is presented in figure 3

Figure 3 digital reconstruction of 1880s painted design on selected architectural features (Ralston 2008)

This provides an initial indication of the original colour scheme of Hinemihi. Bright blue bargeboards (maihi) (this is similar to examples of nineteenth century Ringatu meeting houses, see Brown 2009), an orangey red on the ancestral carvings (a similar colour has been revealed on Hotunui, a 1870s meeting house currently housed at Auckland Museum (Barton 1985) (see figure 4).

Figure 4 Poupou from Hotunui showing 1870s orange/white/ black colour scheme

This colour scheme was considered at the time of the 1980 restoration, as John Perry (Director Rotorua Art Gallery) states in a letter to Mr. Draper who was carrying out the work “large number of Arawa houses at this time were painted in not only red and white, but red, white and blue” (Unpublished letter JF Perry to EW Draper 10/02/1980).

10. Further work required

The proposed conservation treatment of Hinemihi is likely to include removal of the existing paint on the surface of Hinemihi. At that stage, larger areas of the underlying painted design are likely to become exposed. This will provide an opportunity to collect further samples and reconsider the results from this research.

It is proposed that larger areas of paint are removed in a controlled manner in order to establish the intimate relationships between the identified layers. This should enable a more accurate assessment of the coexistence of the identified paint layers and will help to interpret contemporary design schemes. This should enable a reconsideration of the interpretation presented here and provide a resolution of current uncertainties in the sequence.

Further work is required to relate the identification of individual layers to the actual painted design at different periods in the past. This should aim to identify the colour palette for the earlier painted design associated with Hinemihi in Te Wairoa. The white colour is currently missing from this sequence, according to the historic photographs there appears to be areas of the carvings painted white, however no evidence for this early white paint could be identified in the small number of samples containing the early colour sequences. The white layers need further sampling and study in order to be fully understood, this is the case for the early sequences as well as in later interventions.

- Investigate the nature of the “V layer”.

Further research is required to confirm the presence of 1886 volcanic eruption in the V layer (see samples 5, 2a, 2, 8, 7a, 6, T, O, 12, 14, Y, X). Compare the composition of this layer with sample of Rotomahana Mud (sample available from Dean Sully)

- Investigate the nature of the “G layer”.

Does this represent a cleaning layer possibly that took place after the volcanic eruption, possibly after Hinemihi arrived at Clandon Park, or is it a preparation layer for the subsequent painted design?

- Investigate paint sequence in 1925-1960

Very little information is available about Hinemihi from 1925-1960. Further analysis of the paint layers could help to clarify the paint sequences during this period. For example in two samples (T and 11) Prussian blue is found in the 5th intervention (see appendix 1 and 3) and in one sample (G2) in the 6th intervention. The small number

of samples where Prussian blue is found seems to indicate that it was used for detailing rather than for larger areas of painting, however this needs further study.

11. Conclusion

The comparison of analytical results (pigment identification and examination of cross sections) with the historical information leads to new ideas about Hinemihi. It has helped to identify different interventions and to date some of them, to assess the condition of the paint structure and to suggest the significance of the use of specific materials.

The results of this study provide important documentation of evidence about Hinemihi's past painted surfaces. This will become crucially important when Hinemihi's painted surface is stripped in the forthcoming conservation treatment. It is important to study new samples as well as to compare these results with other paint structure studies from other meeting houses in order to rethink some of these conclusions.

Finally, to return to the original research questions for this project we can respond as follows:

Is it possible to find evidence of the first colours, materials, and patterns used on Hinemihi's carvings?

The original colours appear to consist of a palette of Prussian blue, red lead and carbon black. There is currently no information about the contemporary white layer that was not found in the cross sections, but appears in historic photographs.

Is it possible to establish the changes in the painted decorative surface over time?

The colour palettes from 1880, 1960, 1980, and 1995 have been identified within the cross sections. There is less certain information about the period from 1892 – 1960 and further work as required to identify the detailed chronology for this period

Is it possible to relate the different decorative schemes to the history of Hinemihi?

Although the individual paint layers have been identified for the complete sequence 1880-1995, it is difficult to relate these directly to the decorative schemes at different times in the past. Larger sized sample areas can be revealed during the stripping of historic carvings. This will help to understand how the paint layers relate to one another and to the overall painted design

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