

THE EUREKA FLAG: CONSERVATION, ANALYSIS AND DISPLAY OF AN AUSTRALIAN ICON

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The Eureka Flag with its iconic image of the Southern Cross was flown above the miner's stockade at Bakery Hill in Ballarat in 1854. After the battle in which the miners were defeated the Flag was torn down and kept by Trooper King and his family until the late 1800s when it was placed in the care of the City of Ballarat. It was poorly looked after during the early 1900s until it underwent treatment in 1973. The treatment was carried out by local Ballarat seamstress Val D'Angri and the Flag has subsequently hung in the Art Gallery of Ballarat. In 2010 the Textile Conservation section at Artlab Australia undertook an assessment of the Flag's condition and recommended that the previous treatment be redone. The Flag travelled to Adelaide in late 2010 and underwent a new treatment including removal of the 1973 lining, realignment of the remnants and attachment of a new lining using stitching techniques. After lining the Flag was sewn to a new larger backboard made from an aluminium frame with lightweight aluminium honeycomb panel in-fills. Prior to treatment the Flag underwent fadeometer testing and the results of this testing indicated that the Flag was dyed using Prussian Blue. The results of this testing affected the proposed parameters for future display.

INTRODUCTION

The Eureka Flag with its iconic image of the Southern Cross was flown above the miner's stockade at Bakery Hill in Ballarat in 1854. The Eureka Flag was made in Ballarat and was first flown in November of that year at a meeting held by the rebel miners. It was last flown over the miners stockade only a week or so later. After the battle against troops and police, in which the miners were defeated, the Flag was torn down and kept by Trooper King, one of the soldiers involved in the battle. The King family kept the Flag on their farm in rural Victoria where they showed it infrequently at country bazaars throughout the end of the 19th Century. It made its way back to Ballarat in 1895 when the King family loaned it to the City of Ballarat (Cayley 1966: 79).

Since its return to Ballarat it has been kept in various locations on display and in bank vaults until it underwent treatment in 1973. The treatment was

carried out by local Ballarat seamstress Val D'Angri and the Flag has been on continuous display at the Art Gallery of Ballarat since. In 2010 the Textile Conservation section at Artlab undertook an assessment of the Flag's condition and recommended that the previous treatment be redone because although the it had worked reasonably well to support the Flag, the loose threads, in particular, were not adequately secured. The use of a polyester lining was not considered the best choice, as a like fibre such as wool would have better physical affinity to the Flag and a better aesthetic appearance. It was also presented in such a way that the lining did not show or convey the original size of the Flag. All of these issues could not be effectively addressed without redoing the previous lining. The Flag travelled to Adelaide in late 2010 and underwent a new treatment including removal of the 1973 lining, analysis, realignment, attachment of a new lining and attachment to a new display board.

DESCRIPTION AND CONSTRUCTION

Who designed and made the Flag remains a mystery. There was reportedly a story written in the Ballarat Times shortly after the rebellion saying that the designer may have been a Canadian, Henry Charles Ross, and that it was sewn by two women, but Ross died at the battle leaving no records and no complete record of the Ballarat Times still exists (Carboni in Ramsay 2004: 38). There is also a theory that it may have been designed to look similar to an ecclesiastical flag flown by the priest at St Alipius Catholic church: a blue cross on a white background (Linnane in Ramsay 2004: 38). As the Flag was kept by the King family for many years before it came back to Ballarat

many historians refused to accept that this Flag was genuine (Cayley 1966: 79) and reports still exist today that there are two flags and that this one is not the original. Similarly there is much confusion about what the Flag is made from, with oral traditions saying that the stars are made from the petticoats of the

women making the Flag (Sun, Sydney 5 May 1941 in Ramsay 2004: 38) and that the cross is made from sheeting. There are also reports of the Flag being made from silk or mohair (Cayley 1960: 70). The exact truth of who designed and made it may never be known, but thorough examination and documentation of materials and construction can hopefully bust some of the myths and perhaps reveal possible clues to the design.

There are four different fabrics used to construct the Flag: the blue ground, the cream cross, the cream stars and the hoist. All fibres were inspected using microscopy and the results indicated that the

blue ground fabric is a fine plain weave with a cotton warp and a protein fibre such as wool weft. The cream cross fabric is twill, with a cotton warp and wool-like protein fibre weft. The star fabric warp and weft are both made from wool-like protein fibre, and the hoist is cotton. It was not possible for Artlab to determine whether the protein fibre of the blue weft was wool or mohair. Further testing of the fibres was undertaken by Dale Carroll at CSIRO Materials Science and Engineering in Geelong to see if the exact source could be identified. The blue weft was examined using scanning electron microscopy (SEM) and the results determined that they could not confidently confirm the identity of the original source of the protein fibre due to the variations in scale structure present on the fleece of one animal,

cross-breeding of sheep, and scale damage from ageing, processing and dye application (Dale 2010). Therefore mohair as a source of the protein fibre has not been ruled out. More research of the blue fabric including a comparison of similar fabrics of this period would be useful to see if the visual appearance of the fabric, which has a

slight sheen, would help to identify the exact source of the protein fibre.

Flags are most commonly constructed from wool bunting, a fine open plain weave of 100% wool. The blue ground and the stars are both plain weave, but the blue contains cotton. The star fabric is the most similar to bunting but the thread count is much higher with 36 x 30 threads per cm compared to a typical bunting at 14 x 14 threads per cm. The presence of wool in all of the fabrics rules out the idea that any of the fabrics are sheeting which is commonly cotton. So what are the fabrics and where did they come from? This is



Figure 1 | Eureka Flag before treatment 2010

hard to exactly determine and again more research is needed. Comparisons with 19th century clothing would be useful, although very little everyday clothing from this period survives. We believe that the most likely source of the different fabrics is clothing, such as the fine wool used for dresses and shirts. There was frequent mention in writing of the mid 1850s of working men wearing blue woollen shirts (Fletcher 1984: 94) and it is likely that these types of fabrics would have been available in Ballarat for people to buy and make into clothing.

Examination of the Flag provided clues to the design process. Above and below each cream horizontal cross the blue fields are similarly constructed from two horizontal strips of fabric. The strip closest to the cross is a complete width of fabric (750mm) with selvages present each side, and the outer strip is almost exactly half the width (370mm) with a raw edge innermost and a selvage used to form the top and bottom edges of the Flag. The width of the cream cross is the same as the narrow width of the blue field (370mm), i.e. half a width of fabric. The use of one and a half widths of fabric uses the fabric very economically, with no wastage or off-cuts. This suggests that the size of the Flag was determined by the fabrics available as opposed to working to a prescriptive design. This may also explain why the Flag is so unusually large.

Damage

The Flag has had a hard life. Most of the damage present today has occurred after it was flown and is not related to damage that might have occurred

during the battle. The greatest cause of damage is extensive souveniring. The first reports of souveniring occurred directly after the battle with stories of soldiers trampling on the Flag and tearing off pieces (Withers in Ramsay 2004: 24). This practice continued right up into the 20th century leaving the Flag with nearly 40% loss. Where losses in the Flag have straight edges these are assumed to be due to souveniring. Many of these souvenired pieces still exist and the City of Ballarat owns several pieces. Others are present in collections throughout Australia and many pieces must also exist in private hands. The stories of these pieces and how they came to be are fascinating, and there has never been any suggestion that the pieces be reattached. These pieces

also help to verify the authenticity of this Flag. So far all the souvenired pieces that have been visually inspected appear to be similar, strongly suggesting that this Flag is the original and the only one. Documenting the locations of these pieces and verifying their authenticity remains an exciting prospect for the future.

Poor storage has resulted in other damage. There are numerous small holes throughout but most extensively on the stars. These holes are dirty around the edges and there was much talk about them being caused by gunshot. Very unexcitingly it is believed that they are most likely due to insect damage. They are more extensive in the star fabrics as this is 100% wool. There are similar holes in the crosses and ground fabrics but they are less widespread, and in some places only the wool fibre has been consumed leaving the cotton threads intact.

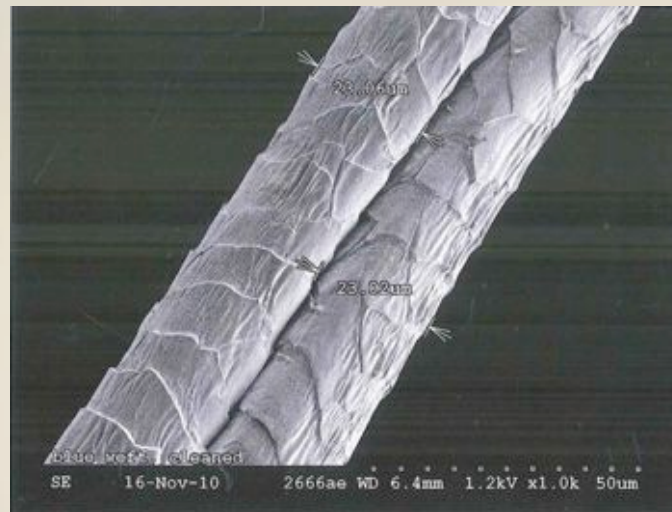


Figure 2 | Scanning Electron Microscope image of cleaned blue weft. Hitachi S4300 SE/N Scanning Electron Microscope operated at a 1.2kV accelerated voltage.

The cream cross fabric also shows significant damage to the cotton warp. This has resulted in extensive splitting. It is assumed that this is due to some inherent problem with the cotton warp, for example a pre-treatment such as bleaching that occurred prior to weaving, but no evidence of the exact cause has been found. Otherwise there is slight staining throughout with some deposits present. There is some evidence of fading with the blue fabric appearing darker in areas where it has been protected from light.

Previous treatment

Up until the 1970s the Flag was very poorly stored and most reports document it being stored in plastic bags in various bank vaults (Cayley 1966: 84). In 1971 the Art Gallery of Ballarat worked towards conserving the Flag and putting it on display. It was wet-cleaned in water and a conservation treatment was undertaken by local seamstress Val D'Angri. It was hand sewn using Sylco™ sewing threads onto a backing made of 2 layers of fabric, Prestalene™ (a polyester dress fabric) and Stabiltex™ (D'Angri 1973). The backing fabrics were used to attach the lined Flag to a timber backing board. It was framed behind glass and hung in the stairwell at the Gallery. In the 1980s it was moved from the stairwell to a gallery space with lower light levels.

In 2010 the Textile Conservation section at Artlab undertook an assessment of the Flag's condition and recommended that the previous treatment be redone. The Flag travelled to Adelaide in late 2010 where it underwent a new conservation treatment.

ANALYSIS

Prior to treatment Bruce Ford from Art and Archival Pty Ltd, a consultant on fading and lighting guidelines to the National Museum of Australia, undertook in-situ lightfastness tests on the Flag using a Newport Oriel® microfading tester. A 300-400µm spot of light of about six megalux, filtered to remove ultraviolet and infrared radiation, was focused on the fibre and the reflectance spectral changes used to calculate colour difference the CIELAB (1976) perceptual model. The findings indicated that the lightfastness of the Flag as a whole is relatively good with the blue dyed wool weft the least light fast element fading at a rate equivalent to the more stable end of the ISO Blue Wool (BW) 4-3 range. While this is

still considered to be in the sensitive or moderately sensitive range for museum materials, it implies decades for perceptible fading to occur at museum type light and UV levels and is at the lower end of fading rates expected for historic dyed textiles. This appears to be borne out by its present condition. Although the Flag was on

intermittent display until 1970s and on permanent display throughout the following decade at what were likely to have been quite high light levels, and subsequently at 30 lux, it is very even in colour and the differences between exposed and protected areas, although noticeable, are not dramatic. Based on the microfading results the least stable colour (blue wool weft) is likely to undergo one Just Noticeable Fade (JNF) for every 7 megalux hours exposure, or about 50 years at 50 lux for 8 hours a day. To put this in context, something like 30 JNFs are required to complete colour loss and perhaps 10 to achieve 'unacceptable' loss, depending on how that might be

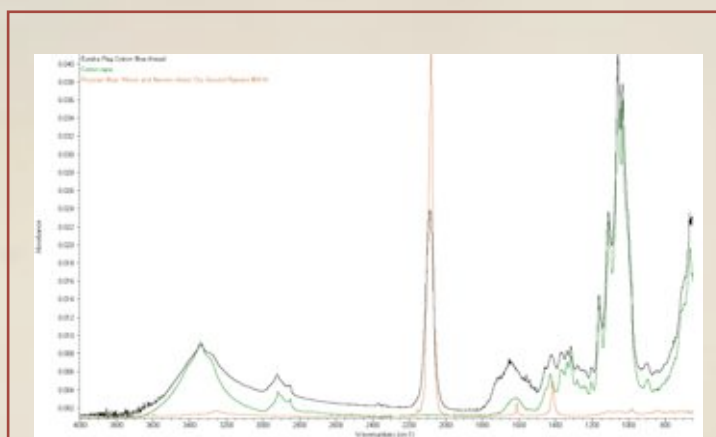


Figure 3 | Eureka Flag blue thread FTIR-ATR spectrum overlaid with FTIR-ATR spectra of known samples of Prussian blue and Cotton. The strong absorption at 2085.24 cm⁻¹ shows the presence of Prussian blue.

defined. The results were used to lend more confidence to lighting recommendations in the conservation management plan for the Flag.

The visible reflectance spectrum obtained during microfading indicated that the blue dye was probably Prussian blue, and this was confirmed using FTIR-ATR (Figure 3). The sample was analysed using a Thermo Scientific Nicolet iS10 FTIR (Fourier Transform Infra-Red) Spectrometer with an ATR (attenuated total reflection) Germanium crystal plate (32 scans at a spectral resolution of 4cm^{-1}). OMNIC Thermo Scientific Spectroscopy Software was used to collect, process, analyse and store the FTIR-ATR data.

The oxidative light-fading of Prussian blue is a reversible reaction; in the dark it characteristically regains much of the colour lost. Along with the relative stability of the dyed textile in this case, this phenomenon helps to explain its current condition (Kirby 1993). It has been known since the early 19th century that the light-fading of Prussian blue is characteristically

accelerated in low oxygen environments in which the reaction occurs via reduction. Although it wasn't observed to be significantly so in this case, when single fibres taken from the flag were tested under argon, its identification rules out anoxic display which might otherwise retard the deterioration of the wool and cotton and thermal yellowing (Kirby 1993).

REALIGNMENT

There is extensive damage to the left hand (LH) side of the Flag and a series of repairs have been undertaken throughout the life of the Flag in this

area. The hoist and remnants of blue field adjacent to the hoist had at some point been completely detached from the main body of the Flag. There was a non-original vertical machine-sewn seam attaching the hoist and remnant to the rest of the Flag (all other seams in the Flag are hand-sewn). This seam positioned the hoist and blue ground incorrectly. The horizontal seams on the blue adjacent to the hoist did not align with the horizontal seams on the main body of the Flag. Furthermore the distance between the LH side and the right hand (RH) tip of the left star, assuming that this star is the same size as the top and bottom star, was also insufficient. The thread used in this seam was the same as that used in other areas in 1973 and Val D'Angri states in her documentation that she released a machine sewn seam in this

location and then re-sewed it, suggesting that the seam pre-dated 1973.

A piece of star was attached to the LH side of the blue ground and was positioned in such a way that it represented the LH most point of the LH star. Examination of this piece indicated that it was not in fact a point of a star but was an edge of a star with a

small piece of blue ground sewn to it. The bottom edge of the cream fabric on this remnant was folded so it appears to be a point but no original seam was present. The seam securing the cream piece to the small piece of blue ground was similar in construction and thread type to all other seams in the Flag suggesting it is an original seam. The only threads holding this remnant in position were sewn through the lining attached in 1973. The LH edge of the blue ground where the remnant was positioned was cut out in a shape that was similar to but not exactly the same as the remnant. There is no other



Figure 4 | Photo of plastic overlay used to determine the original size and alignment of the left hand star.

physical evidence to suggest that the star remnant was located in the present position prior to 1973.

All of this information was documented and a digital image of the Flag with the proposed changes of position was produced to show the Flag's custodians its possible final appearance. After considering the information provided, the decision was made by the custodians of the Flag that the machine sewn seam and the threads securing the star remnant would be released and the Flag repositioned so that it more accurately reflected the original layout.

The hoist and LH side of the Flag were positioned so that the horizontal seams aligned. The main body of the Flag was positioned further to the right so that the distance between the left side and the RH point of the star was approximately the same as for the other stars. The grain on the star/small blue fabric remnant indicated that it originally came from the LH star but an exact position could not be determined. Using an overlay to show the original position of the star the remnant was located along the edge of the star. It is possible that it came from any point along this edge but the decision was made to place it as closely as possible to the LH point of the star as this was approximately the location it had held since 1973. If further research provides more accurate insight into its location, it can easily be repositioned.

As a result of the changes, the overall size of the Flag increased with the larger gap between the LH side and the main body of the Flag, and on the RH side the length increased to include the distance required for the star plus the same distance for the blue ground as on the LH side. The final size of the Flag is 2580mm (w) x 4000mm (h).

TREATMENT

Initially all of the stitching from 1973 was removed and the machine-sewn seam released. The Flag was then removed from the old lining. A new lining of fine plain weave wool was selected because it was considered more appropriate to sew the Flag to a lining with a similar fibre type, and that the wool would provide a much more pleasing aesthetic match. The lining was commercially dyed to a mid-grey

colour. The lining was placed underneath the Flag, the Flag aligned and the re-stitching undertaken using a fine thread and contemporary conservation stitching techniques. Staggered vertical grid lines were sewn using Skala™ thread and all couching was done using Tetex™ threads. After completion of the support stitching the edges of the lining were hemmed by hand in a running stitch to reflect, but not copy, the original stitching.

Underneath the top edge of the hoist a small separate piece of blue ground was found. It was not possible to find its original location as the edges of the piece did not match any other edges on the Flag. It was decided that small piece should stay with the Flag so that it did not become confused with other souvenired pieces and it was positioned so that it could not be seen underneath the hoist. A label has been placed with it to explain its present location.

At some point in time the hoist has shrunk causing cockling of the blue ground fabric adjacent to the hoist. In areas where the cockled blue ground was damaged, the flat lining did not provide sufficient support. In these areas an additional piece of the grey lining was used to patch the cockled areas. The patched area was then sewn to the lining.

The stitching on the Flag took approximately 300 hours and the task had a limited timeline. An occupational risk assessment was carried out for this task and it was considered high risk for static posture and repetitive strain injury. Engineering controls to reduce the risk of injury were developed by Justin Gare, Senior Objects Conservator. This involved the modification of a work table (in this case the old backboard from the Flag) so that it could be raised, making the work surface sloped. A sloped surface improved visual and manual access, reducing the risk of neck and postural strain. Once an area of Flag was completed the Flag was moved down and over the rounded end of the work table and was then rolled face out onto a roller suspended underneath the table. The system also incorporated a padded bar suspended along the front edge with a 50 mm gap between the bar and the rounded end of the work

surface. The conservators could lean on the bar, rather than on the surface of the Flag, with the padding supporting elbows and wrists and providing support for the upper torso body weight, greatly reducing the muscular strain associated with unsupported static postures.

Administrative controls were also incorporated including the development of a Safe Operating Procedure. The procedure included tasks such as frequent micro pauses to relax muscles, in-situ stretching and macro rests – longer active rests to aid recovery. Active intervention by a physiotherapist to monitor and treat conservators as required was also employed. The controls worked very effectively with all conservators completing the stitching in good health.

DISPLAY

A new backboard was constructed consisting of an aluminium frame with inserts of Aylite 2022TP™, an aluminium honeycomb panel faced with an aluminium. Oddy tests were carried out on the Aylite panel and it was considered to be appropriate for use. A timber beading was placed on the back to enable stapling. The Aylite was drilled throughout. The backboard was covered with two layers of washed fabric, flannelette underneath and light grey cotton sateen, selected to best



Figure 5 | Sloped work surface used to reduce muscular strain for conservator, Mary-Anne Gooden undertaking stitching.

suit the Flag, on top. Each layer was wrapped around the aluminium frame and stapled using stainless steel staples into the timber beading underneath. The flannelette was also stitched through the Aylite panels using the drilled holes so that the backing fabrics and subsequently the Flag will be supported throughout the centre.

The lined Flag was then placed on the new covered backboard and hand sewn into position. It was sewn around all edges and in staggered vertical lines throughout the centre using Skala™ thread. For display it has been recommended that it be placed within the case at an angle of no less than 75° from horizontal.

CONCLUSION

A Conservation Management Plan was developed to address the key elements instrumental in the ongoing preservation of the Flag including environmental conditions for display and storage, display case design, controlled access, disaster management, inspection and maintenance. On its return to Ballarat the Flag will become the centrepiece of the new Australian Centre for Democracy. It is hoped that the analysis of the Flag documenting the fabrics, dyes and construction will clarify some of the misconceptions in the public domain, and that the realignment, showing a more



Figure 6 | Overall photo Eureka Flag after treatment 2011.

original layout, will also enable more accurate interpretation in the future.

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AUTHOR BIOGRAPHY

Kristin Phillips is a textile conservator at Artlab Australia. Artlab undertakes conservation work for the major state institutions in Adelaide including a large collection of Asian textiles at the Art Gallery of South Australia. The residency enabled Phillips to travel to Yogyakarta to visit the many textile collections in the area, in particular at Sonobudoyo Museum, allowing her to expand her knowledge of textile conservation practices in the region and to present workshops on different aspects of textile conservation.

