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THE SILVER LINING: PRELIMINARY RESEARCH INTO GOLD-COLOURED VARNISHES FOR LOSS COMPENSATION IN TWO 19TH CENTURY SILVER GILDED FRAMES

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ABSTRACT

Golden varnishes appear on frames, furniture, wall hangings, leatherwork, panel paintings, mural paintings, and polychromy, and were applied to white metal gilding to imitate gold and other semi-precious materials. Despite the number of examples in cultural heritage there are few publications that discuss the ethical considerations of treating coloured silver gilded surfaces. The chromatic reintegration of gold-coloured varnishes on white metal gilding present specific material and technical challenges. In 2021 the Art Gallery of New South Wales (AGNSW) treated two identical late 19th century silver gilded frames for portraits by Joseph Backler from the Australian collection. In addition, a third portrait required the fabrication of a reproduction frame identical to the others. Conservation of the frames presented an opportunity for carrying out experiments into coloured coatings for loss compensation on silver gilding exploring applications for select conservation paints, dyes, and synthetic resins as substitutes for shellac. The results of experiments demonstrate that with the right application Liquitex Soluvar Gloss Varnish, Laropal A81 and Paraloid B72, present gloss levels and visual film forming properties comparable to shellac coatings when applied to burnished gilding. Additional tests with various dye colours illustrate that Orasol ® dye mixtures in colours Yellow 2GLN, Yellow 2RL, and Brown 2GL are reliable colour imitations for traditional gold-coloured varnishes. Although this research is preliminary, it may inform the selection and application of appropriate retouching materials for compensating losses to burnished silver leaf and golden varnishes in gilding conservation.

Keywords. Golden varnish; Silver gilding; Golden ® MSA; Orasol ® dyes; Gilding conservation; Frames conservation.

1. INTRODUCTION

1.1 Background

The imitation of gold using coloured varnishes applied to silver and tin leaf has been practiced since antiquity. The earliest documented recipes for golden varnishes record the use of egg yolk, animal glues, gums and drying oils mixed with organic dyestuffs, inorganic pigment, and animal bile [1] [2] [3]. From the 17th century permutations of recipes expanded to include spirit-based natural resin and shellac varnishes that became very popular during the 19th and 20th centuries. Shellac was popular for its ability to form a fluid, durable, and flexible high gloss finish and for its inherent yellow and orange lac dye present in unrefined grades of shellac [4]. The shellac could be further doctored with synthetic dyes making it a versatile gold-coloured varnish material. As shellac ages it becomes more permeable to water and increasingly yellowed, embrittled, and less soluble [5] complicating its removal from cultural materials [6] [7]. The use of shellac to replace varnishes on gilded surfaces is less recommended with respect to contemporary conservation ethics of reversibility, of differentiation of original from interventions, and in consideration of its poor long term ageing properties.

Whilst it is true that silver and tin gilding was intentionally used in some cases for mechanical strength and decorative effect [8] [9], reducing the

costs of gold is perhaps the most recognised reason for the widespread establishment of these surrogate gilding techniques. Traditionally, the gilding was burnished to a mirror finish before applying a coloured varnish although matte gilding was also used to create a satin finish to contrast with burnished passages. This gilding scheme is prevalent in Baroque and Rococo polychromy and for period gilded frames.

Several authors have discussed silver leaf gilding in particular reference to Latin America, Northern Europe, Portuguese, and Spanish religious art [10] [11] [12] chartered the development and material evolution of some coloured varnishes for silver leaf in Europe with a focus on 16th-18th centuries and earlier period treatises [13] [14]. It is recognised that due to the ability for these coloured gilding schemes to go undetected, there is growing interest in the microanalytical identification and characterisation of faux gold gildings [15] [16] [17] [18] [19]. Case studies that examine compensating losses sustained to original-coloured coatings on gilded objects using non-traditional materials and methods is not as researched in practice.

Treatment approaches to compensating losses to these types of gilded surfaces can be daunting. In addition to finding compatible coloured varnish systems suitable for gilding, there are challenges of surface preparation and application of materials which have a significant impact on the intended surface effect. On the flat areas of frames the distinctive lay lines from gilding are visually apparent, especially if areas are tarnished or the coloured coating has faded. The in-gilding and in-glazing of losses without causing brush marks or shifts in tone and colour convergences is technically demanding. Depending on the condition of the gilded object, conservators may need to replace or infill multi preparatory layers for water gilding, select a suitable metal leaf replacement for in-gilding silver, choose appropriate gilding techniques, and may need to burnish passages before a coloured varnish can even be considered. These foundation layers are critical to the visual success of a highly reflective surface that creates the illusion of burnished gold.

1.2 Research aims

In 2021 the AGNSW treated frames for two 19th century Victorian family portraits titled Portrait of a young girl with flowers (1861) and Portrait of a young girl holding a book (1861) by Joseph Backler. The frames are silver gilded on black bole with thin matte gilded slips with burnished cavetto, and burnished primary moulding with pressed metal ornament relief corners. The golden varnish medium on both frames was identified as orange shellac through complimentary analyses of Fourier Transform Infrared Spectroscopy (FTIR) and ultraviolet light cross section microscopy (Figure 1).

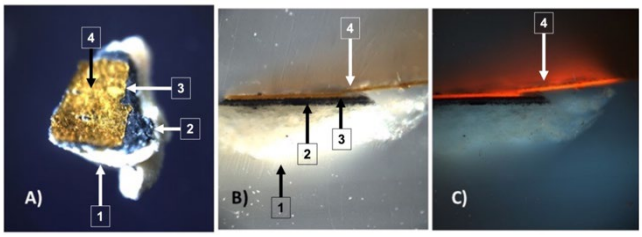

Figure 1 – Cross-section sample of frame for Portrait of a young girl holding a book. (A) sample viewed under stereomicroscope before embedding in cross section, (B) cross section of sample under visible light x400 magnification, and (C) cross section viewed under ultraviolet light x400 magnification. Sample shows stratigraphy of gesso ground (1), black bole (2), silver leaf (3), and orange shellac (4).

The frames had sustained losses to gesso, bole, silver gilding, and shellac coating, and areas of silver leaf had tarnished beneath the golden varnish. The frame for Portrait of a young girl holding a book had lost its original slip. To determine a treatment approach to compensate losses to ground, gilding, and original golden shellac varnish, several experiments were carried out on traditional water gilded sample mock-ups and metal token samples gilded non-traditionally [20] using aluminium leaf. Tests were carried out with various paints, dyes, and resin materials as substitutes for shellac, and a third portrait in the series required a reproduction frame identical to the original frames.

2. MATERIALS AND METHODS

2.1 Criteria for selecting materials for experiments

There are stable synthetic resins commonly used as picture varnishes in conservation that possess relatively low molecular weights and high refractive indexes which give optical properties to the coating akin to natural resin varnishes [21] [22]. Such resins may be suitable to imitate shellac however the difficulty is in finding a combination of resin, solvent, and colourants that are compatible in a system more optimal for gilding. Systems of lower polarity are better suited for gilding preparations which can be sensitive to more polar solvents [23] [24] [25]. Such considerations are important not only for application but also for any possible future removal of these coatings. If using dyes in resin formulations, it is necessary to select a solvent of intermediate or higher polarity to form a stable emulsion with even colour dispersion as more polar solvents are required to satisfactorily wet pigments and dyes in solution. Orasol® dyes have applications in conservation treatments to imitate coloured lacquer [25] and depending on the colour, they have demonstrated results of very good or excellent lightfastness [26]. Their disadvantage is that they are soluble in lower alcohols, glycol ethers and ketones [27] which are more polar solvent systems. Some paints developed for conservation use such as Gamblin colours and Golden ® Mineral Spirit Acrylics (MSA) are soluble in low polar solvents and compatible with Liquitex Soluvar varnishes as they are based on similar poly (n-butyl methacrylate) polymers [28] so could be said to be preferable for gilded surfaces.

Materials were selected to test based on the following criteria:

- stable and reversible with no observable visual change to the gilding;
- lower polarity system preferable;
- colour match with the original surface;
- workable consistency of application: good levelling or brushing, colour dispersion, adhesion, saturation, and clarity;
- suitable for mirror (burnished) and satin (matte) finish;
- retain lustre of burnished gilding after applying coloured coating;
- appropriate finish in one level application or ability to layer to the correct finish;
- possibility for additional isolation layer over original gilding, before application of coloured varnish.

2.2 Preparation of traditional water gilded samples

Traditional water gilded samples were constructed from blocks of radiata pine sealed with 1-2 coats of rabbit skin glue: water size (1:6) followed by the application of between 10-15 coats of traditional gesso prepared with calcium carbonate with 8wt% - 5wt% (w/v) rabbit skin glue: water. The gesso was strained through cotton gauze before being brush applied to the sample, left to dry between each subsequent layer, water applied to reactivate gesso for wet sanding, left to dry and then further sanded until smooth. The final few coats of gesso, once brush applied, were smoothed with fingers to reduce air bubbles before final dry sanding. A size layer of gelatine: water (1:14) was applied to seal the surface followed by between 6-12 coats of black bole prepared with gelatine size between 1:14-1:20. The bole was also strained through cotton gauze to refine consistency, brush applied to the surface, left to dry between each layer then sanded to a polished finish with nylon scourger and wiped with microfibre cloth to remove residues. A 10% (v/v) ethanol: water solution was applied with a synthetic sable brush followed by application of loose metal leaf applied with gilders tip. For tests, several metal leaf types were experimented with for colour matching the frames including: 13ct white gold, 18ct gold**,** 16.7ct green gold**,** 20 ct citron gold**,** 23ct gold leaf. Samples of silver leaf gilding were also prepared for reference. The gilding was tampered with cotton wool and after touch dried some samples were burnished with agate while others were left matt.

2.3 Preparation of non-traditional gilded samples

A set of small metal tokens were gilded non-traditionally, coated with one layer of acrylic dispersion Plextol B500 (ethyl acrylate and methyl methacrylate co-polymers) diluted 2:1 with water: ethanol (4:1) that was brush applied, activated with exhalation, and gilded with aluminium leaf. To compare the appearance of traditional silver gilding with non-traditional aluminium gilding on the same traditional ground preparation the following sample was prepared: traditional sample water gilded with silver leaf and burnished on one half of the sample whilst the other half of the sample was non-traditionally gilded with aluminium leaf on dilute Plextol B500 (Figure 2A).

Table 1.1 – List of varnish materials tested in experiments on gilded samples

Material	Polymer classification	Preparation
Laropal ® A81 (BASF)	urea-aldehyde resin	20% (w/v) 1-methoxy-2-propanol or M-xylene
Paraloid B72 (Rohm and Haas)	copolymer of ethyl methacrylate (EMA) and methyl acrylate (MA)	20% (w/v) 1-methoxy-2-propanol or M-xylene
Liquitex Soluvar Gloss Varnish	n-butyl and isobutyl methacrylates-combination of Paraloid B-67 and F-10.	direct with paints
Liquitex Soluvar Matte Varnish	n-butyl and isobutyl methacrylates, fumed silica	direct with paints
Golden ® Polymer Gloss Varnish with UVLS	methyl methacrylate and n-butyl acrylate copolymer emulsion	direct with paint
Reglarez 1094	hydrogenated hydrocarbon resin	white spirits with 2% (v/v) HALS Tinuvin ® 292
Arkon P-90	hydrogenated hydrocarbon resin	20% (w/v) white spirits

2.4 Materials selected for experiments

The varnish materials selected for experiments are presented in table 1.1 and the paint and dye materials tested in the experiments are presented in table 1.2. For initial experiments paints were thinned with solvent, mixed with proprietary varnishes, and mixed with resin varnish solutions of Laropal ® A81 and Paraloid B72 prepared at 20% (w/v). Solutions of Regalrez 1094 and Arkon P-90 were also prepared with addition of 2% (w/v) hindered amine light stabiliser (HALS) Tinuvin ® 292. The elastomer Kraton™ G1650 was

Table 1.2 – List of paints, pigment and dyes tested in experiments on gilded samples

Material	Polymer/pigment classification	Colours
Golden ® Mineral Spirit Acrylics (MSA)	poly (n-butyl methacrylate)	Quinacridone Red Light (PR 207), Quinacridone Gold (PO48), Nickel Azo Yellow (PY150), Burnt Umber Light (PBr7), Carbon black (PBk7)
Gamblin colours	urea aldehyde paints	Transparent Earth Red (PR101), Transparent Earth Orange (PY42/ PR101), Transparent Earth Yellow (PY42), Indian yellow (PY83), Ivory black (PBk9)
Golden ® PVA colours	Vinavil ® Raviflex BL5S poly (vinyl acetate) polymer	Nickel Azo Yellow, Quinacridone Gold, Quinacridone Red, Quinacridone Nickel Azo gold
Golden ® High Flow Acrylic (HFA)	acrylic emulsion paint (polymer unspecified)	Quinacridone /Nickel azo gold
Ciba Geigy Orasol® dyes (BASF)	metal dye (1:2 chrome or cobalt complexes/metal free monoazo dye -Yellow 4GN)	Yellow 4GN (Yellow 146), Yellow 2GLN (Yellow 88), Yellow 2RLN (Yellow 89), Brown 2GL (Brown 42), Brown 6RL (Brown 44), Orange G (Orange 11)
Ciba Geigy Microlith ® dye	diarylide yellow with ethyl cellulose carrier resin	Yellow R-2A (Yellow 1550)
Dragon's Blood dry pigment		

omitted from the varnish used in experiments due to unavailability of the material during tests. As these varnish solutions are not compatible with any colourants they were tested as clear top coatings superimposed on other materials. Further experiments conducted after treatment of the frames explored applications of Orasol ® dye tinted resins. Each dye colour with the addition of dragon's blood dry pigment was mixed at 3wt% dye to 20% (w/v) resin varnish solutions. Dyes at 1% (w/v) and 0.5% (w/v) concentrations were also tested to compare for colour strength.

3. RESULTS AND DISCUSSION

3.1 Compensating gilded losses on original frames

Initial investigation into the frames revealed that the ground layers were able to be burnished through the shellac coating in adjacent areas of loss. Taking advantage of this, it was decided to fill the lacunae with gesso and bole in preparation for traditional water gilding. This method enabled a more seamless transition to the correct level of reintegration with the existing burnished leaf without any need to artificially recreate surface shine through non- traditional gilding methods. Although various metal leaf gilding was considered the aluminium leaf appeared dull when compared with burnished silver (Figure 2A). 20ct citron leaf whilst closer in hue to the golden varnish, was by itself not adequate to simulate the appearance of a golden varnish. When colour was then later tested on citron gilding it lacked the depth and clarity achievable on white metal. It was ultimately decided to in-gild the frames with the 13carat white gold leaf (figure 2B). This was a very close match for the frame slips where the coloured coating had presumably faded, and it was the closest substitute for silver leaf while being comparatively more stable.

3.2 Reproduction frame for the third Backler painting, Portrait of Elizabeth Collins (1861)

The reproduction frame for the third painting, Portrait of Elizabeth Collins (1861) was constructed by AGNSW Reproduction Frame maker to the same design as the original frames and water gilded with the same white gold leaf used to in-gild the sister frames. In keeping with traditional period frame making practices, the golden varnish was formulated from shellac coloured with spirit-based dyes (figure 3). White lac was used to ensure better clarity based on experiments carried out on gilded samples with shellac reference materials, this was the best likeness for the original shellac and provided an additional reference for colour matching a coloured coating system for the two original frames.

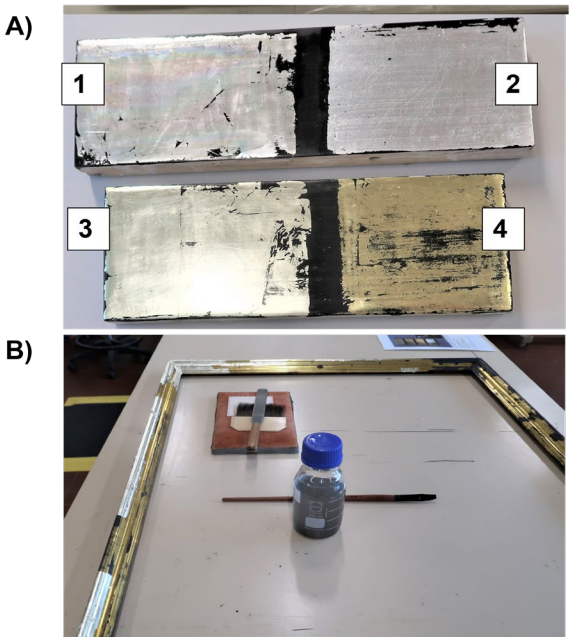

Figure 2 – A) Samples of various metal leaf tested in experiments. (1) burnished silver leaf, (2) aluminium leaf, (3) burnished 13ct white gold, (4) burnished 20ct citron gold. B) in-gilded frames with burnished 13ct white gold leaf

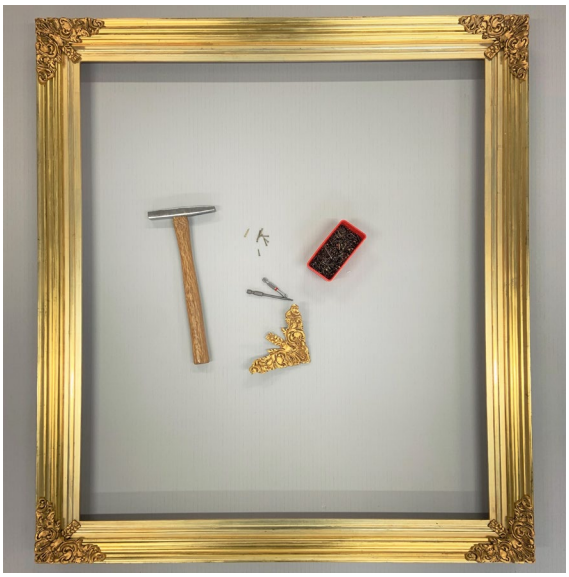

Figure 3 – Reproduction frame for the third Backler painting, Portrait of Elizabeth Collins (1861)

3.3 Results of tests into coloured coatings and varnishes

The results of gold-coloured varnish systems tested in experiments are presented in table 2. Most paint systems performed to a certain degree for golden colour depending on the desired hue but generally have a more limited colour selection and performed less well for saturation and clarity when compared with dye tinted resins. The application of a clear top coat of Regalrez 1094 or Arkon P-90 varnish whilst introducing gloss did little to improve clarity, and over top of Soluvar Gloss varnish , A81 and B72 did not have a demonstrable change to gloss levels.

3.3.1 matte gilding

The Golden ® PVA and MSA paints performed the best for a matte finish. The PVA paints were weakly saturated, had fewer colours for accurate colour matching in addition to requiring polar solvent. A top layer of Regalrez 1094 and Arkon P-90 over the PVA paints increased gloss and marginally improved saturation but did not achieve the right level of depth and clarity. MSA paints thinned with mineral spirits or Shellsol D40 produced sheer light golden washes. MSA paints with Soluvar matte varnish produced similar results. Both were appropriate to apply to matte gilding although when used without varnish brush marks were visible. In the case of the Backler frame slips this was an advantage as the original coating also had brush marks.

Table 2 – Results of experiments evaluating the appearance of gold-coloured coatings on gilded samples

Sample[1]	**Material**[2]	**Results**[3]				
		colour	***saturation***	***layering***	***sheen***	***clarity***
		Reference samples				
TS/b/silver leaf TS/b/13ct TS/m/13ct Token	Orange shellac	GY	S/V	N	G G M G	CD* CD* CD CD*
TS/b/silver leaf TS/b/13ct Token	Coloured lac	E	S/V	N	G	C
		Initial experiments				
TS/b/13ct TS/m/13ct Token	MSA	GD	W	N	M	CD
TS/m/13ct Token	MSA/SM	GD	W/V	Y	M	CD
Token TS/b/13ct TS/b/20ct TS/b/23ct	MSA/SG	GD	W/V	Y	G	SC
TS/b/13ct	MSA/SG +	GD	W/V	Y	G	SC
Token	MSA/SG/ Regalrez	GD	W/V	Y	G	SC
TS/b/13ct Token	Gamblins/SG	L	M/V	Y	G	SC/CD
TS/b/13ct	Gamblins/A81	L	M/V	N	G	SC/CD
TS/b/13ct	Gamblins/B72	L	M/V	N	G	SC/CD
Token	PVA	L	W	N	M	CD
Token	PVA-A81	L	W	N	SG	CD
Token	PVA-B72	L	W	N	SG	CD
Token	PVA/Regalrez	L	W	N	G	CD
Token	PVA/Arkon P90	L	W	N	G	CD
	PVA-B72/Regalrez	GD	W	N	G	CD
Token	HFA	GY	M/V	Y	G	C
Token	HFA-B72	GY	M/V	Y	G	C
Token	HFA-PGUVLS	GY	M/V	Y	G	C
TS/b/13ct	MSA/SG, HFA	GD	M/V	Y	G	C
Token	dyes/pigment-A81	E	W	N	G	C
Token TS/b/13ct	MSA/SG, dyes/pigment/A81	E	GD	Y	G	SC/C
		Further experiments				
TS/b/silver leaf TS/b/13ct Token	dyes-A81 dyes-B72	E	S/V	N	G	C
TS/m/13ct		E	S/V	N	M	CD
TS/b/16.7ct		E	S/V	N	G	C
TS/b/18ct		GD	S/V	N	G	C
TS/b/20ct		TY	S/V	N	G	SC
TS/b/23ct		TRO	S/V	N	G	SC
TS/b/13ct	Iso MSA/dyes-A81	E	E	GD	G	C
	Iso B72/dyes-A81	E	E	GD	G	C

1. TS (traditional water gilded sample), b/ (burnished gilding), m/ (matte gilding) 13, 16.7, 18, 20, 23, (ct gold leaf), Token (non-traditional sample gilded with aluminium leaf on dilute Plextol B500 2:1 water ethanol (4:1).

2. MSA (Mineral Spirit Acrylic), MSA/SG (MSA with Soluvar Gloss varnish), MSA/SG+ (repeated layers), PVA (Golden ® PVA colours), HFA (Golden ® High Flow Acrylic), PGUVLS (Golden ® Polymer Gloss Varnish with Ultraviolet Light Stabilisers, dyes (Orasol ® and Microlith ® dye complexes), 'coloured shellac' (white lac with spirit-based dyes), IsoB72 (Isolation coating of Paraloid B72, Iso SG (Isolation coating of Soluvar Gloss varnish) IsoSM (Isolation coating of Soluvar Matte varnish.

3. L (limited colour selection available to colour match accurately), GY (good colour but can be very yellow), TY (not suitable colour match-too yellow), TRO (not suitable colour match- too red/orange), GD (good selection for colour matching), E (excellent selection for colour matching), N (not able to be layered without resolubilisation), Y (yes can layer the same material), S (strong), S/V (strong/variable), W (weak), W/V (weak/variable), M (moderate), M/V (moderate/variable), G (glossy), SG (semi-glossy), M (matte), C (clear), SC (semi-clear), SC/C (semi-clear/cloudy), CD (cloudy), CD* (can be cloudy unless dry heat applied).

3.3.2 burnished gilding

The MSA paints were difficult to work with when compared to other paint systems, they were very viscous, sticky, and greasy, and problematic to evenly dissolve in varnish even when firmly ground and mixed. It was found that soaking the paint in the varnish over a period of a few days noticeably improved the colour dispersion and ability to brush out. The paints were weakly saturated but had the potential for producing good colour mixes and saturation could be improved when mixed with Soluvar Gloss varnish allowing for subsequent layer applications (waiting minimum 2-3 days in between coats). It was however difficult to retain clarity of the underlining gilding past three applications, and after this the finish was still not complete to fully reintegrate with the original shellac coating.

Gamblin colours mixed with Soluvar Gloss varnish were comparable with MSA paints and Soluvar and presented similar gloss levels. The yellow colours selected in the Gamblin range however produced matt finishes when applied to burnished gilding and without a yellow the resultant colour mixture was too orange to be appropriate for accurate colour matching. It was also not possible to superimpose dye tinted resins over Gamblins as they have the same solubility.

Experiments showed that Golden ® HFA paint tended towards an inherently yellow golden colour that may be too yellow depending on the area to colour match. The paint performed very well for clarity and had good colour saturation and gloss. Its low viscosity was ideal for glazing, it dried fast, and could be layered to deepen the hue. For concerns of its use directly on gilding it could be mixed with B72 varnish or layered successfully over a protective coat of B72 or Soluvar varnish. It also performed very well mixed with Golden ® Polymer varnish with UVLS.

3.4 Results of removability tests after 4-6 weeks

Removability tests were conducted on gilded samples with solvent dampend cotton swabs 4-6 weeks after application of coloured coating. All materials used in tests were removable including the shellac reference samples as these were un-aged. The average removal time was 2-3 rolled passes with swab with little observable change to gilding. The exception was removing shellac on non-traditional aluminium samples, where the methylated spirit swelled the surface and disrupted the gilding in the process of removal. The PVA paints with B72 varnish were found to require more passes as the coating was more stubborn and uneven to remove in the first attempt. It is expected that over a greater period of time these materials would require more passes with solvent swabs or other solvent cleaning systems to remove.

3.5 Compensating losses to golden varnish on Backler frames

3.5.1 retouching matte gilded slips

Based on successful experiments with paints for matte gilding it was decided to use MSA paints thinned with shellsol D40 to colour the in-gilded passages on both slips (figure 4 B). The most successful colour match was achievable with a 2:1 mix of Burnt Umber Light and Nickel Azo yellow.

3.5.2 Combined approach to retouching burnished gilding

The HFA paint was promising for colour, saturation, gloss and ability to layer however considering the extent of retouching required on the frames it was decided to explore potential for dye tinted conservation resins. At the time of treatment the dyes available were

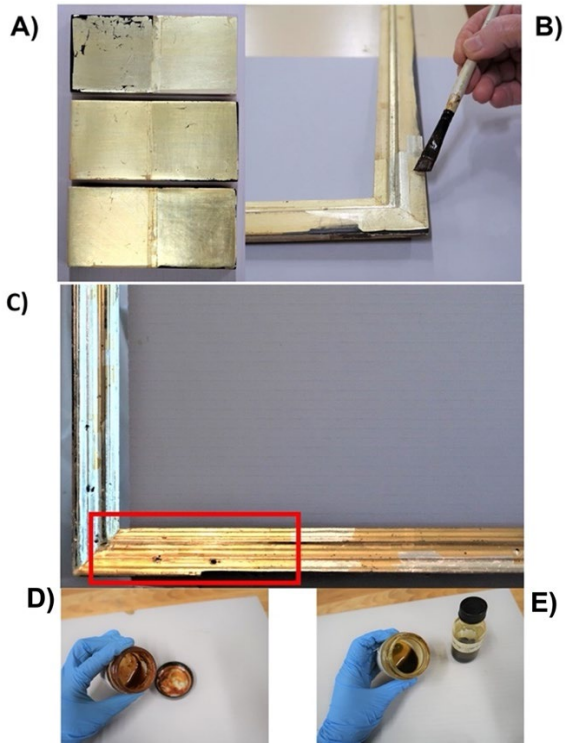

Figure 4 – A) Samples of traditional matte and burnished 13ct gold leaf testing MSA paints. B) Retouching the matte gilded slips with MSA paints. C) Combined approach to retouch burnished passages using MSA with Soluvar Gloss varnish (D) followed by dye/pigment tinted A81 resin glaze (E)

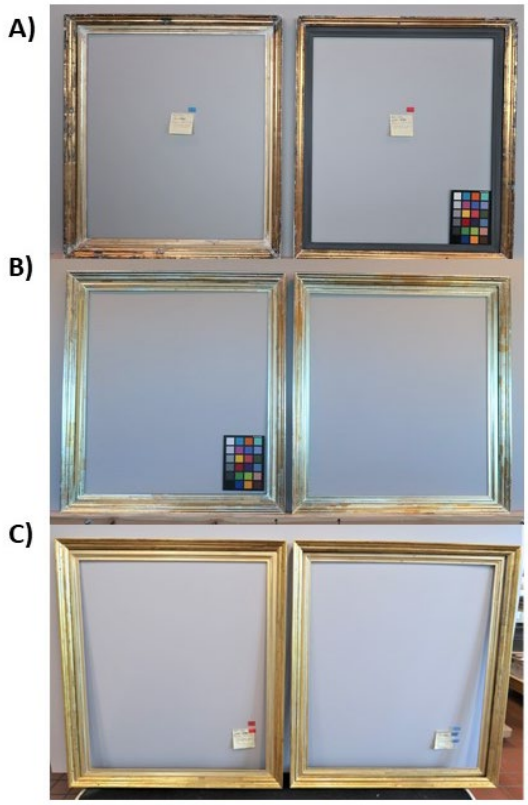

Figure 5 – A) During the treatment to infill and prepare a new slip, B) in-gilding and burnishing and C) after applying golden colour treatment to in-gilded passages.

Orasol ® Brown 2GL and Microlith ® Yellow 2-RA. In the absence of a red dye the dry pigment dragon's blood was added with these in A81 solution to produce a more accurate colour match. The tinted resin had good colour accuracy, gloss, and clarity but when applied on its own was too transparent and did not have adequate coverage to convincingly replicate missing areas of shellac on the frames. It was not possible to layer dye tinted varnishes without risk of resolubilising the previous layer. Tests exploring applying a tinted resin superimposed on top of a previous alcohol insoluble MSA/Soluvar varnish application resulted in improved coverage a good colour match with appropriate clarity. It was therefore decided to use a combination of paint and dye tinted colouring systems to achieve the right level of finish on the frames.

MSA paints mixed with Soluvar Gloss varnish were applied to burnished areas in two thin successive applications (waiting 2-3 days in between) and later followed by a thin application of an Orasol ® and dry pigment tinted Laropal ® A81 resin glaze (figure 4C). It was not possible to completely disguise the appearance of lay lines from gilding or disruptions from tarnishing, however, an application technique consisting of applying colour to the middle of the in-gilded passage and brushing outwards on both sides helped to mitigate this issue, producing a softer transition. This was particularly important for the dye tinted glaze which has less working time and requires rapid and decisive application. The result was less colour convergence with original shellac finish and a more harmonised general presentation (figure 5).

3.6 Further experiments with Orasol ® dye tinted resins

As the dyes demonstrated superior performace for colour saturation and clarity, a number of further experiments were undertaken after treatment of the frames to explore the potential for several of these

dyes for use in future treatments (Figure 6). Both A81 and B72 resins with dyes were comparable, although it was observed that B72 had shorter working time when compared to A81. The consequence is that they could cause visible brush marks an uneven colour dispersion if not applied quickly and evenly. The dyes have a diverse colour palette and were highly saturated requiring very little dye to varnish. The 3wt% dyes were too strongly concentrated and solutions of 1wt% and 0.5wt% dye to resin still retain impressively strong chromaticity. Any one of the dye mixes tested produced a suitable golden varnish although, based on tests, colour mixes of 1:1 Yellow 2GLN (mid shade) and Yellow 2RLN (reddish yellow) had the most promising balance of yellow to orange/red for most accurate mid-shade gold imitation. The addition of dyes such as Brown 2GL (yellow brown) or Brown 6RL (dark red-brown) can modulate the shade to match various colour temperatures of metal leaf, patinated, or aged gilding.

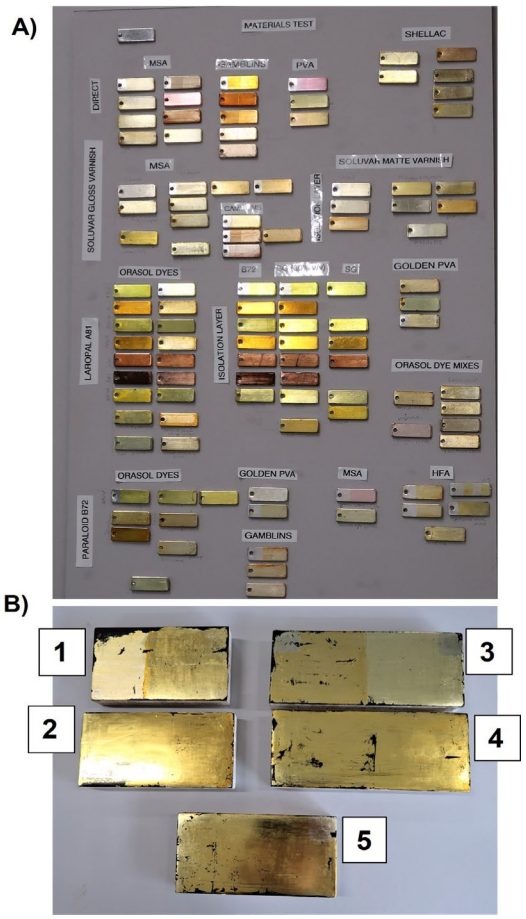

Figure 6 – A) Sample metal tokens gilded non-traditionally with aluminium leaf on Plextol B500, swatch testing each paint and dye colours (in varying concentrations), and colour combinations. B) Traditional water gilded samples prepared with gesso and bole gilded with 13ct white gold leaf and burnished. Comparing coloured coatings of (1) orange shellac (reference sample), (2) coloured white lac (reference sample), (3) combined system of MSA: Soluvar Gloss varnish followed by dye tinted Laropal ® A81 varnish, (4) MSA: Soluvar Gloss varnish (x 3 layers), (5) dye tinted Laropal A81 resin

3.7 Experiment with isolation layers with golden varnish

A traditional 13ct gilded and burnished sample was coated on one side with 30% (w/v) Soluvar Gloss varnish: white spirits and the other side coated with 20 % (w/v) B72: M-xylene. After drying a golden varnish of Orasol ® dyes in Laropal ® A81 was then applied over the top and the results of each side of the sample compared (figure 7). The results show little discernible difference to the quality of the gilding between each side however in the case of the Soluvar Gloss varnish, due to the differing polarities of the varnish and dye resin solution, a slight hydrophobicity of the glaze was observed to occur on the surface. This irregularity is so small and depending on the condition of the gilded surface it may not be noticed. If this is a concern however a very small percentage of wetting agent can be added to the varnish to lower the surface tension of the coloured varnish for better wettability and adhesion. It was observed that the application of an isolating layer improved brushability and adhesion of dye/resin solutions, in addition to protecting the gilding.

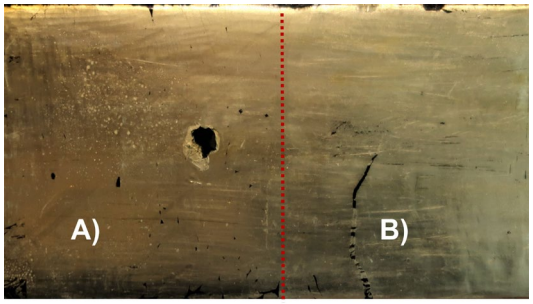

Figure 7 – Isolation layer tests on gilded burnished sample with A) Soluvar Gloss varnish and B) Paraloid B72 after application of A81 dye tinted golden varnish.

4. CONCLUSIONS

The chromatic reintegration of golden varnishes on white metal gilding are technically challenging to treat. As demonstrated through experiments, the qualities of a coloured varnish system applied to gilding, relies on both the underlining gilding preparation as well as the physical and chemical characteristics of the varnish or coating materials and the technique in which it is applied. It is challenging to find varnishes and colourants that are compatible in a system that is optimal for gilding and that satisfies criteria for retouching such a demanding surface finish. With a combined approach however, it is possible to find solutions that may be adapted to suit the treatment context and object requirements.

The result of experiments demonstrates that with the right application, Liquitex Soluvar Gloss Varnish, Laropal ® A81 and Paraloid B72 present gloss levels and visual film forming properties comparable to shellac coatings when applied to burnished gilding. It was difficult to achieve the right colour, gloss, and coverage, while still retaining translucency and clarity with paints and varnishes alone. Most paints tested were found to be weakly saturated when mixed into varnish systems and caused some matting to the surface even if gloss and colour criteria could be satisfied. The exception to this were Golden ® HFA paint which were comparable to dyes for colour saturation and clarity but are an artist acrylic emulsion paint not specifically designed for use in conservation. Golden ® MSA paints were successfully used to retouch the matte gilded slips whilst a combined paints, varnishes and dyes approach was required to unify losses in the original shellac varnish on both frames.

Experiments show that dye tinted resins outperform all materials for colour selection, saturation levels, and clarity but tend to be transparent when used in isolation which can be problematic to achieve correct level of finish. Additional tests with various dye colours illustrate that Orasol ® dye mixtures in colours Yellow 2GLN, Yellow 2RLN and Brown 2GL are reliable colour imitations for traditional gold-coloured varnishes. These qualities were a faithful imitation for the shellac reference samples and reproduction frame.

The results of this research have informed the conservation treatment of the Backler frames while further experiments have identified materials that are applicable for restoring lost golden finishes on both matte and burnished gilding. These dye colours have been recently successfully used in frame treatments in the Art Gallery of new South Wales International collection. Although this research is preliminary, it is hoped that is may inform the selection and application of appropriate retouching materials for compensating losses to burnished silver leaf and golden varnishes in gilding conservation.

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