

The Conservation of a Mummified Child from the Australian Institute of Archaeology

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Abstract: The paper discusses a child mummy's past restoration, pre-treatment condition, and the minimally invasive conservation interventions undertaken. The mummy was purchased in 1965 by the Australian Institute of Archaeology and has been displayed and stored since that time. Conservation was made possible by a grant. Images taken soon after the mummy arrived in Australia guided some conservation decisions. Analytical methods used to identify materials associated with previous restorations and the mummy's deteriorating condition included Fourier transform infrared spectroscopy, Energy-dispersive X-ray spectroscopy fluorescence and Reflectance Transformation Imaging.

Keywords: Mummy; mummification; conservation; cartonnage

Introduction

The conservation of the mummified child from the Australian Institute of Archaeology (AIA) was an important milestone in the life and research history of this ancient Egyptian mummy. The AIA acquired the mummy at Sotheby's auction house in London on the 26 April 1965 (AIA Doc 255; Sotheby & Co. 1965: 26). The Sotheby catalogue had no provenance information but described the mummy as that of a child from the Ptolemaic Period. However, a Graeco-Roman date has been suggested to be more probable because of the style of decoration (Crocker 1990: 70; Davey et al. 2003; Mann 2006).

The mummy was brought to Australia to contribute to the AIA's school education program based at Ancient Times House in Little Bourke Street, Melbourne. The mummy was displayed with temperature control but limited humidity and light regulation. Since the closure of Ancient Times House in 1999, the mummy had been displayed occasionally and was otherwise stored in a dark insulated location. The mummy's condition was very poor, and remedial conservation was required to prevent loss and to restore aesthetic integrity.

In 2016 the AIA was awarded a grant by the Copland Foundation to conserve the cartonnage and wrappings of the mummy. Grimwade Conservation Services, The University of Melbourne, undertook the work between February 2017 and April 2019. The final stage of the conservation was completed in conjunction with Pod Museum and Art Services, Melbourne, which constructed a custom support acrylic cradle, and display and storage cases. As the mummy contains the remains of a once-living person, assessments and interventions were done respectfully, and ethical guidelines were followed¹.

Visual inspection, ultraviolet (UV) light examinations, scientific testing and our literature review indicated that the cartonnage and wrappings had undergone previous interventive restoration. The motive for the earlier work was revealed by photographic images of the mummy (AIA 1971) showing the mask's nose and a portion of the cheek on the proper left side missing (Figure 1).

Four elements of the mummy were the focus of the conservation: the linen wrapping and three separate cartonnage plates on the face and neck, chest, and legs. Cartonnage is made from textile and gesso moulded to the form of the mummy and painted with decoration. Each cartonnage plate had been painted by a different hand, and there was no stylistic continuity, raising the possibility that not all of them date from the time of mummification.

The attribution of the mummified child to the Graeco-Roman period is based on the assessment of the three cartonnage plates. The practice of mummification ceased during this period which began when Alexander the Great invaded Egypt (323 BC) and ended in the early Christian era (3rd – 7th century AD) (Bard 2008; Abdel-Maksoud and El-Amin 2011). Egyptian mummification practices commenced in the third millennium BC, during the Old Kingdom, and peaked in the New Kingdom (16th – 11th Century BC) (Bard 2008; Abdel-Maksoud and El-Amin

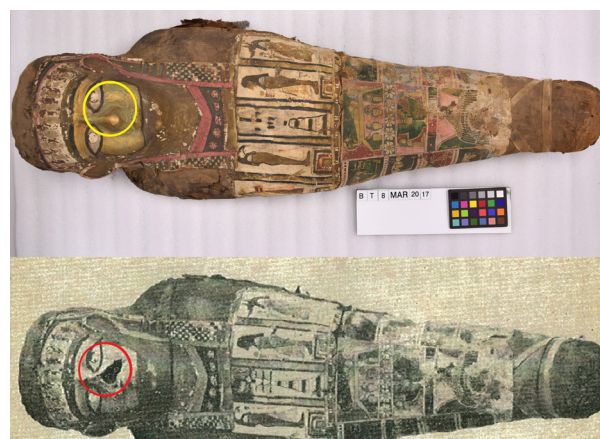


Figure 1: Images illustrating the previous restoration work. Top image: March 2017, the nose and proper left side of the cheek, circled in yellow, have been restored. Bottom image: 1960s, shows a cavity where the nose and proper left side of the cheek should be, circled in red. Top image: Grimwade Conservation Services, 2017, Bottom image: from AIA (1971).

2011: 129–130). An AIA publication (1971:2) suggests that the painted row of rosettes, together with the design of dots down the sides of the leg cartonnage, were first used together in the Graeco-Roman period. However, this argument alone is not enough to date the mummified child because of the stylistic differences between the three cartonnage plates.

Condition of the linen wrappings

The textile wrappings were in very poor condition. They were discoloured, friable and structurally fragile. Losses and lifting sections of wrapping were present on the top of the head, on the sides of the chest, on the proper right shoulder, the lower torso, and across the back. The wrappings in these specific locations readily shed fibres and other material, including frass (insect faeces), human bone and insect casings. Human bone was visible through a tear extending from the front surface across the entire width of the back profile. This area of damage was the most critical point of structural weakness.

Surface debris, accretions and extraneous materials were also present in localised areas on the textile wrappings, including synthetic fibres near the feet. These materials were examined under induced UV light, using bright blue fluorescence, to assist with the identification of materials, detecting insect damage or surface coatings, and detecting previous restoration or repair areas. When certain materials absorb UV light, it is reflected towards the eye as a longer wavelength of visible light. This is known as UV-induced visible fluorescence (AICCM 2017).

Handling the mummified child, particularly on the proper left shoulder region, the top of the head, and along the mid-section where extensive tearing and losses were present, resulted in further shedding and loss of textile fibres (Figure 2). A large area of loss and extensive tears was present on the upper leg region. The textile wrappings in this area were heavily degraded and damaged with tears and evidence of past insect activity. Unsupported sections of textile wrappings were visible inside the exposed interior cavity. Evidence of previous insect damage,

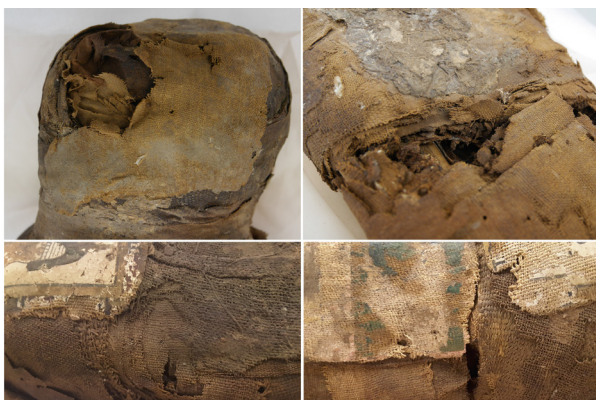


Figure 2: Areas of loss and lifting wrappings on mummified child. Images: Grimwade Conservation Services, 2017.



Figure 3: A large patch on the top of the Child Mummy's head. Left: Front view, and Right: Rear view. The patch represents past restoration work. Image: Grimwade Conservation Services, 2017.

frass and insect casings, was present inside the exposed interior cavity and in areas where the textile wrappings were lifting from the surface.

Examination of the top of the mummified child's head using visible light and UV-induced visible fluorescence identified a large fabric patch measuring 130 mm wide and 190 mm long (diagonally) extending from the 'hairline' region of the forehead to the back of the head. The large square patch was lighter in colour than the linen wrapping and was inconsistent with other textile strips wrapping the mummified child (Figure 3). The patch was disguised by what appeared to be a 'slurry' made from sediment containing plant fibre. The slurry extended beyond the borders of the patch and appeared to have been intentionally applied to blend the patch with the surrounding areas of the ancient wrapping. It can be speculated that the patch and slurry were either an attempt to cover and contain the exposed human skeletal remains or were undertaken to make the mummified child appear more complete, thereby increasing its monetary value. Several tears in the patch were probably caused by the movement of protruding disarticulated bones.

Condition of the cartonnage mask

A painted mask with the visage of a human face and head adornments is positioned over the mummified child's head (Figure 4). The mask was in fair-to-poor condition with losses, cracks and surface abrasions present on the

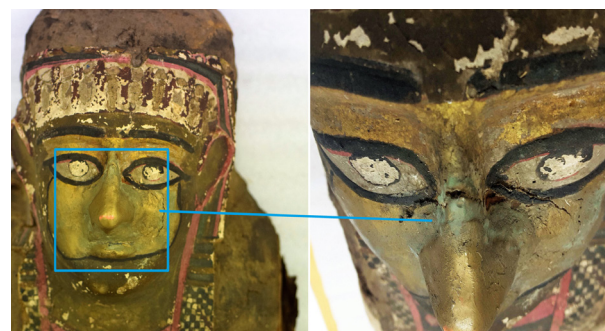


Figure 4: Presence of overpainting showing Schlag on the nose and surrounding facial features. Images: Grimwade Conservation Services, 2017



Figure 5: The presence of large cracks and losses on the proper right side of the mask. Image: Grimwade Conservation Services, 2017.

front and sides. The surface of the mask was friable, and the pigments were prone to flaking when light pressure was applied to the surface. There were large cracks on the proper right side of the mask extending from the forehead to the décolletage of the mask. Cracks were also on the front and the proper left side. The ear on the proper right side was lifting from the gesso ground of the cartonnage, suggesting that the mask may have been originally designed for a deceased person with a broader face. Numerous losses were across the surface of the mask ranging in size from less than 10 mm to 30 mm. Loss of pigment was evident on the forehead, chin, eyes, ears, neck, and the décolletage regions of the mask. Pigment fading and loss were also apparent along the borders of the mask. In these areas, the underlying gesso ground was exposed. In localised areas, including the ear on the proper right side, the losses extended past the gesso ground exposing the underlying textile backing (Figure 5).

The previous restoration of the mask distracted from the overall aesthetics (Figures 1 & 6, Image B). The restoration was undertaken by unidentified people before 1969 according to the curator of the AIA collection 1969–1982 (C.J. Davey pers. comm.). The large, restored nose covered the upper lip and did not complement the comparatively small facial features. Numerous cracks were around the restored nose indicating that



Figure 6: The centre images show the changes made to the djed pillar panel on the chest cartonnage. Images: Grimwade Conservation Services (A) and AIA (B).

the restoration materials were incompatible with the cartonnage. Excessive amounts of adhesive had been used. The restoration and surrounding area was overpainted to cover up the repair. The restored area and the area around the nose on the proper left side were finished with a metallic leaf, which had green-blue discolouring, indicating copper corrosion (Figure 4). The area surrounding the restoration was not discoloured.

Kyi and Kowalski (2017) undertook Energy-dispersive X-ray spectroscopy fluorescence (EDS-XRF) analysis of the mummified child cartonnage identifying the pigments present on the three sections of cartonnage, which included red ochre and malachite (Appendix 1). They also identified copper in the metallic leaf on the restored nose. The coating was probably an alloy of copper and zinc called Schlag, also known as Dutch metal. Schlag was probably used as an inexpensive alternative to gold leaf (Rivers and Umney 2003: 646), and may tarnish if left uncoated (Figure 4).

Condition of the chest cartonnage plate

The chest cartonnage plate was in fair-to-poor condition. The pigment had faded, and there were losses on the lower proper left side and upper, lower, and proper left borders. The most significant losses were near the lower corners. A sizable crack was directly on the painted figure of *Imsety* immediately to the left of the central figure. The surface of the cartonnage in this area was pushed inwards and portions of the cartonnage were missing. All areas of damage had associated pigment and gesso loss. Moderate pigment fading was noted on the four central figures, representing the sons of *Horus*.

One register of the chest cartonnage plate differed from the image taken soon after 1965 (Figure 6). The central *djed* symbol was altered prior to 1969 (C.J. Davey pers. comm.). The traditional four horizontal lines were replaced by vertical lines. Although the *djed* symbol is no longer accurately represented, it provides evidence of past restorations contributing to our knowledge of the early materials and techniques used by restorers and what was considered acceptable; it is part of the mummy's story.

Condition of the leg cartonnage plate

The upper proper right corner of the leg cartonnage plate was covered in sediment, dust, and debris. The pigments on the leg cartonnage appeared to be muted. Portions of the painted surface were faded or missing, particularly on the upper centrally positioned pictorial scene, the proper right side of the cartonnage, the proper left side of the cartonnage, and along the border where the chest and leg cartonnage align. The most extensive loss was approximately 50 × 10 mm in size. Large tears were present between the chest and leg cartonnage. One tear extended from the proper right side across the back surface to the proper left side of the body. The surface of the leg cartonnage, like the chest cartonnage, was not uniform. Using specular enhanced images captured using



Figure 7: Detail of the surface of the chest cartonnage. Left, a visible light photograph, and Right, a specular enhanced image captured using Reflectance Transformation Imaging showing surface undulations. Image: Grimwade Conservation Services, 2017.

Reflectance Transformation Imaging (Cultural Heritage Imaging 2013), it was apparent that the surface of the leg cartonnage undulated, particularly along the front and proper left sides of the cartonnage (Figure 7).

Most surface damage, including losses, cracks, scratches, and abrasions, was present along the top border and lower proper left side. Evidence of insect activity, including the presence of frass, was also evident. Small circular holes deemed to be insect exit holes were present on the proper left side and along the upper border of the cartonnage (Figure 8). The holes varied in size between 1 to 4 mm. Alternatively, these holes may have been deliberately formed for tying cartonnage to the mummy.

Documentation

The condition of the mummy was recorded in a Condition and Treatment Report. The Report also documents the



Figure 8: The circular holes present on the side registers of the leg cartonnage suggestive of tie points used to secure the cartonnage. Image: Grimwade Conservation Services, 2017

processes undertaken during and after the conservation treatment. It is a professional requirement of the conservation discipline (see footnote 1) and contains: the conservator's record of all condition observations, analyses, treatment processes and materials, and the rationale for treatment decisions as agreed with stakeholders. Drawings, photographs, and analytical graphs are included. Future conservators and researchers can use the Report to ascertain the mummy's condition and conservation treatments. The Report is permanent record and part of the mummy's biography.

Conservation Treatment

It is intended that the mummified child will be displayed in a museum setting as a basis for inquiry by school students, amongst others. Until that time the mummy is to be kept in an environmentally stable and dark location. One exception will be a planned imaging at the Australian Synchrotron. The conservation therefore aimed to make the cartonnage and mask clear for study and, with the aid of suitable display and storage cases, to stabilise the mummy adequately for handling and travel.

Working with mummified human remains was a privilege and comes with the understanding that we were not caring for an inanimate object. We were conserving the remains of a person who had a family and a life before our own (see Cassman & Odegaard 2004; Fletcher et al. 2014). Signage was used to identify that sensitive material was being conserved within the laboratory, and access was restricted to personnel connected with the conservation intervention (Figure 9).

Ethical guidelines for conservation of ancient things, especially human remains, prescribe 'minimal intervention' with appropriate conservation materials that are identifiable and have good ageing properties, and methods that enable re-treatment that will reduce possible future treatment problems². Past restoration practices, fashions and display standards resulted in things being heavily modified and devalued (Keene 1994: 19). Today, the physical, aesthetic, and historical integrity of the thing being conserved is deemed to be vital in conservation, which aims to retain or reinstate its significance (France-Lanord 1996: 241). Conservation treatment changes can never be fully reversed. The ethical guideline of 'minimal intervention' acknowledges that past conservation treatments have often failed or been too interventive.

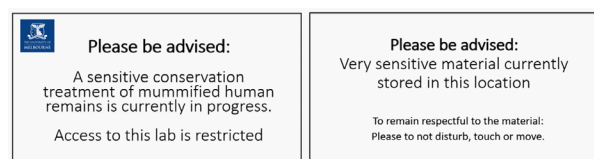


Figure 9: Custom signage used during the conservation treatment of the Child Mummy. Image: Grimwade Conservation Services, 2017.



Figure 10: Example of the process of repairing failing or detached sections of linen wrapping using Japanese Kozo tissue paper and wheat starch paste. Image: Grimwade Conservation Services, 2017.

Before commencing conservation, the environment where the mummified child was housed was examined to determine appropriate treatment materials. A literature survey identified the most recent techniques used to conserve mummies (Bartindale 2021; Cassman and Odegaard 2004; Gänsicke et al. 2003; Quinton 1995; Rozeik 2011; Singer 1995; Thompson and Kataoka 2011; Watkins and Brown 1988). The first conservation intervention required was securing failing linen wrappings. As the mummy was expected to experience variations of temperature and humidity in the near term, robust materials were selected. Japanese Kozo paper (hereafter, called Japanese paper), made from the bark of the mulberry tree, and wheat starch paste were selected in preference to other adhesives often used on mummy wrappings, such as Methylcellulose paste or BEVA films (Cruckshank and Tinker 1995; Gänsicke et al. 2003; Thompson and Kataoka 2011).

The process began by repairing the wrappings on the back of the mummified child. Sieved wheat starch paste was diluted with deionised water to achieve the appropriate consistency. Strips of untuned and toned Japanese paper were then carefully applied using bullnose tweezers and micro spatulas (Figure 10) (Cruckshank & Tinker 1995; Gänsicke et al. 2003; Thompson & Kataoka 2011). The paper was toned with Golden® Artist acrylic paints. The repairs were gently weighted to ensure good adhesion.

Before re-attaching each layer of wrapping, the surface was gently dry cleaned using a soft art brush and a variable suction Hepa filter vacuum cleaner. The vacuum cleaner nozzle was covered with tuille to prevent unintentional damage to the bandaging, and the vacuum suction



Figure 11: The process of dry brush vacuuming the mummified child. Image: Grimwade Conservation Services, 2017.

was adjusted to 'Low' (Figure 11). Removed material, frass, linen fibres, sawdust-like material, and tiny bone fragments were collected and placed in labelled sample vials. This process was completed for each failing or detached linen wrapping section on the front and back profiles. These sections varied in size from small single layers of wrapping measuring 10 mm to multi-layer areas measuring 200 mm in length.

The distorted wrapping was gently humidified using dampened blotter paper, Reemay®, a vapour-permeable barrier and weights (Bartindale 2021: 221; Singer and Wylie 1995). The Reemay® acted as a barrier through which the linen wrappings were moistened. The blotter paper was dampened using a pressurised Dahlia® sprayer which controlled the quantity of moisture, droplet size and uniformity. After five hours, the distorted sections of linen relaxed sufficiently to facilitate repair.

The insect exit holes/tunnels on the mummified child front and back textile wrappings were plugged to prevent future insect attacks. A small number of the insect exit holes had only penetrated through surface layers of the mummified



Figure 12: Use of Japanese tissue paper 'ropes' to support/prop fragile sections of the cartonnage mask on the proper right side and prevent further loss of original material – fragments of textile wrapping. Image: Grimwade Conservation Services, 2017.

child and did not require backfilling. Approximately ten insect holes penetrated to the interior cavity containing the human remains. All holes were filled using Japanese paper 'ropes' made by twisting 50 mm lengths of Japanese paper. The 'ropes' were eased into the holes with a pair of needle-nosed tweezers (Figure 12). The final 'rope' used to plug each hole was toned to complement the colour of the linen wrapping. The process was straightforward, minimally invasive and intended to reduce the risk of future insect attack by blocking these access points.

The largest area of loss of the linen wrappings was present on the mid-section of the back profile. The damage extended from the top proper left corner of the leg cartonnage to the edge of the proper right register of the leg cartonnage (Figure 13). In this area, linen wrappings were failing or missing altogether, human skeletal remains were visible, and material readily fell from the



Figure 13: The most significant area of loss and damage to the linen wrappings, verso profile. Image: Grimwade Conservation Services, 2017.

cavity resulting in the loss of ancient material, including friable human skeletal remains. The large loss area on the back profile was first bridged with Japanese paper strips measuring approximately 15 mm in width. The strips acted as a ‘web’ or support layer on which the ‘patch’ of Japanese paper was placed to close the large loss. Three strips of toned Japanese paper running vertically were anchored, followed by three strips placed running horizontally. The strips were held in place with viscous wheat starch paste. The process required the adhesion and curing of one side of each strip to ensure that it was anchored before being secured to the other end. Once the ‘web’ of Japanese paper strips was cured, two patches of toned Japanese paper were placed approximately 4 mm over the edges of the loss and under areas where linen wrappings were present. The patches were secured with



Figure 14: Gentle weighting using thin metal clips, small weights and balsam wood support blocks were selected during the humidification process. Image: Grimwade Conservation Services, 2018.

viscous wheat starch paste applied with custom-shaped Mylar spatulas, metal spatulas, tweezers, and brushes.

The final stage of stabilising the fragile and lifting areas was carried out on and around the restored patch on the mummified child’s head. Before repairing the area of loss, distorted and misaligned wrapping layers surrounding the loss were gently humidified for 24 hours. The humidified sections were then weighted and held in place with metal clips, weights and balsa wood support blocks, using a Reemay® barrier (Figure 14). A patch composed of toned Japanese paper was applied approximately 4 mm over the edges of the loss using viscous wheat starch paste. After treatment, the skeletal remains were no longer visible, and the wrappings were stable and correctly aligned.

The cartonnage mask had textile fibre loss and required stabilisation to prevent further loss. A void of about 40 mm was present between the mask and the mummified child allowing textiles fragments to fall from the cavity on the proper right side of the mask. To prevent further loss, Japanese paper ropes were inserted into the cavity (Rozeik 2011). To achieve aesthetic unity, the final ropes were toned to the colour of the wrappings. The process was repeated on the proper right side, below the right ear on the cartonnage mask where structural cracks were mobile and prone to detaching.

The Nose Replacement

At the request of the AIA the large, restored nose was removed and replaced by a nose that better fitted the shape and size of the mask. A scalpel and needle-nose tweezers were employed to pare back the outer layers of the restored nose carefully (Figure 15). A slow, controlled intervention was required to ensure that no damage was caused to the mask. Fill material was removed gently, and sample jars were used to collect each material layer as they were removed (Figure 16).

Solubility testing was performed before removing the nose to determine which solvents would dissolve the



Figure 15: Process of removing the outer layers of the nose using mechanical means, specifically the use of a scalpel and tweezers. Image: Grimwade Conservation Services, 2018.

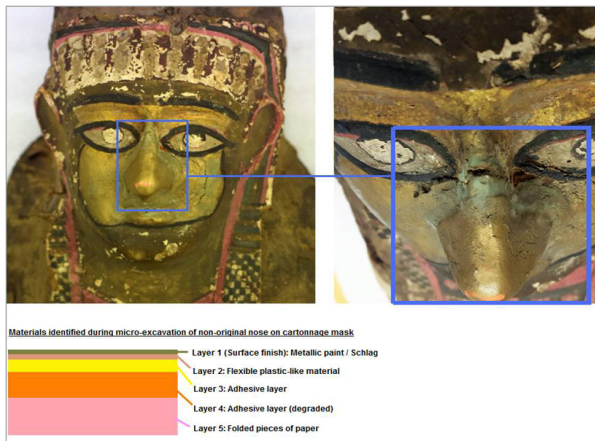


Figure 16: Documenting the materials identified and collected during the micro-exavation process. Image: Grimwade Conservation Services, 2018.

restoration materials. Solvents including 100% acetone and 100% ethanol were tested. Acetone effectively removed the Schlag coating, softened the adhesive, and degraded polyurethane/polystyrene material found within the nasal cavity. Poultices made of cotton wool dampened with acetone softened the adhesive layers. The cotton wool was cut to conform to the restoration contours (Figure 17). After twenty minutes, the poultices were lifted to locate and remove small portions of the restoration. The working time following the removal of the poultice was approximately five to eight minutes, which meant that this step was repeated many times.

The removal of the restored nose exposed numerous idiosyncratic restoration materials. Six materials were identified: Schlag, a hard epoxy like layer (layer 1), a flexible plastic material that sat where the boundary of the nose ended, a putty plasticine-like material (layer 2), degraded polystyrene or polyurethane adhesive (layers 3 and 4), and a sizable amount of pink paper pieces wedged into the proper left cheek cavity (layer 6). The solvents proved effective in removing the polyurethane/polystyrene and the Schlag covering the surface of the nose and surrounding areas of the proper right and left cheek. Acetone and other tested solvents, ethanol and White Spirits, were ineffective in dissolving adhesives



Figure 17: Application and use of cotton wool poultices dampened with 100% acetone to soften the adhesive present on the nose. Image: Grimwade Conservation Services, 2018.

found in the nose cavity (layers 2 and 3), only softening these materials (Figure 15).

After most of the restored nose had been removed, residual adhesive and pink paper used in the old restoration were left in place to prevent the mask from collapsing inwards. This reduced the amount of intervention and provided a foundation for building an appropriately sized nose. A sample of each restoration material was collected and placed in individually labelled sample jars for future analytical testing. Seven samples, predominately from the upper section of the cartonnage mask were removed as part of the conservation treatment. The seven samples were analysed using Fourier transform infrared spectroscopy (FTIR). The purpose of the analysis was to determine what types of materials and adhesives had been used in the past restoration. The resulting data identified polyvinyl chloride (PVC), cellulose nitrate and an epoxy resin (Appendix 2). Identifying past restoration materials demonstrated the multitude of materials and methods of what are now considered unsuitable and idiosyncratic materials which were used before the discipline of conservation evolved.

Building and shaping the new nose necessitated several steps using carefully selected sound conservation materials, which are different from the original material and therefore detectable. Two layers of dry Japanese paper ropes, ranging from 50 mm to 80 mm in length and 15 mm to 20 mm in width, were used to fill the proper left cheek cavity (Rozeik 2011). Three additional layers of Japanese paper ropes wet with starch paste were then applied on top to form a sound foundation on which to place the new nose.

The peripheries of the nose and proper left cheek cavity were consolidated with a 10% solution of Paraloid™ B-72 in acetone (weight/weight) and left to dry. Paraloid™ B-72 (hereafter referred to as B-72) is a resin that conservators have used since 1949. It became popular for consolidating friable material in the 1960s and 1970s. B-72 is a stable thermoplastic acrylic copolymer composed of ethyl methacrylate monomers and methyl acrylate at a ratio of 70:30 (Koob 1986). Rohm and Haas manufacture it as solid pellets that are dissolved in a solvent. By altering the solution concentration, adding a bulking agent, or modifying the application technique, B-72 can be used as a consolidant, adhesive, coating, and in-filler (Quinton 1995: 122). The consolidant acted as a barrier layer between exposed linen wrappings, on the upper bridge of the nose and along the peripheries of the nasal and proper left cheek cavity and the fill material. Thin layers of Liquitex® Modelling paste were applied with a flexible metal spatula (Figure 18) to the upper part of the nasal bridge, the Japanese paper filled cheek cavity, and the area around where the nose sits. Liquitex® modelling paste (hereafter referred to as Liquitex) is composed of marble dust and acrylic emulsion. The fill material is commonly used in conservation to build heavy textures on rigid supports and create three-dimensional



Figure 18: The process of filling losses around the nasal cavity and the proper left cheek cavity with *Liquitex* modeling paste. The paste was applied in numerous layers to ensure the fill contoured the facial features of the mask and sat flush with the surface. Image: Grimwade Conservation Services, 2018.

forms. It dries to the hardness of stone and can be sanded or carved when thoroughly dry (Barov & Lambert 1984; Craft & Solz 1998). *Liquitex*[®] was chosen because of its adhesive qualities and its well-known properties. Following each application of *Liquitex*[®], any cracks present on the surface were pared back with a combination of acetone, used to soften the paste, and custom-made files made from sheets of alumina oxide abrasive paper files (grades P120, P320, P400), double-sided tape and archival board scraps. The files were used to abrade and pare back divots and undulations (Figure 19). Filling the losses required multiple applications of *Liquitex*[®] and shaping to ensure that the cavities were filled and followed the contours of the mask's facial features. A minor gesso loss under the lower edge of the proper left eye was also infilled, and inpainted using Golden[®] Artist acrylics paint to match the surrounding surface colour and finish.



Figure 19: The materials and equipment used during the process of filling losses on the cartonnage mask, specifically around the nasal cavity and the cavity on the proper left cheek. Image: Grimwade Conservation Services, 2018.

The new nose was custom made to better fit the contours, size, and shape of the mask. Numerous images of cartonnage masks were examined to gain an understanding of ancient Egyptian facial features and how they were translated to cartonnage masks (Figure 20). Two test noses were prepared to determine which material would best create a lightweight nose using *Liquitex*[®] and *Sculptamold*, a cellulose compound fill material. *Liquitex*[®] was ruled out as the weight of such a nose would be too great for the mummified child. *Sculptamold* is lightweight when dry, does not shrink, has good working properties, and can be shaped and carved. The process of shaping the nose involved sanding and the application of very thin layers of *Liquitex*[®] diluted in deionised water fill undulations in the surface of the nose resulting from the use of *Sculptamold*. The nose was then sanded and polished with *Micro-mesh*[®]. *Micro-mesh*[®] is a fabric with abrasive particles secured with a latex film. The cloth backing makes it useful for shaping awkward areas for which abrasive papers are too stiff. Grits from size 1500 – 6000 contain silicon carbide, and finer grits (8,000 and 12,000) contain aluminium oxide. When a satisfactory finish had been achieved, the nose was secured to the mask using 40% solution of Paraloid B48-N in acetone (weight/weight) (Horie 2010). Paraloid B48-N is a colourless, thermoplastic acrylic resin copolymer of methacrylate methyl methacrylate and butyl acrylate, supplied as solid pellets. It remains solid up to 50°C and therefore has increased stability at elevated temperatures and is suitable for fluctuations in temperature. At the time of adhesion, any voids or gaps between the nose and the surrounding infilled areas of the nasal and proper left cheek cavity were filled with *Liquitex*[®]. Again, the process was time-consuming and involved several applications of *Liquitex*[®] in thin layers to ensure that the nose blended seamlessly with the facial features of the mask. Final shaping of the nose was completed using a combination of 100% acetone



Figure 20: The new nose attached to the cartonnage mask. *Liquitex* modeling paste was used to fill voids between the nose and filled nasal and proper left cheek cavities. The nose was carved, sanded and polished to achieve a smooth, even finish. Image: Grimwade Conservation Services, 2018.



Figure 21: The process of gilding the nose and proper left cheek area of the cartonnage mask. Image: Grimwade Conservation Services, 2018.

applied with a fine soft art brush, mechanical reduction using a sharp scalpel, and custom sandpaper files and Micro-mesh® of varying grades from coarse to fine. The result was a smooth, even surface finish that was essential for the final stages of the treatment process—gilding and inpainting.

Doing trial runs with gold pigmented paint determined that it would not adequately match the surface of the gilt remaining on the mummy's cheeks. Schlag was not considered because of the corrosion present on the previous restoration. Therefore, gold leaf was selected to match the original materials and prevent corrosion. Gilding the new nose and Liquitex® fills involved using gold leaf, a large flat blade palette knife, fine inpainting brushes, gilder's cushion, gilder's tip, mop and duster brushes, and acrylic gold size. In preparation for gilding, the surface was lightly brushed clean to remove any dust

or particulate matter and prepped with Langridge Acrylic Gold Size adhesive applied with a fine brush. The size was left to dry for 10 minutes to achieve the right tack level before the gold leaf was applied. Twenty-three-carat gold leaf was selected to provide the closest colour match to the ancient gold leaf present on the mask. Once applied, any areas where the gold leaf was missing were carefully filled with small squares of gold leaf. Excess gold leaf was gently brushed off the surface using a gilder's mop brush, and the gilded areas were left to settle. Small areas, less than 3 mm in size, of the gilded nose and proper left cheek were left ungilded to match the 'aged' surface condition of the ancient gilded and painted surfaces (Figure 21). The final process of this treatment step involved carefully adding layers of paint over the gilded surface to blend in sympathetically with the ancient surface of the mask. Minimal intervention practice required that the paint and gilding be applied to the conserved area only and not overlap ancient cartonnage materials. The conservation repairs undertaken addressed key condition issues and restored the mummy's visual integrity in an ethically considered and thoughtful manner (Figure 22).

Concluding comments

The conservation treatment of the child mummy marked an important point in the history and preservation of the mummy. Throughout the conservation process, from the initial literature and material assessment phase to determine the most appropriate conservation materials, to the conservation treatment of the mummified child, respect and care were at the forefront for all parties involved. All aspects of the treatment process were researched, tested, and applied in an ethically considered manner, and the subsequent re-housing of the child mummy was a successful collaboration among the AIA, Pod Museum Services and Grimwade Conservation Services. The result is a more structurally stable and aesthetically integrated mummy.



Figure 22: The mummified child after conservation treatment supported by the acrylic cradle made by POD Museum Art Services. Image: AIA

Working on this project came with some challenges; the fragility of the mummy before treatment meant that handling and shifting were minimised, and all examinations and treatment steps were meticulously planned and documented to prevent any unnecessary movement. Conservation treatment concentrated on stabilising the wrappings and making a new nose that fits the mask's proportions. The child mummy is now secured to a back-support and a custom-made case and storage box which are designed for transport, storage, and display.

The story of the child mummy continues to be written. New research paths are being explored to learn more about the mummy and the story of the person whose remains are contained therein. The imaging at the Australian Synchrotron was straight-forward because the mummy did not need to be removed from the carrying case made by Pod Museum Services.

A radiocarbon dating program is to be pursued and will begin with suitable material collected during the treatment process. Sampling human remains has become more sensitive because of experience working with First Nation human remains (see Wills et al. 2014). Invasive testing is not envisaged. In future it is hoped that people will know more about the person whose well-presented mummy they can now observe, courtesy of the conservation program just described.

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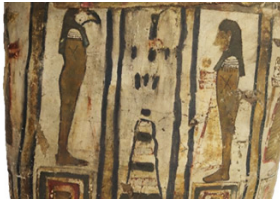

Endnotes

- 1 Conservation work is guided by ethical standards established by national and international conservation organisations. Conservators use these codes as principles that moderate and guide their practices. Ethics in conservation can range from discussions about whether a thing should be conserved, to the choice of materials used in conservation processes. Ethical decisions relate both to the thing undergoing treatment and to stakeholders' wishes.
- 2 During the Enlightenment, museums separated things from their social and cultural context; in doing so, 'things' were singled out as objects for view. The authors acknowledge that words such as 'object' and 'artefact' have colonial origins and are related to power and control that can exclude the original owners and/or descendants and affect how we value and handle things (see Ouzman 2006: 269; Harrison 2013: 15; Sully 2008). This paper avoids the use of the words 'object' and 'artefact'. Instead, when possible the child mummy is referred to as the mummy. The word 'thing' replaces the word object.

Materials and Supplies List:

Pressurised Dahlia® sprayer	Ethanol AR Reagent Laboratory Grade
Reemay®	Sculptamold
Blotter paper	Liquitex® Modelling Paste
Wheat Starch Paste	Micro-mesh®
Kozo Japanese paper (K38)	23 carat Gold Leaf
Golden® Artist acrylics	Langridge Acrylic Gold Size
Paraloid™ B48N®	
Paraloid™ B-72®	
Acetone AR Reagent Laboratory Grade	

Appendix 1: EDS-XRF Analysis of the cartonnage

Cartonnage	Colour	Element detected	Pigment
Cartonnage 1 - Face Mask 	White	Calcium (Ca)	Calcium Sulphate or Calcium Carbonate
	Red	Iron (Fe)	Red Ochre
	Pink	Lead (Pb)	Red lead or organic pigment
	Green and faded green	Copper (Cu)	Malachite, Egyptian Green
	Blue	Copper (Cu)	Azurite or Egyptian Blue
	Yellow	Arsenic (As)	Orpiment
	Black (blue faded black)	Copper (Cu)	Carbon/bone black mixed with Azurite or degraded Azurite
Cartonnage 2 – Chest 	White	Calcium (Ca)	Calcium Sulphate or Calcium Carbonate
	Yellow	Calcium (Ca)	Organic pigment
	Red	Iron (Fe)	Ochre
	Red	Calcium (Ca)	Organic pigment
	Black	Calcium (Ca)	Carbon/bone black
	Blue/black	Copper (Cu)	Carbon/bone black mixed with Azurite
Cartonnage 3 – Leg 	White	Arsenic (As)	?
	Yellow	Arsenic (As)	Orpiment
	Metallic paint	Gold (Au), Zinc (Zn), Copper (Cu) and Iron (Fe)	Metallic colours
	Red	Calcium (Ca)	Organic pigment
	Black (green)	Copper (Cu)	Azurite
	Black	Calcium (Ca)	Carbon/bone black

Appendix 2: Fourier Transform Infrared Spectroscopy, Summary of Results

Sample	Location/description of sample	Result
A	Bronze paint or schlag, removed from the reconstructed nose	Silicate material and possible metallic pigments are predominant in the sample. The dominance of the pigments appears to mask clear identification of the binder.
B	Opaque orange material from reconstructed nose	Polyvinyl chloride (PVC). Some peaks could be further characterised.
C	Clear adhesive from mask	Epoxy resin. Some peaks could be further characterised.
D	Dark orange adhesive from mask	Cellulose nitrate. Some peaks could be further characterised.
E	Slightly opaque, discoloured (brown) adhesive material from reconstructed nose	Possibly alkyd resin (oil and synthetic resin mixture). Some peaks could be further characterised.
F	Adhesive sample presented on exposed bone (verso profile)	Inconclusive result
G	Black paint from beneath proper-left eyelid on mask	Silicate material predominates in the sample – this could relate to the dense black pigment. Possible epoxy binder. Some peaks could be further characterised.