The techniques, ethics, and approach for repairing metal sculpture, statuary, and heritage objects, both structurally and aesthetically.

Keir Bayley

George Alexander Foundation Fellowship, 2025

International Specialised Skills Institute

THE George Alexander FOUNDATION

First Published 2025

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Printed by Elgin Printing

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ISBN: 978-1-923027-80-0

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The Awarding Bodies

The Fellow sincerely thanks The George Alexander Foundation for providing funding support for the ISS Institute and for this Fellowship.

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In 1972, George Alexander AM set up an independent philanthropic foundation as a way of sharing his wealth and giving back to the community. The focus of The George Alexander Foundation is supporting access to education for promising young people, particularly those from rural and remote areas. The George Alexander Foundation's aim is to help overcome barriers and make it possible for talented students to achieve their potential and go on to contribute to the Australian community.

The George Alexander Foundation (GAF) Scholarship Programs form the core of the foundation's work, operating in partnership with major tertiary institutions, while our Fellowships and other Education grants provide other enriching and challenging educational experiences.

George Alexander believed in the notion of 'planting seeds and hoping they grow into pretty big trees'. The programs supported by the Foundation endeavour to support this ideal and as GAF Fellowship recipients go on to contribute to the community, George's legacy and spirit lives on through their achievements.

Fellow's Acknowledgements

The Fellow, Keir Bayley, would like to acknowledge the support of the International Specialist Skills Institute (ISSI) and the George Alexander Foundation for funding this study, as well as International Conservation Services (ICS) for welcoming Keir into Australia's conservation sector and continuing to help him develop skills and knowledge in the field of conservation. Keir would also like to extend a special thanks to ICS conservator colleagues and former ISSI Fellows Claire Rowson and Amy Walsh for bringing the fellowship to his attention and assisting with the application process. Additionally, Keir extends thanks to Nicola Ashurst of Adriel Consultancy for her support throughout the fellowship and for passing on many valuable contacts that were instrumental in conducting the study in the UK.

Below are a list of individuals and organisations Keir would like to thank for their support during this fellowship:

- Nicola Ashurst, CEO, Adriel consultancy
- Claire Rowson, Senior Project Manager, International Conservation Services
- Amy Walsh, Senior Objects Conservator, International Conservation Services
- Julian Bickersteth, CEO, International Conservation Services
- ICON – Metal, organisation
- English Heritage, organisation
- West Dean College of Arts and Conservation
- John Wallis, managing director, Dorothea Restorations
- Geoffrey Wallis, director, GW conservation
- Rupert Harris, managing director, Rupert Harris Conservation

02
Executive Summary

Keir, currently engaged in the private conservation sector in Australia, has identified a pressing need for advanced technical expertise in the ethical restoration of Australia's public and private heritage metal objects, particularly metal sculptures and statuary. He has observed the detrimental consequences of misused contemporary materials and poorly executed restoration techniques, resulting in further deterioration and damage to these invaluable heritage metal artworks and artifacts. The primary objective of this fellowship is to acquire knowledge related to these restoration techniques and to skilfully integrate traditional and modern materials and methods, with the ultimate aim of applying and sharing this knowledge to facilitate ethical restoration practices within Australia.

Supported by a network of professional contacts and mentors within Australia, as well as connections in the UK specialising in these types of conservation and restoration work, Keir embarked on this journey with the generous backing of ISSI and GAF.

The fellowship was awarded to Keir in April 2022, enabling him to make two trips to the UK, one between July and September 2022 and another in August 2023. During these visits, he engaged in professional site visits, attended courses, and received theoretical insights and practical training from global experts in the field. The expertise gained from this fellowship, as detailed in this report, encompasses the following key areas:

1. Restoration of lead sculptures and statuary
2. Repair of cast and wrought iron objects, including bespoke heritage railings, gates, bridges, and industrial machinery, along with an exploration of their historical production processes
3. Armature replacement for public bronze and lead sculptures and statuary
4. Assessment of armature structural integrity and the development of repair methodologies
5. In-depth knowledge of materials and manufacturing processes specific to metal sculpture

Upon his return to Australia, Keir had the opportunity to apply, refine, and expand upon this newfound expertise within the private conservation sector. The skills he acquired are already being put into practice in undertaking conservation and restoration projects that were previously unavailable in Australia.

An additional objective of this fellowship is to strengthen networking ties in the conservation field between UK specialists and Australian conservators in the heritage industry. This could potentially lead to the invitation of UK specialists to Australia for presentations, talks, and conferences with their Australian peers.

03
Fellowship Background

Keir first learned about the George Alexander Foundation Grant and ISSI through several colleagues at International Conservation Services who had previously been Fellows of the grant. Their experiences highlighted an opportunity for him to gain the specialised knowledge and skills necessary to address these challenges and improve conservation practices in Australia.

While relatively new to the conservation sector in Australia at the start of this fellowship, Keir brought to it a robust practical foundation acquired at one of Sydney's esteemed fine art foundries, Crawford's Castings. During his time at the foundry, he developed expertise in various techniques associated with lost wax casting, including silicone rubber mould making, wax working, investment moulding, metal casting, welding, armature fabrication, metal finishing, and patination. Additionally, his experience at the foundry broadened his skills in metal fabrication.

With a background in fine arts from Kingston Upon Thames University in the UK, Keir has long harboured a passion for fine art and sculpture. In 2012, he relocated to Australia, where he made his permanent home. His professional journey in Australia began at Crawford's Castings, where he applied his creative technical expertise to the creation of fine art sculptures.

In 2021, Keir transitioned from fine art production to the field of conservation. He became a member of the Australian Institute for the Conservation of Cultural Material (AICCM) and joined International Conservation Services, specialising in Objects and Outdoor Heritage conservation. In his current role as a Principal Metals Conservator, Keir has seamlessly integrated his technical metalworking skills into the realm of conservation. These skills have been adapted to align with the ethical standards set by the AICCM for conservation practices in Australia.

His experience at International Conservation Services revealed a significant gap in the Australian metals conservation landscape, particularly in the area of structural repair for statuary and metalwork. There is a shortage of specialists equipped with the necessary technical skills and knowledge to execute specific treatments. Consequently, the Australian conservation sector often relies on related artisanal industries such as art foundries and blacksmiths. Regrettably, these industries aren't normally educated in conservation ethics, and there is often hesitation stemming from the unknown technical and financial aspects, leading to the abandonment of many potential conservation and restoration projects.

However, specialised conservation industries that address these issues exist abroad, inspiring Keir's pursuit of this fellowship. Companies like Rupert Harris Conservation and Dorothea Restoration in the UK, as well as Mckay Lodge Conservation in the USA, exemplify the expertise and resources available for the restoration and conservation of metal sculpture and historic metalwork.

With this context and understanding of the Australian conservation sector in mind, Keir made the goal of this fellowship to address the growing

need for advanced repair methodologies and techniques regarding metal sculpture and heritage objects within conservation practices in Australia. To achieve this, Keir planned on gaining knowledge and practical skills to work with ferrous, non-ferrous, and lead metals from the experts suggested by Australian industry experts in related heritage fields, such as architecture, who have spent many years working in the UK, like Nicola Ashurst. Keir plans for these goals to not only enhance his own skills, knowledge, and confidence but also to pass them on to others working in conservation and similar or aligned heritage trades to prevent the abandonment of certain projects.

04
Fellowship Learnings

Introduction

This section of the report aims to provide an in-depth understanding of the skills, learning experiences, and knowledge acquired in the field of repairing metal sculptures, statuary, and heritage objects. It is centred on both structural and aesthetic restoration, emphasising the techniques, ethics, and approaches involved in the conservation of these valuable cultural artifacts. It also highlights the need for these specialised skills and techniques to be brought back to Australia, as they are not readily available in the current conservation landscape.

Ethical considerations in conservation work

The code of ethics relating to conservation is very similar in Australia and the UK, as outlined by the ACCIM (Australian Institute for the Conservation of Cultural Material) and Historic England, the governing conservation bodies in each respective country. However, the application of these ethical guidelines is to be interpreted by the individual or group on a case-by-case basis when undertaking a conservation treatment. Given that such treatments are not currently performed in Australia, it is crucial to seek out the expertise of industry specialists abroad, particularly those with first-hand experience in carrying out these complex treatments.

Keir has sought the knowledge and guidance of leading experts in the UK, including Rupert Harris of Rupert Harris Conservation Ltd, widely regarded as the UK's foremost expert in lead sculpture repair. Rupert has worked extensively on the conservation of non-ferrous heritage sculpture across the UK. Keir has also consulted Geoffrey and Jon Wallis of Dorothea Restorations Ltd, who are considered among the leading authorities on the conservation and repair of historic ironwork in the UK.

Rupert Harris has been involved in significant projects such as the lead sculpture Equestrian Statue of King George at Stowe Landscape Gardens in Buckinghamshire and the lead roof figures at Lyme Park, Disley, Stockport, Cheshire, among many other high-profile lead works across the UK. Through discussions with Rupert and by examining past projects, Keir has gained invaluable knowledge, particularly regarding the techniques and methodologies used in the repair of lead sculpture (see section 1.05c). Both Rupert Harris and Geoffrey and Jon Wallis emphasise the importance of understanding the original production methods when making ethical decisions about conservation treatments. Since no lead sculptures were ever produced in Australia, the first-hand knowledge required for these treatments can only be found overseas.

Rupert's insights into how the sculptures were originally produced and the reasons behind their dilapidation were invaluable, and these are further discussed in section (1.03). Rupert explained that lead treatments, especially structural repairs, often require significant interventions due to the lead being

such a soft metal, it cannot support itself without an internal armature and is very susceptible to external impact damages.

A particularly interesting case study he shared was the repainting of the Bargate Lions in Southampton, UK[i]. This conservation project ultimately won an award, largely due to the extensive historical research and paint analysis conducted. Paint samples were taken and analysed under a microscope, revealing the original colour beneath layers of later repainting. With the support of the client, Southampton City Council, it was decided to restore the lions to their original colour scheme. Further reading on the Bargate project can be found on the BBC News website[ii].

Geoffrey and Jon Wallis from Dorothea Restorations also discussed their approach to the ethics of conservation, particularly in relation to the restoration of historic ironwork. They shared examples of large-scale projects, including monumental iron bridges and architectural pieces such as the Iron Bridge in Shropshire, which spans the River Severn[iii], and Coombe Cliffe Conservatory[iv]. More information about these projects can be found on the Dorothea Restorations and English Heritage websites.

To illustrate the subjective nature of ethical decision-making in conservation, Geoffrey Wallis presented a photograph of a heritage iron fence with missing pieces. He posed the question: should the missing pieces be replicated and replaced, or should they be left as missing? He explained that this question often divides opinions, with valid arguments on both sides. This example highlights that ethical decisions in conservation, even within the framework of conservation codes, can be subjective and open to interpretation.

However, Geoffrey Wallis emphasised that when working with public, structural, architectural, and heritage objects, health and safety must always take priority. Interestingly, health and safety are not explicitly mentioned in either the AICCM or British Heritage codes of ethics. He explained that compromises often need to be made between ethics, structural integrity, and health and safety, particularly when dealing with functional architecture and buildings, such as bridges. One example of this was the use of modern materials, such as carbon fibre patches, in the repair of iron bridges. While these materials are not historical techniques, they were proven to be fit for purpose and structurally sound through engineering testing, making them the best choice for ensuring the bridge remained functional.

Geoffrey went on to explain that there are normally multiple options for repairing heritage objects. The key is selecting the most appropriate option and being able to confidently justify the decision-making process, ensuring that as best they can, all interventions and repairs align with conservation codes of ethics.

Sophie Godfrey, Conservator, Author and a lecturer at West Dean, also discussed ethics and ethical decision-making in detail, referencing an article on the Historic England website[v]. Ethics and ethical decision-making were also central themes at the ICOM Metal 22 Conference.

Conversations with leading industry professionals in the UK have given Keir the confidence to make informed ethical decisions in conservation and effectively communicate these decisions and repair methodologies to tradespeople in Australia, many of whom lack a conservation background.

Assessment of structural integrity (and reasons for dilapidation)

When assessing the structural integrity of artworks and architectural components, it is often necessary to understand the original production processes, as this provides valuable insight into the reasons behind their deterioration. Experts such as Geoffrey and Jon Wallis and Rupert Harris shared in-depth knowledge of these processes. Geoffrey Wallis, in particular, provided detailed information on the production and historical use of cast iron and wrought iron in architecture. One key takeaway for Keir was learning how to distinguish between cast and wrought iron, as they have very different structural properties. Cast iron performs well under

compression, while wrought iron is stronger under tension. The linear structure of the iron can be a key indicator in identifying each type.

Rupert Harris provided valuable insight into the production of lead sculpture in the UK and Europe during the 18th and 19th centuries. Many of the specific lead casting foundries from that era no longer exist, so acquiring knowledge of the lead casting process can now only be done either academically or through knowledge being passed on by experts like Rupert. The challenge of retaining and passing on this expertise has become a global issue, not just in Australia.

At Keir's request, Rupert shared detailed advice on the inherent structural issues with lead sculpture and even offered guidance on a lead sculpture repair project Keir was planning to undertake upon his return to Australia. This project is discussed in section V.05c of the report.

Common structural issues in lead sculpture, identified by Rupert, include sagging and deformation of the lead itself. Lead is an inherently soft material and cannot support its own weight in sculptural forms. To address this, lead sculptures were often cast with an internal armature of cast or wrought iron, with casting investment left inside to provide further support. However, because these sculptures were predominantly designed for outdoor display, the iron armatures corrode over time, and the casting investment breaks down, leading to limbs falling off and unsightly deformation. Pictorial examples of this issue can be found on Rupert Harris's website.

Rupert also discussed the negative impact of previous repairs using unsuitable materials and techniques, which often caused further damage. He identified issues such as resin repairs, dissimilar lead solder, and instances where sculptures were filled with expanding foam. Although these repairs are now considered inadequate, Rupert acknowledged that they may have been the best available options at the time and speculated that some sculptures might have been decommissioned if no repairs had been made at all. Further details and images related to these issues can be found on Rupert's website[vi].

The correct repair techniques, as demonstrated and described by Rupert, are discussed in the next section.

Jon Wallis shared insights into the use of modern technologies for assessments, such as drones to access hard-to-reach areas of statuary or architectural components on rooftops and heritage-listed buildings. He also described how 3D imagery, now easily accessible via apps on mobile devices, and paint thickness testing devices are revolutionising non-intrusive analysis and documentation, in line with conservation ethics.

All the experts Keir met with emphasised the importance of understanding the causes of corrosion, such as environmental factors, the use of dissimilar reactive metals, and the failure of protective coatings. An example of this was when Geoffrey Wallis demonstrated galvanic corrosion by placing a mild steel nut on a stainless-steel bolt, submerging them in water, and using an electrical current reader to show that the two metals created an electrical charge, resulting in corrosion. This was new and critical knowledge for Keir, particularly regarding the incompatibility of stainless steel and mild steel in terms of stability.

Developing a treatment plan

After the sculpture has been analysed and the causes of any damage or corrosion identified, a treatment plan can be developed. As Geoffrey Wallis explained, treatment plans must take into account not only the condition of the object but also the needs of the client, the intended purpose of the object, its historical significance, and the available budget—all of which are crucial factors. He noted that historical significance can sometimes be subjective, the client's needs may require negotiation, and budgets often play a decisive role in determining which, if any, treatments can be undertaken. These are all important considerations when planning any conservation work.

Once these factors have been established and agreed upon, an appropriate treatment plan can be created, using the repair techniques outlined in the next section.

Restoration techniques for different metals (ferrous, non-ferrous, lead)

In this section, the Fellow will describe the techniques learned during the fellowship, with reference to accompanying photographs.

The section is divided into three subsections:

(a) **Ferrous Metals,** which covers metals such as cast iron, wrought iron, and mild steel;

(b) **Non-Ferrous Metals,** which includes metals like bronze, brass, and copper;

(c) **Lead Sculpture,** which provides a detailed overview of the repair techniques for cast lead sculpture, a major focus of this fellowship.

(a) Ferrous metals

The skills and techniques acquired in relation to the repair of ferrous metals were primarily learnt from Geoffrey and Jon Wallis of Dorothea Restorations, as well as the blacksmiths at West Dean College. Practical skills gained include brazing and welding cast iron, removing paint and corrosion from ferrous metals, uninstalling and reinstalling iron architectural components such as cast iron railings, and forging wrought iron in a traditional blacksmithing workshop.

Traditional Blacksmithing at West Dean

[Photo: Blacksmiths at West Dean College using a traditional coal furnace to forge ironwork.]

While forging ironwork was not a specific skill Keir aimed to focus on during the fellowship, this demonstration showcased the expertise of highly skilled tradespeople working with metal in a traditional setting.

Additionally, it was insightful to learn from Geoffrey that no new wrought iron is produced in the UK today. Instead, it must be salvaged and repurposed from existing wrought iron objects or imported. However, importing wrought iron comes with its own risks, as it can often be of low quality.

Cast iron repair techniques as demonstrated by Jon Wallis

[Photos: Geoffrey demonstrating the brazing of steel plates with silicon bronze weld rods.]

In these photos, Geoffrey demonstrates the brazing of steel plates using silicon bronze weld rods, a repair technique commonly employed by Dorothea Restorations on cast iron. Brazing is preferred for cast iron because it is notoriously difficult to weld. This technique joins the metal using a filler rod without melting the base metal, ensuring a strong and durable repair.

Removal and reinstallation of cast iron railings as demonstrated by Geoffry and Jon Wallis

In the following set of images, Geoffrey and Jon Wallis demonstrate how to safely remove and reinstate iron railings. Although not directly related to the core focus of this fellowship, Keir has included this process as the same principles and techniques used in the removal and reinstallation of railings are sometimes applicable to the safe removal of sculptures and other objects before performing structural and aesthetic repairs. The railings were leaded into the stone, and the images describe the process of carefully removing and reinstalling them using the same methods originally used during installation.

This photo shows the removal process, Geoffrey is drilling a series of small holes around the railings, before using plyers and lever bars to remove the individual railings

To reinstate, firstly lead is melted in an iron crucible using an oxy torch.

The molten lead is carefully poured into the void below the railings.

The lead is shaped using hammers and cold chisels to refine its form.

The finished reinstallation of the iron railing.

Repair of an ornamental cast iron bench

In the following series of photographs, Keir demonstrates the application of skills learned from Geoffrey Wallis in the repair of cast iron work. Keir undertook these repairs in Australia after returning from the fellowship. Prior to the welding and brazing repairs, the chair was abrasive blasted to remove old paint and corrosion. Before abrasive blasting, the chair was carefully documented, and paint samples of the original paint were taken. After the weld repairs were completed, the chair was repainted in white, using the paint samples as a reference.

This photo shows an example of cracking in an ornamental cast iron garden chair. You can see that a previous attempt at welding has failed, demonstrating that without using the correct techniques and materials, repairs are likely to fail.

In this image, Keir is heating a large area around the repair using an oxy-LPG torch. Preheating the metal before and after welding is crucial when repairing cast iron. This ensures that the surrounding areas heat up and cool at the same rate, helping to prevent cracking in the repair itself or in the surrounding metal.

This image shows the successfully completed weld repairs after the entire area has cooled. As you can see, there is no cracking, and the welds appear smooth and uniform, in contrast to the previous repair attempt, which failed.

This image shows another section of the bench post-welding and cooling, demonstrating the high quality of the weld that Keir was able to achieve using the knowledge and skills acquired during the fellowship.

This image shows the bench as a whole after the welding was completed. As you can see, there were numerous areas that required welding. The heat tarnish around these sections also highlights the size of the areas that needed to be preheated and post-heated, even for these relatively small repairs.

The repair of cast iron heritage machinery

In the following series of images, Keir demonstrates another repair on cast iron, this time on a piece of heritage industrial machinery being repurposed into a display piece. The process shown in the images below is similar to the repair techniques used on the iron chair.

This photo shows a detached leg from the piece of industrial machinery. Using knowledge acquired from Geoffrey Wallis, Keir was able to clearly identify the metal as cast iron, based on the crystalline structure observed at the breakage point.

In this image, Keir has cleaned the area around the repair to remove corrosion, dirt, and grease, as these could affect the quality of the repair. He then preheated the area before welding and applied post-heating to prevent cracking.

This image illustrates the weld after the repairs were made. It was decided to leave the welds visible, rather than grinding them back and visually integrating them. This decision was made both to maintain structural integrity—since leaving the welds proud adds strength—and because the pieces were to be displayed in their original condition, rather than fully restored.

(b) Non-ferrous metals

Keir already had substantial experience working with non-ferrous metals, such as bronze, having worked in a fine arts bronze casting foundry. Rupert Harris provided valuable additional insights into repair techniques. After Keir described his methods and shared photos of his work, Rupert confirmed that Keir was using the correct approach, which was particularly reassuring given the limited number of peers performing similar work in Australia.

It's also worth noting that Keir shared images of his previous work with tutors at West Dean College. They were impressed and even invited him to speak on the metals course in a future year, presenting a great opportunity for further networking and knowledge sharing between the UK and Australia.

Skills acquired and confirmed during the fellowship include TIG welding of bronze sculpture, silver soldering of copper and copper alloys, and patination.

Patination of bronze

This image shows the patination board at West Dean College, displaying various chemical formulas. During the course, Keir participated in a patination workshop. Although Keir already had some experience with patination from his time in a bronze foundry there is always more to learn, he was also able to contribute to the workshop by sharing his knowledge with both the lecturers and fellow students.

Bronze statue repair

The following selection of images shows Keir applying the knowledge gained during the fellowship to the repair of a small bronze statue with a broken arm. After attempting to reattach the arm using traditional TIG welding techniques, Keir found the process unsuccessful due to the composition of the bronze alloy. As a result, he decided to use a brazing technique similar to the one he learnt from Geoffrey for cast iron repairs.

By preheating the metal and welding at a lower temperature—just enough to melt the silicon bronze weld rod—Keir was able to successfully rejoin the arm to the main body of the sculpture. This demonstrates how the skills acquired during the fellowship can be repurposed and applied to different materials.

This image shows the sculpture with the missing arm before any treatment was undertaken.

This image shows the detached arm of the sculpture before the repair process began.

This image shows the arm being carefully aligned with the main body of the sculpture before welding.

This image shows the arm successfully welded back onto the sculpture using brazing techniques Keir learnt during the fellowship.

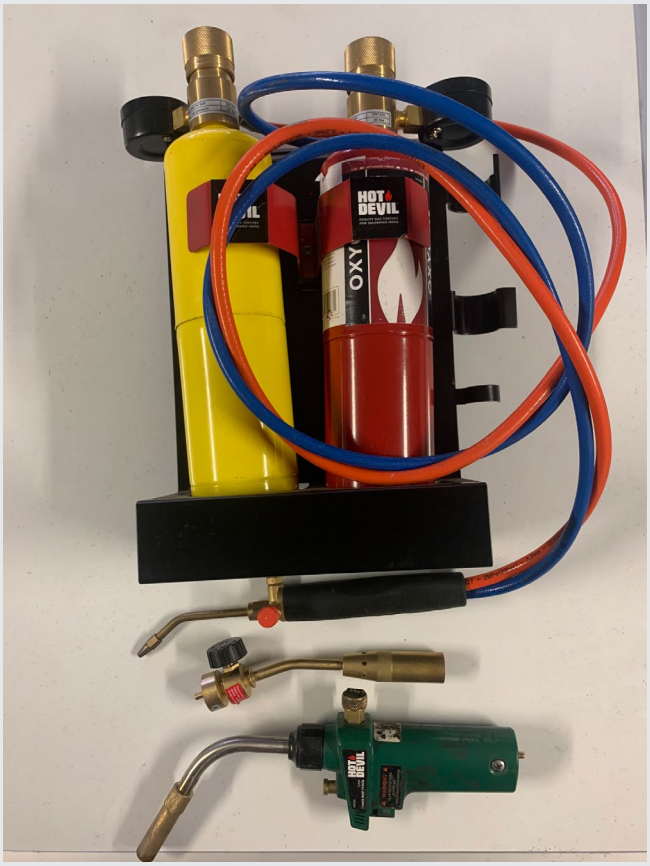
This image shows Keir carefully chasing and finishing the repair to ensure the texture and form of the welded area match the original sculpture.

This image shows Keir applying a potassium polysulphide, AKA liver of sulphur patina to help integrate the repair area and blend it with the surrounding surface of the sculpture.

(c) Lead sculpture

Skills and techniques related to the repair of lead sculpture were primarily learnt from Rupert Harris, along with additional research by Keir and insights from the English Heritage book Metals – Practical Building Heritage, which was provided during the course at West Dean. Key skills acquired include lead burning/ welding, reshaping and chasing lead welds, removing old armatures and installing new ones, applying paint finishes over lead repairs, and identifying poorly executed previous repairs.

Basic Lead working tools, PPE and techniques with Rupert Harris



Here details the hot works tools required in the repair of lead sculpture. At the top a small oxy torch used for lead burning/welding and below 2 small butane and trap map gas blow torch attachments used to gently heat the lead during reforming of the shape

A good set of hammers and some custom made punche/chisels used for removing dents and reshaping the form

Plyers, lead scraper, scissors and a sharp knife are required for both reshaping and preparation of weld joins

Essential PPE required for working with lead. Lead is a notoroulsy hazadouse matterials to work with so using the correct PPE is crucial. A face shield to protect the eyes and face, leather gloves to protect the hand when using tools that produce a naked flame and to prevet cuts and abbrasions when using sharp tools and power tools. Eqaully important is a respirator with a minium P-100 rating to prevent in inhilation of dust and fumes

Powered tools required in repair of lead statuary include and angle grinder with grinding and cutting disks and a TIG welder for welding together the sections of armature.

This photo shows the prepped lead joint, with the edges of the plates being cleaned back using a scraper to remove any oxidation before lead burning/welding. This step is crucial in ensuring a strong and consistent weld, as it removes impurities that could affect the integrity of the join.

These are the weld rods prepared by Keir prior to welding. They are cut from lead sheet, and all surfaces are scraped back to reveal clean, untarnished metal. As Rupert explained, it is crucial to make your own weld rods in this way rather than using store-bought lead solder. Store-bought solder often contains additives that prevent the metal from naturally patinating like the surrounding leadwork, which would result in a visually distracting repair.

Here you can see the finished lead-burning weld joining the two plates.

This practice attempt at lead burning/welding, under Rupert's guidance, was the first time Keir had worked with lead in this way. It served as the foundation for his leadwork treatments, teaching him not only the essential techniques but also providing the confidence to apply these skills to heritage items.

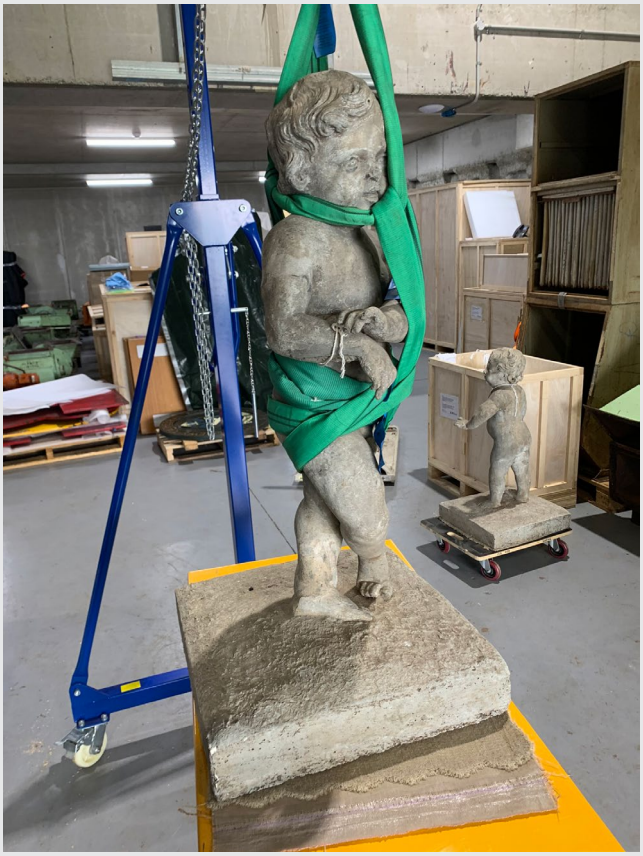
Repairing a pair of lead baby statues

The following selection of images showcases a treatment on a set of lead babies that Keir undertook upon his return to Australia, encapsulating everything he had set out to learn during the fellowship. Though unconfirmed, The owners of the pieces suspected the lead babies to have once been part of the collection at Hampton Court Palace, UK, before making their way to Australia in the very late 1800's. Keir showed pictures of the lead babies to Rupert Harris and from there characteristics he suspected that they could have been made by English sculptor John Cheere in the 1700's and cast at a foundry in London

Inspired by Jon Wallis, Keir began the work by using modern technology, specifically Ground Penetrating Radar (GPR), to ascertain whether any original lead bases were concealed within the concrete. This was done to avoid unnecessary damage during the removal process. No lead bases, or any other bases, were detected.

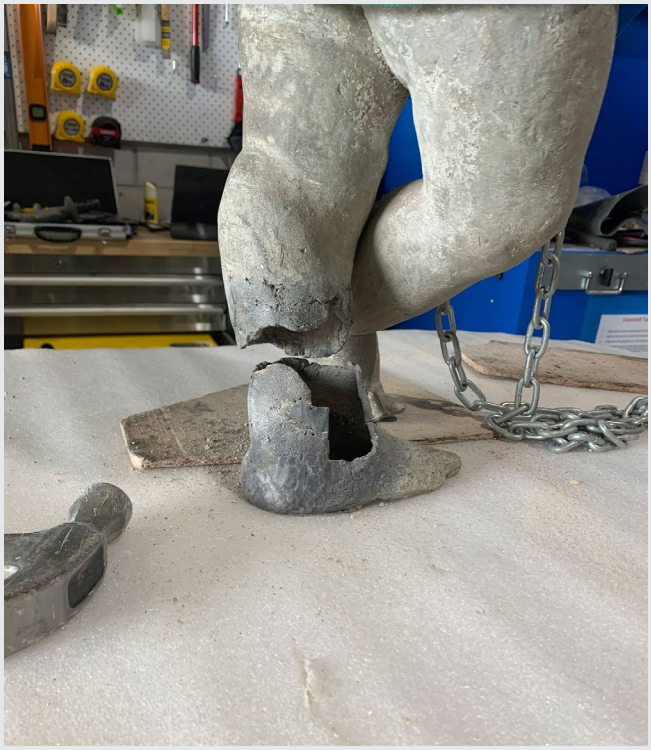
Following Rupert Harris' advice, Keir also checked for remnants of paint in crevices and other areas. He found a white paint substance inside the nostrils and ears. This was documented but not removed. After discussing with the clients, it was decided not to fully repaint the sculptures but instead retain their weathered and aged appearance, which was also Rupert's recommendation when he saw the photos of the pieces in the UK.

After completing the initial investigation, Keir proceeded with the treatment as outlined below.



This photo shows the lead children sculptures before treatment. Rupert Harris emphasised that lead work must be fully supported throughout the treatment process. In the image, you can see how Keir used slings to support the sculpture at multiple points. The sculpture had to be re-slung several times during the treatment to maintain proper stability and prevent any damage.

In this photo, you can see a concrete fill used to address a loss on one of the baby's ankles/legs. Rupert Harris had previously noted that concrete fills were commonly used in improper repairs on lead sculpture, and these pieces were no exception.



The concrete and threaded rod extended all the way up the leg, and Keir had to carefully removed it. This photo shows the area of loss in the leg, which had previously been filled with concrete and would now need to be fabricated.

While beginning to remove the sculpture from the concrete bases, Keir uncovered threaded rods that had been inserted into the leg for support and to anchor the sculpture to the concrete base. Thanks to the knowledge gained from Rupert, Keir was able to identify these as later additions, as the use of scrap or unsuitable materials for repairing lead sculpture had been a common practice in the past.

Here, Keir is cutting and fitting pieces of lead sheet to match the shape of the losses in the leadwork.

In this image, Keir holds the foot in place with additional lead sheet before cutting out the next section of loss.

In this image, the foot is fitted and welded to the main part of the sculpture, after carefully adjusting and shaping it with hammers to ensure correct alignment.

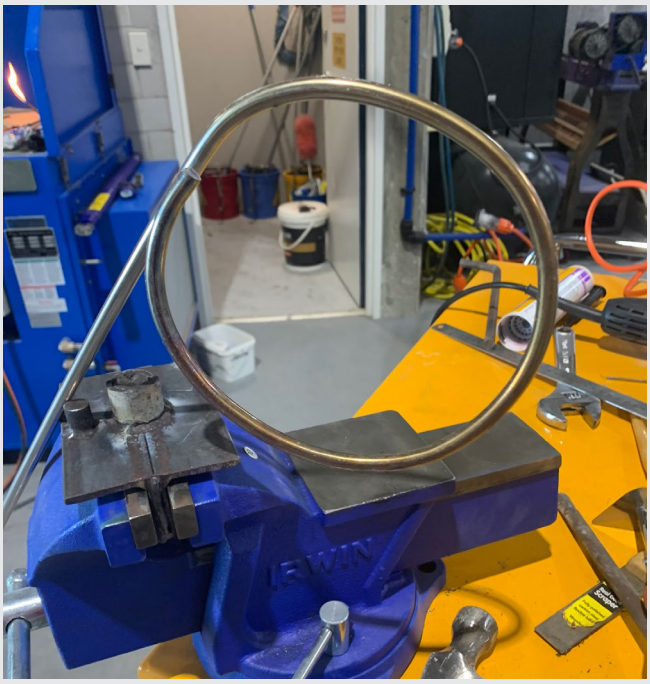
In this image, you can see the foot with the fills completed.

Keir then had to cut a large window into the back of the sculpture to remove the original casting investment, allowing for the installation of a new stainless-steel armature. This was a significant step, and Keir would not have felt comfortable undertaking such a drastic intervention without first consulting Rupert Harris, who provided valuable guidance. Rupert's advice was crucial in reassuring Keir that such measures were sometimes necessary in lead sculpture repairs.

More damage was found on the arms, which Keir confidently identified as original seams or joins, thanks to the guidance from Rupert. The crack had been covered with an epoxy resin substance, which Rupert had previously mentioned as a common material used in improper lead repairs. This further reinforced Keir's understanding of past, less appropriate repair methods.

This image shows a flattened arm, likely caused by an impact, which required significant reshaping to restore its original form.

The reshaping of the arm required more drastic intervention, involving cutting a slit and creating a hole to allow Keir to use tools to pull the arm back into its correct shape.



This photo shows Keir bending and shaping one of many rings that would be used to form the armature, providing internal support to the sculpture, using design principles learned from Rupert.

In this image, you can see the armature partially installed inside one of the sculptures. As advised by Rupert, Keir has ensured that the armature makes as many contact points as possible with the lead walls to distribute the load evenly, preventing future point-loading and potential damage to the sculpture.

This image shows the formation of one of the main structural bars, which extends from beneath the base of the foot up into the body of the sculpture for added support.

Here you can see the final part of the armature that supports the bottom of the foot. This image demonstrates the extensive work involved in ensuring the sculpture is fully supported, with as many contact points as possible, to provide structural integrity and prevent further damage in the future.

After the armature is installed, the cut-out windows are carefully repositioned and tacked back into place, securing them to the sculpture. This ensures the structural integrity is maintained while allowing the leadwork to be reformed and properly supported.

The windows, along with all other repairs, are fully rejoined using lead burning. This photo highlights the significant improvement in Keir's technique since his initial practice with lead burning in the UK, showcasing a much more refined and confident approach to the repair process.

After all the pieces and damages had been repaired and rejoined using lead welding, Keir chased and finished the weld repairs with hand tools, scrapers, and files to match the original form and texture of the sculpture. This step ensured the repairs were seamlessly integrated, maintaining the aesthetic continuity of the work.

This photo shows the ankle with large losses, before and after the metalwork repairs had been completed. The area that once had significant damage has been carefully rebuilt using lead sheet, welded, and reshaped to restore the integrity of the sculpture.

After inpainting over the repair areas with mineral silicate paint, the same paint system Rupert used on Southampton's Bargate Lions.

After inpainting one of the damaged arms, the repair area is barely distinguishable from the original sculpture.

The two finished sculptures of the babies, now standing side by side on custom-fabricated stainless steel bases, showcase the completed treatment. These bases were specifically chosen for their non-intrusive, contemporary design, which makes no pretence of being part of the original sculpture. This approach adheres to the conservation code of ethics, ensuring that the new elements are clearly distinguishable from the historical work, preserving the integrity of the original sculpture while providing a functional and visually respectful display mechanism. Keir felt it important to include this project in some detail within this report as it encapsulated everything he had set out to learn as part of the fellowship. It demonstrates him applying the most valuable technical skills and ethical decision-making knowledge acquired from the industry experts in the UK. This project is considered a great success by Keir, the owners and custodians of the sculptures, as well as by his colleagues and peers in the Australian conservation sector. It would not have been possible without the support of the George Alexander Foundation and the ISSI.

As highlighted, the skills Keir learnt in leadworking from Rupert Harris were invaluable, providing him with the expertise required to successfully undertake the repairs. Additionally, the ethical decision-making guidance from tutors at West Dean and other industry professionals played a critical role in shaping the approach to the project, ensuring that the conservation interventions were both appropriate and respectful of the sculptures' historical significance.

05

Personal, professional and sectoral Impact

There has been a lengthy period of time between Keir undertaking the international learning aspect of the fellowship and completing this report due to unforeseen circumstances. Due to this though, Keir is happy to report that he has already seen many positive impacts personally, professionally creating in turn to positive impact to the Conservation sector in Australia which have all been directly influenced by undertaking this fellowship.

In the 12 months or so since retuning, some of the personal impacts from undertaking this fellowship include; Keir has been promoted principal conservator metals at ICS, the most senor conservator role that can be achieved in the company, which is also the largest privatised conservation company in Australia. Keir also believes that he is now potentially the leading expert in the physical repair of sculpture within Australia's conservation sector. This belief is supported by peers and is being actively promoted by both Keir and his employers at ICS through newsletters, client presentations, and conferences. These efforts are aimed at raising awareness within related industries, including construction, architecture, public bodies, councils, museums, and galleries, about the availability of these specialised skills in Australia.

One of the institutional bodies that Keir and ICS have brought awareness of the availability of these skills to is the NSW National Trust. A good example of this is the Repton House National Trust property in Bowral NSW which by Australian standards has a significant collection of lead sculpture that has never had anyone with the correct skill set and expertise to work on. Repton House with the National Trust NSW is currently seeking funding to undertake treatments on some of its lead sculptures, Keir recently undertook a conditional assessment on. Keir has also very recently been approached by the MCA Gallery, Sydney to undertake conservation repairs on more contemporary lead and mixed media sculpture due to his experience working with lead.

Perhaps the most important personal outcome of undertaking this fellowship has been the confidence Keir has gained. He now has the confidence to undertake complex treatments in Australia, knowing he can still reach out to leading UK experts for advice and guidance. Keir's ever-growing confidence is leading to more willingness to undertake bigger, more complex and challenging treatments in Australia for which this fellowship was a crucial building block. He is also able to pass on this confidence to others working in conservation and related fields, so that more can be achieved in preserving and repairing Australia's metal sculptures and heritage objects for the future.

Keir, with the assistance of his peers and colleagues hopes to write a report specifically explaining in detail about the conservation repair of the lead baby statues mentioned in this report and have it published through the ACCIM. Keir and his employers ICS also

hope to run training sessions with National Trust NSW volunteers to help them better understand the maintenance and care required for metal sculpture (amongst other mediums) in their collection. As a direct result of undertaking this fellowship Keir will be able to explain with firsthand experience of what will need to be done if sculpture aren't maintained and cared for properly.

06

Recommendations and Considerations

The knowledge and skills gained from this fellowship have already been put into practice numerous times since Keir's return to Australia. Without undertaking this fellowship and acquiring the necessary expertise—particularly in the repair of lead sculpture—such treatments would not have been possible. The innovative nature of these treatments has generated significant interest in the Australian conservation sector, with several projects featured in AAICM and ICS newsletters and bulletins. As mentioned before Keir hopes to expand this sharing of knowledge by writing an article for the AAICM, detailing the repair of the lead children sculptures. He plans to feature Rupert Harris in the article, as Rupert provided, not only the skills to undertake the treatment but he also provided valuable insight into the likely artist behind the sculptures, when Keir showed him images during his time in the UK. Keir also intends to acknowledge ISSI and the George Alexander Foundation within the article, highlighting how such support and funding can help achieve significant outcomes in conservation. He hopes this will inspire others to seek similar opportunities.

The networking opportunities in the UK have been invaluable. As mentioned earlier, Keir has been invited to speak at the West Dean College course he attended, sharing his experiences with the treatments he has undertaken in Australia. He plans to pursue this invitation when an appropriate opportunity arises, facilitating further networking and knowledge exchange between the UK and Australian conservation sectors.

When Keir suggested, experts such as Geoffrey Wallis and Rupert Harris did show interest in visiting Australia and presenting the information shared with Keir to local peers. If this could be arranged, it would be an excellent opportunity to involve other prominent figures in Australian conservation, such as Nicola Ashurst, who has previously worked with both Rupert and Geoffrey in the UK, as well as specialists like Julian Bickersteth (ICS CEO) and Claire Rowson and other colleagues at ICS. Keir would likely need support from ICS, AACIM, and ISSI to help facilitate and promote this knowledge exchange to ensure the highest treatment standards worldwide.

07
Conclusion

In conclusion, Keir's journey through the George Alexander Foundation fellowship with ISSI has had a lasting impact on both his personal development and the broader conservation landscape in Australia. Building on his practical foundation in metalworking and fine art production, Keir planned to undertake this fellowship with a clear goal to address the gaps in Australia's capabilities, particularly in the conservation repair of metal sculptures and heritage objects. The skills and knowledge gained during the fellowship have empowered Keir to undertake complex treatments for structural and aesthetic restoration, especially in the repair of lead sculptures and statuary, areas where Australia previously lacked expertise.

Keir's learnings have already yielded tangible results. As the Principal Conservator Metals at ICS, his recognition as a leading expert in sculpture conservation highlights the value of the fellowship in advancing his career. His contributions extend beyond personal achievement, as evidenced by his efforts to raise awareness through client presentations, collaborations with institutions such as the NSW National Trust. These efforts are making a significant impact on the conservation sector, ensuring that critical conservation work on sculptures and heritage objects is no longer neglected due to a lack of specialized skills.

Moreover, the fellowship provided Keir with the opportunity to engage with world-renowned experts in the UK, such as Rupert Harris and Geoffrey Wallis, who shared invaluable insights into the ethical considerations, technical challenges, and restoration techniques for metals used in sculptures and heritage architecture. These conversations, case studies and practical skills acquired ranging from the conservation repair of lead sculptures like the Equestrian Statue of King George to the repair of ironwork on monumental bridges, have shaped Keir's approach to performing reactive conservation treatments on metal sculpture and heritage objects in Australia. The knowledge gained regarding the causes of corrosion, the importance of understanding production methods, and the ethical decision-making processes behind treatment plans will be crucial in shaping the future of Australian conservation practices dealing with the repair of metal sculpture.

Additionally, Keir has gained confidence in making informed ethical decisions based on his interactions with UK experts, particularly when it comes to balancing aesthetics, structural integrity, health and safety, and conservation ethics. This newfound confidence, coupled with the technical expertise gained from the fellowship, will allow Keir to take on increasingly complex and challenging conservation projects in Australia. His ability to pass on this knowledge to colleagues, peers and trades people from related heritage fields will ensure that conservators and heritage trades people are equipped to handle these delicate conservation and restoration tasks.

In summary, this fellowship has not only propelled Keir's career and personal growth but is also having a growing impact on the Australian conservation sector, filling a crucial void in the skills required

for the conservation repair of metal sculptures and heritage objects. Through knowledge exchange with international experts, hands-on learning, and the application of advanced treatment techniques made possible by this fellowship, Keir is now positioned to significantly influence the future of the conservation and repair of metal sculpture, statuary, and heritage objects in Australia, helping to ensure that the country's cultural heritage is preserved with the highest level of expertise and care.

08
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Endnotes

i No 4 in references

ii No 4 in references

iii No 7 in references

iv No 6 in references

v No 2 in references

vi No 3 in references

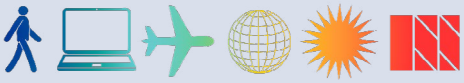
09 Appendices

Code of conservation ethics

1. **Respect for Authenticity:** Conservation efforts must respect the authenticity and integrity of objects and sites, preserving their original appearance, materials, and historical context.
2. **Minimal Intervention:** Conservators aim to use the least invasive methods to maintain and repair artifacts, ensuring that interventions are reversible and cause no harm.
3. **Documentation:** Thorough documentation of conservation work is essential to track changes over time, enabling future assessments and research.
4. **Transparency:** Conservation processes should be transparent and well-documented, allowing for peer review, collaboration, and informed decision-making.
5. **Cultural Sensitivity:** The cultural significance and values associated with artifacts must be acknowledged, and the heritage of all communities respected.
6. **Environmental Responsibility:** Conservation should consider the environmental impact of treatments, materials, and practices, aiming for sustainability.
7. **Education and Research:** Continued learning and research are fundamental to the field, as they enhance conservation methods and principles.
8. **Collaboration:** Multidisciplinary collaboration among conservators, scientists, art historians, and other experts is essential to ensure well-informed and effective conservation work.
9. **Public Engagement:** Encouraging public awareness and understanding of conservation efforts and cultural heritage is crucial for the long-term preservation of artifacts and sites.

- **Preventative conservation** – Avoiding and minimizing future deterioration or loss
- **Reactive conservation** – Repair after deterioration or damage occurrence
- **Conservation Treatments** - a hands-on, alterative (“interventive”) work performed in order to preserve and/or restore objects.
- **Intervention** - hands-on, alterative work performed to preserve and/or restore objects
- **Ferrous** - containing or consisting of iron
- **Non-ferrous** - metals or alloys that do not contain iron
- **PPE** – (abbreviation) Personal Protective Equipment

- **Inpainting** - A conservation process in art restoration where damaged, deteriorated, or missing parts of an artwork are filled in to present a complete image.
- **Conservation** - preservation and repair of archaeological, historical, and cultural sites and artefacts
- **Dilapidation** - the state or process of falling into decay or being in disrepair



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