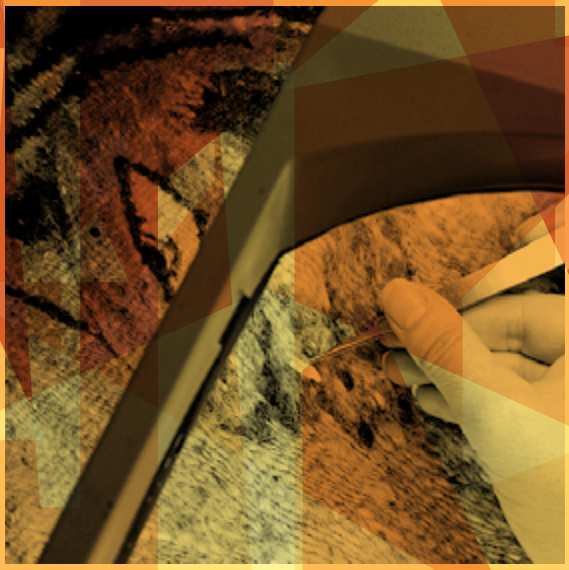
Tangible Heritage Conservation:

Three years of success towards changing the context of African conservation

Edited by Salomé le Roux



SCHOOL OF THE ARTS
UNIVERSITY OF PRETORIA
FACULTY OF HUMANITIES

UNIVERSITEIT VAN PRETORIA
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ESI
EMERGING SCHOLARS INITIATIVE

ESI Press

University of Pretoria, Lynwood Avenue, Hatfield, Pretoria, South Africa
https://www.up.ac.za/faculty-of-humanities

Cover design: Stephen Symons
Typography & design: Stephen Symons

All photographs used in this manuscript were taken by contributers of the book

First published by ESI Press 2022
ISBN: 978-0-6397-1530-8 (print)(Print)
ISBN: 978-0-6397-1531-5 (E-book/digital)

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Alexio Motsi, Mabafokeng Hoeane and Salomé le Roux discussing a paper conservation document.
Photograph by Isabelle McGinn

Daniéle Knoetze and Laura Esser working on ceramic objects. Photograph by Isabelle McGinn

Carmen Joubert, Nancy Collett and Jabu Ntuli working on a textile object. Photograph by Isabelle McGinn

Johanna Nghishiko and Chelsea Roberts working on a tapestry. Photograph by Rozelle Greyling

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Foreword

Professor Alexander Johnson
(Head of the School of the Arts, and Chair of Music)

The MSocSci (Tangible Heritage Conservation) was launched in 2018 when the UP School of the Arts was formed. The programme had its first intake in 2019, with the three students graduating in 2020. In 2021 the second intake of five students graduated (four with honours). The programme rapidly grew to nine students in 2021 and eight in the 2022 intake.

The reason for starting this 'first of its kind' programme at the University of Pretoria is the dire lack of conservators in South Africa and across the continent. Most local conservators were trained in Europe or did apprenticeships under European-trained conservators. Consequently, there is a severe lack of young conservation professionals with formal training in the newer technologies and ethical viewpoints. In Africa, people come to the conservation profession via vastly different pathways than in the rest of the world. They usually migrate from archaeology, museum studies, and cultural heritage management programmes.

Everybody in the programme is acutely aware of issues such as repatriation, access and co-curation. In Africa, we want to be prepared to play our role in this process, but for this, we need skilled people and an educational incubator to help build centres of excellence across Africa and to accelerate training and skills. We hope to fulfil this role not just by preparing students with an interdisciplinary and holistic approach to conservation but also by using past students to create centres of excellence across southern Africa to continue the work through short courses and training programmes in local museums and as caretakers of heritage objects.

Professor Vasu Reddy
(Dean of the Faculty of Humanities)

The more you know of your history, the more liberated you are — Maya Angelou

Our rich and varied cultural heritage has a profound power to help build our nation—Nelson Mandela

The development of the MSocSci (Tangible Heritage Conservation) (THC) programme commenced in 2016 with a Mellon Foundation pilot grant, which enabled wide consultation and investigation that led to the development of this pioneering degree in sub-Saharan Africa.

Diverse forms of moveable and immoveable material culture offer visceral, social, and psychological links between the past, present, and future as heritage is innately linked to identity and the knowledge of self. It is increasingly becoming clear that preconceived ideas about the past are one of the conditions of the heritage and conservation method: always the subject of discussion and debate. It is also clear that conservation naturally lends itself to bigger and deeper questions of interdisciplinarity and transdisciplinarity—in the commitment to the service of the social sciences, the broader sciences and the humanities. Our societies are constantly looking at the 'messiness' of our past and to narratives of origin to understand, interpret, contest and better make sense of the political conditions in the present.

Our programme has prepared students to take up leading roles as professional conservators and conservation managers in museums, libraries, archives, and other sites that care for cultural heritage. This is a programme that brings into collaboration and conversation the shared worlds and 'two cultures' of art and science. Can the divide ever be breached? It's a common misconception that art and science are vastly different and never overlap. But creativity is as essential to the scientific process as it is to the artistic method. Artists and scientists share a curiosity for the unknown, an appreciation for the beauty of the worlds they explore and an interest in creating something new. Conservators play a central mediating and bridging role in showing the linkages between theory and praxis.

We made a conscious decision to develop a postgraduate programme and not an undergraduate one as heritage conservation is still largely an unrecognised profession in the southern African context. The most urgent need was to develop student skills and competencies to a level where graduates could be appointed to decision-making positions in the heritage sector and provide the advocacy to design, create and curate future restorative conservation interventions. Perhaps this is an opportune moment to consider the prospect of an undergraduate programme in tangible heritage conservation.

Our programme is also unique compared to similar iterations in the European and American contexts in that it primarily focuses on a holistic conservation approach—encompassing, for example, ethics and the purpose of preventative conservation—underpinned by the material science of the different objects.

In 2018, the School of the Arts was formed (encompassing music, visual and performance arts, art therapies and museum studies in one creative hub). The MSocSci (THC) programme was launched in 2019, located within this school and in collaboration with the Javett-UP Art Centre.

In 2021, the first three students graduated, with a further five students graduating in 2022. The nine students of the 2021 intake are busy with their dissertations, and the eight students of the 2022 intake are currently immersed in their coursework. The conservation of South Africa's THC resources is vitally important for the transmission of ideas, knowledge, and values in pursuit of the education of a new generation of cultural custodians. It is thus clear that the programme is growing, and with more local and international collaborations, the impact of our programme and our students will reach far and wide.

Professor Norman Duncan
(Vice-Principal: Academic)

The MSocSci (Tangible Heritage Conservation) (THC) programme is not simply fulfilling the University of Pretoria's strategic goal of fostering and sustaining a transformed, inclusive, and equitable university community with students of all races, sexes and age groups represented, but also contributes towards the Sustainable Development Goals.

Apart from the academic offering, students regularly participate in community engagement. For example, after the UCT Jagger Library Reading Room fire in 2021, Isabelle McGinn, a lecturer in THC, and three students immediately departed for Cape Town, joined by a fourth student who was doing his internship at the Iziko Maritime Archaeology Unit. Due to their skill set, they could immediately join the triage tent, helping to sort salvaged material as it came in. Two of the students were invited back at the beginning of 2022 to assist with the start of the restorative conservation under the auspices of the visiting German conservator, Tina Löhr. Subsequently, UCT offered one of our graduates, Daniéle Knoetze, a position on the project.

At the end of 2020, a year in which the students had very limited hands-on exposure due to COVID-19 restrictions, Jordan Saltzman from the Johannesburg Holocaust and Genocide Centre (JHGC) reached out to Isabelle McGinn as she unexpectedly received funding for a limited period to start cataloguing, photographing, and digitising their archival collection. Eight THC students used the opportunity to work at the JHGC, assisting with the practical work of sorting, cataloguing, documenting, and repacking the archival material. The experience turned out to be an excellent case study of collaboration and mutually beneficial partnership.

The programme's international relationships are also expanding. Apart from the continued support from Yale's Institute for the Preservation of Cultural Heritage, the Netherlands Institute for Conservation Art and Science also recently enabled an exchange, which entailed a visiting textile conservator teaching students, followed by an immersive visit to various South African museums as

part of their Mellon-funded project, An International Research Infrastructure for Heritage Science.

The long-awaited Fulbright scholarship that Prof Maxi Schoeman received in 2019 is also finally coming to fruition this year, with Prof Jean Dommermuth of New York University teaching polychrome conservation in August.

All of these initiatives are helping to grow the programme into a unifying structure, bringing together people and resources from across the globe to elevate the standing of cultural heritage in society, as no society can move forward effectively if it does not recognise where it comes from.

Chapter One

Introduction

Salomé le Roux and Isabelle McGinn

Tangible Heritage Conservation (THC) is a new programme at the School of the Arts, Faculty of Humanities at the University of Pretoria (UP) and the first such programme offered at a university in sub-Saharan Africa. The programme, inaugurated in 2019, had been in development since 2015. It is a two-year, full-time, lectured master's programme with core and specialisation modules in the first year and internships and a mini-dissertation in the second year. The primary motivating factor for this degree was and is the safeguarding of South Africa's and the continent's heritage as expressed in the African Union's 'Agenda 2063: The Africa We Want' (African Union 2015: 7–8) as well as a [South African] national imperative in the National Development Plan and Vision 2030 (National Development Plan 2013)' (McGinn 2017: 40). However, the development of this new programme is the culmination of many years of developments which converged at the proverbial 'right place at the right time'.

By 2015, the University of Pretoria was one of three institutions in South Africa to offer a qualification in museum studies—a postgraduate diploma since 1976 and an honours in museum studies since 2004 (UP Archives, MKD timeline). In addition, like many institutions of higher learning, the University of Pretoria has, over its 100-year existence, collected some 80 collections through purchase, donations, bequests, or while carrying out research, teaching and training across a range of academic subjects such as medicine, natural history, archaeology, art, history and cultural history, and architecture to name a few (De Kamper 2018: 4). By 1922, the University's first dedicated museum space showcasing a few artworks and sculptures was opened to the public on the University's main campus, and in 1937, a gallery was opened on the upper floor of the Old Merensky Building, which today houses the UP sculptural collections. By 1999, the University recognised the need to exhibit the Mapungubwe Gold Collection, but the collection was fragile and required conservation. As there was little to no expertise available in the country, the Department of Metals Conservation at the British Museum in London was tasked with stabilising and restoring Mapungubwe's crown jewels, namely the gold sceptre, bowl and rhino figurine, to allow them to

be placed safely on exhibit to the public (McGinn & Tiley-Nel 2018: 8).

By 2004, a dedicated conservation space was created in the Old Arts Building to address the dire need for preventive and remedial conservation of the University collections (Barrier 2008: 18), and four years later, Isabelle McGinn, a specialist in ceramics conservation, became the University of Pretoria Museums' first in-house conservator. From that point, conservation became a full-time activity at the museums; workshops were held, and preventive conservation was integrated into the museum studies programmes at the University. In addition, the University had been considering establishing an additional art centre as a public-private partnership. Discussions surrounding the funding and building of this new art centre, which was to become the Javett-UP Art Centre, led members of the University executive committee to tour a number of institutions in the United States, facilitated by the Andrew W. Mellon Foundation.

The Andrew W. Mellon Foundation is at the origin of numerous endeavours to develop, advance, and transform heritage conservation worldwide (McGinn 2021: 181). These institutions highlighted the strategic value and importance of having in-house facilities to manage, maintain and conserve collections, and the University, in turn, saw the potential to create a unique centre of excellence, as no academic conservation training was available in South Africa (McGinn 2021: 182). In general, heritage conservation is globally dedicated to ensuring the ongoing survival of cultural objects and traditions—whether these objects are classified as fine art, functional objects, oral traditions or literature within the contexts of art, antiquity, archaeology, the built environment, the land and the marine environment. All of these objects and contexts inform our local and global diversity, which are entangled to make us human (Reddy in Panyane Sa). Thus, all the support structures for a proposal that the University implement teaching and training in conservation were already in place (McGinn 2021: 179).

In 2015, the Andrew W. Mellon Foundation initiated a brief survey questionnaire, which resulted in the institution of an art conservation workshop. The questionnaire was aimed at 'South African national, regional, private and public institutions involved in heritage education, curation and conservation. Respondents included curators, conservators, administrators and academics from 16 institutions' (McGinn 2017: 35–36). After responses from the questionnaire were reviewed, it was found that a workshop at UP would be required to further investigate four key issues: 'Is there a need and potential for university-based training in conservation in South Africa? What components should such

a programme have and what competencies would it foster? Who could plan, launch, test and develop such a programme? And finally, should alternatives to a formal academic programme be considered in the meantime, or in addition to formal academic training?' (Westermann in McGinn 2017: 36).

Isabelle McGinn (2017: 36), lecturer and conservator in Tangible Heritage Conservation, noted that after the workshop, there was

> an agreement that the provision of postgraduate training and education for conservators by universities and related partner institutions could constitute one of the key mechanisms to promote the conservation of cultural heritage. It was decided that South Africa could benefit from the development of a master's degree programme in the theory and practice of conservation. The envisioned academic programme would serve to build the research capacity of a new generation of conservators and applied research on materials research, collections-based research, and documentation of such ongoing research; thereby contributing toward diversifying the demographics in the current conservation profession.

After the survey questionnaire and successful art conservation workshop, UP received a multi-disciplinary grant from the Andrew W. Mellon Foundation to develop and plan the Tangible Heritage Conservation curriculum. Thus, between 2015 and the inaugural year 2019, McGinn and UP initiated a diverse and representative series of conversations and consultations with stakeholders in the South African heritage sector (McGinn 2017: 36). The outcomes of these collaborations echoed the difficulties observed during the art conservation workshop, which included: 'diminishing subsidies, freezing of posts, ageing infrastructure, overcrowding of repositories, a lack of dedicated budgets for conservation, a misunderstanding of the role and purpose of conservation, scant expertise and research, a non-existent publication record on local content, conservation practitioners close to retirement, poor succession planning, and a lack of local training opportunities' (McGinn 2017: 37).

Some of these issues are briefly addressed in local short courses, workshops (which are generally centred around a single material type, such as paper or

books), and postgraduate diplomas—these usually include short and inadequate introductions to conservation principles and considerations. However, they do not aid continuous professional development or teach conservation advocating skills to create awareness of the little-known field of heritage conservation in South Africa (McGinn 2017: 38).

Thus, Tangible Heritage Conservation was aimed at addressing the following issues recognised by McGinn and UP:

> The current state of conservation in South Africa can thus be ascribed to a general misunderstanding at management level that collections form the core of a museum's *raison d'être*, and that preserving the collections ensures the survival of the museum and minimises the need for future costly restoration on the one hand, and on the other hand to limited skills and expertise in conservation. These challenges can be attributed to insufficient exposure to preventive conservation as part of general museological training, a lack of professionally trained conservators in the sector, and no academic qualifications in the field of conservation. What is required then, in both instances, are academically trained professionals, interventive conservators, conservation managers and collection managers who can advocate for heritage preservation and conservation.

The identified issues would be addressed by training and educating graduates to fill leading roles as professional conservators, conservation managers, conservation scientists, and collections care managers in the sub-Saharan museum and heritage management environment. The specialist skills acquired from a master's degree in Tangible Heritage Conservation would allow graduates to 'identify risks to collections, stabilise a variety of materials and attend to remedial treatments' (McGinn 2017: 41). The programme curriculum equips students with analytical skills such as materials analysis, understanding degradation processes of heritage 'objects' and materials, and understanding how to mitigate these risks through preventive conservation.

Although the name of the programme, Tangible Heritage Conservation, refers to cultural objects that are concrete and tactile, it is impossible to disentangle

these objects from the intangible heritage to which they are linked. The intangible is felt, experienced, remembered, heard or lived. McGinn (2017: 39) notes that 'cultural heritage resources are a material link between past, present and future, and are central to the shaping of identity, the exploration of accepted and counter-narratives, and they find a use in the pedagogic sphere and transmission of knowledge, ideas, thereby shaping and aiding in the transformation of South African society.'

Now, more than ever, it is imperative to preserve and safeguard Africa's rich and diverse cultural heritage as this heritage is constantly threatened by detrimental factors such as urbanisation, vandalism, poor handling practices, accidental damage, neglect, climatic influences, and natural ageing processes. The survival of this heritage depends on the availability of educated and trained conservation professionals. The programme builds the requisite skills and expertise to protect, restore, repair, conserve and preserve this heritage, to build conservation capacity in our museums, libraries, archives, and other cultural entities, and to contribute to building and protecting our heritage, no matter how contested it might be (Reddy in Panyane Sa). The programme equips prospective students with specialised knowledge and skills in the arts, sciences and cognate fields, including analytical skills such as materials analysis, understanding degradation processes of heritage 'objects' and materials, and understanding how to mitigate these risks through preventive conservation. In addition, students learn basic concepts in interventive treatment to stabilise the structure, reintegrate the appearance of deteriorated cultural material and adapt to environmental conditions to prolong their life. The overall aim of the programme is to equip students with sufficient knowledge and understanding to take up leading roles and advocate for the importance of heritage preservation in South Africa and the continent (McGinn in Panyane Sa).

In this publication, the first three years of the master's programme in Tangible Heritage Conservation are explored through three annual reports (initially compiled by Maggi Loubser, course coordinator and senior lecturer appointed in 2019), student perspectives, curriculum layouts, student assignments, and photographic visuals. This unconventional format was chosen to highlight the experiences of individuals. The second chapter is the first three years' update reports that include various aspects of each year's start, progress, difficulties, successes and tidbits. These reports were written by Maggi Loubser to Professors

Johnson, Reddy and Duncan. They represent insight from Loubser, who constantly and meticulously fought for this programme's place at UP.

Chapter Three is devoted to two student perspectives written by Laura Esser and Daniele Knoetze, from the 2020 intake, who were severely affected by the COVID-19 pandemic. Their first year's perspective discusses their experiences in each module. Chapter Four is a breakdown of the various modules and how they are assessed during the two years of study. The module content, outcomes and purpose are from the THC study guide written with care by McGinn and handed out to each student at the start of the degree. Chapter Five is the contents of discovery kits that were meticulously compiled by McGinn and Loubser for the 2020 students when COVID-19 level 5 lockdown was implemented in South Africa. Students had to complete various at-home assignments based on the different material types and identification equipment in their respective kits. The discovery kits were a huge success and were again distributed for the 2021 and 2022 intakes of students. They are now a core aspect of the THC 804 module.

Chapter Six is a list of previous students' dissertation titles and abstracts. It also includes 2022 students' titles, but at the time of writing this book, their research was not yet complete, so their abstracts are not included. The dissertations of graduates are available at the UP Repository on the University's library website. Chapter Seven is a compilation of former students' assignments. The assignments were included as they were submitted in order to show the diverse types and formats of assignments. Students truly have the opportunity to express their thoughts and understandings through multiple formats of assignments. The conclusion, Chapter Eight, is a short summary of the content and brings together individuals' experiences as understood throughout the book.

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Chapter Two

Year Reports

Maggi Loubser and Salomé le Roux

The Inaugural Year

Introduction

On 4 February 2019, Isabelle McGinn's dreams and aspirations came to fruition. It was the first day of the inaugural year of the MSocSci (Tangible Heritage Conservation) programme (THC), a degree that she had been researching, developing and compiling for three years in the Faculty of Humanities at the University of Pretoria (UP). Along with the newly appointed Maggi Loubser, course coordinator, McGinn, lecturer and conservator, welcomed three students: Emila Zambri (a paper conservator with an honours degree in fine arts), Mabafokeng Hoeane (honours in history), and Salome le Roux (master's in visual studies).

As programme coordinator, appointed after the course programme design process was initiated, Loubser was pre-appointed to be involved in the design of the science module without much insight into the programme as a whole. In retrospect, Loubser should have been appointed as coordinator at least six months prior to the initiation of the programme in order to get to grips with the logistics and organisational aspects before teaching started. But she bought into the dream and was determined to hit the ground running and make the programme a success. Loubser's involvement in conservation science grew over about five years before she became involved with the University. She was a trainer and instructor in analytical chemistry, her specialty, to conservators in the USA and Europe. From this exposure, Loubser realised that South Africa was lacking in this area compared to the institutions abroad. Little did she know, all those years ago, that McGinn from UP was brainstorming a programme that would be the first of its kind in southern Africa.

With the Mellon Foundation's gracious funding of the programme, the dream was developed into a programme, or hub of established knowledge, relevant to our continent and open to the possibility of becoming the leading education platform and research base for local solutions to the protection of invaluable

cultural and artistic heritage. This growth would allow African institutions to have the relevant skills and capabilities to welcome home cultural heritage objects removed from Africa during colonialism. These skills and capabilities are not taught at other institutions or universities but were previously transferred to a generation via internships in Europe, a continent that has advanced in its conservation approaches and surpassed the handful of practising restorers and conservators in South Africa. In addition, skills were affected once South Africa became a democracy and budgets were redistributed between museums and galleries, causing conservation to be put on the back burner. There is thus a serious lack of training opportunities for both practising and prospective conservators and no centre to serve as a hub for research and development.

The curriculum

However, this programme is changing the outlook of cultural heritage conservation. The three students began the first semester with formal lectures and practical exercises, re-enforcing the theory taught. In each module, students were given at least one large assignment as well as smaller continuous assessment exercises. During the first semester, four modules were presented. The first module was THC 801: Conservation Principles and Strategies, a review of the significance, value and use of cultural heritage, as well as the roles and responsibilities of its custodians within relevant professional, ethical and legislative frameworks. The students started this module by presenting their biographical objects. The lectures were presented by Isabelle McGinn and numerous guest lecturers from within and outside the University: Dr Rachel Baasch (Rhodes University), Dr Avi Sooful (UP, Fine Arts), Prof Lize Kriel (UP, Fine Arts), Dr Stefan Simon (then Inaugural Director of the Institute for the Preservation of Cultural Heritage at Yale—2015–2019), Dr Alexander Antonites (UP, Archaeology), Ms Dominique Niemand (UP, Museum and Heritage Studies), Prof Karen Harris (UP, History), and Mr Alexio Motsi (South African National Archive).

Next, THC 802: Science Fundamentals for Conservation was presented. It is an introductory chemistry module specifically tailored to enabling students with no previous science background to gain a greater insight into the chemical processes involved in the practices and techniques used in conservation. The module content focuses on major conservation issues, including material types, environment, cleaning and deterioration. Lectures were presented by Ms Maggi

Loubser (UP, THC), and a mineralogy lecture was presented by Ms Wiebke Grote (UP Geology).

Figure 2.1: Ms Wiebke Grote taught mineralogy to Mabafokeng Hoeane, Salomé le Roux and Emilia Zambri in THC's initial lecture room (photograph by Maggi Loubser)

THC 803: Research Theory and Methodology in Conservation is focused on the research involved in conservation and aspects of collections-based research, including documentation of artefacts, photography, the preparation of research projects, writing project proposals and academic writing for publication. The module was led by Loubser with the help of Dr Aniko Bezur from Yale's Institute for the Preservation of Cultural Heritage (IPCH). Dr Bezur and Loubser were already collaborating, and upon Loubser's appointment at UP, Dr Bezur offered Yale's services to the programme. Darren Alexander (Darren Alexander Photography) was co-opted to teach the students object photography, and Prof Patricia Forbes (UP, Chemistry) taught chromatographic techniques. The module's main assessment was a layout of their proposed research and dissertation focus. The purpose was for the students to keep their own interests in mind while learning about research theory and methodologies so that they could choose relevant theories and methods in advance. This module was also attended by a non-degree-purpose student, Loreley Cairns, an MSc (Chemistry) student working on a thesis entitled 'Fluorescence studies of binders used in paintings; aging and pigment effects', as well as Sandra Markgraaf, a paintings conservator at UP Museums and in private practice.

Figure 2.2: Salomé le Roux and Emilia Zambri looked at types of prints with a USB microscope and a light table (photograph by Isabelle McGinn)

THC 804: Materials, Mechanisms of Decay and Stabilisation of Artefacts explored the physical, mechanical and chemical properties of organic, inorganic
30 and synthetic-based materials. It consists of numerous sub-headings, covering all the different materials. Specialist guest lecturers from within and outside the University presented this component together with Isabelle McGinn and Maggi Loubser:

- Introduction to working with collections—Ms Isabelle McGinn
- Archaeological collections—Ms Isabelle McGinn
- An introduction to maritime archaeological collections—Jaco Boshoff (Iziko Museums of South Africa)
- Inorganics 1: Adobe, clay & low-fired ceramics—Ms Isabelle McGinn and Mr Gerard de Kamper
- Inorganics 2: Porcelain & glass—Ms Isabelle McGinn and Mr Gerard de Kamper
- Inorganics 3: Plaster, gesso & lime—Ms Isabelle McGinn
- Inorganics 4: Stone—Ms Isabelle McGinn
- Inorganics 5: Metals—Ms Maggi Loubser and Dr Farahnaz Koleini
- Organics 1: Review of organic chemistry—Ms Nancy Child (Iziko)
- Organics 2: Introduction to hair, wool and natural textiles—Ms Talita Fourie (South African Post Office Museum)

- Organics 3: Horn, feathers & quills—Ms Nancy Child (Iziko)
- Organics 4: Epidermal products—Ms Nancy Child (Iziko)
- Organics 5: Structured products—Ms Nancy Child (Iziko)
- Organics 6: Wood—Ms Nancy Child (Iziko)
- Organics 7: Furniture
- Organics 8: Introduction to paper; history and manufacture—Ms Mary Minicka (Western Cape National Archive)
- Organics 9: Introduction to books, history & manufacture—Mr Alexio Motsi (National Archive)
- Organics 10: Introduction to photographic material—Janus Boshoff & Dennis da Silva (Alternative Print Workshop, Johannesburg)
- Polychrome topic: Introduction to composite objects, polychrome surfaces as composite objects, easel painting construction, special characteristics of polychrome surfaces, handling storage and exhibition of polychrome surfaces, determination of stability, surface cleaning—Ms Sandra Markgraaf (UP Museums)

THC 804's 'Organics 1: Review of organic chemistry' was also attended by Sandra Markgraaf, and THC 804's 'Organics 2: Introduction to hair, wool and natural textiles' was opened up to South African Museums Association members, and four attended: Hannelie du Plessis (curator at the Pretoria Art Museum), Ruth Makwela (collection officer at the South African Post Office Museum), Mmafa Moloisi (South Africa Post Office Museum and UP PGDip Museum Studies alumnus), and Inandi Maree (curator of the historical collection at the KwaZulu-Natal Museum).

Figure 2.3: Salomé le Roux surface cleaned a ceramic and velvet doll in THC 804 (photograph by Emilia Zambri)

The second semester was focused on a specialisation module, THC 806: Conservation: Paper-based and Archival Collections. Here, students are given the opportunity to apply the theory they were taught in the first six months on a specific topic, under the guidance of subject specialists. This module has the most hands-on conservation practice, where not just preventative but also restorative techniques are taught, and students are given the opportunity to work on real artefacts. The introductory principles of remedial conservation were explored within the chosen area of specialisation, including treatment options and evaluation, with final decision-making processes for appropriate treatment options for cleaning, stabilisation and conservation of artefacts. This module was also attended by Sandra Markgraaf, as well as Ria van der Merwe from UP Archives, who attended specific sections.

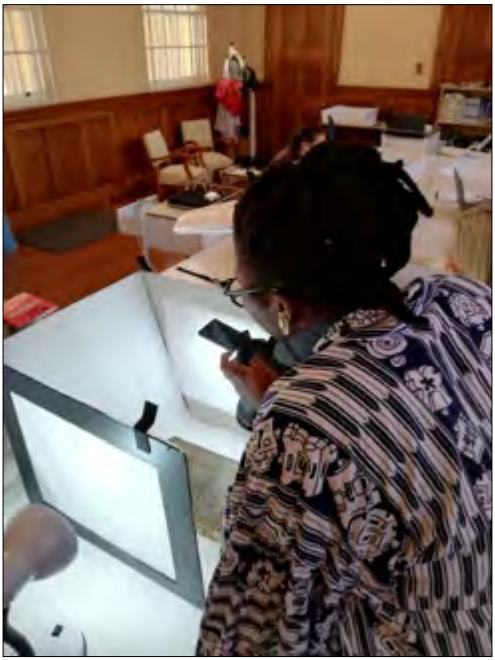

Figure 2.4: Mabafokeng Hoeane photograpeds a book for her condition report assignment in THC 806 (photograph by Isabelle McGinn).

The following topics were taught by Mr Alexio Motsi from the National Archive and Ms Mary Minicka from the Western Cape National Archive:

- History of books, manuscripts and paper in the African context
- Paper manufacture & identification
- Manufacture of marbled and decorative papers (Mr Alan Jeffrey, Brenthurst Library—retired)
- The development of the codex in Africa
- Islamic manuscript tradition in Africa
- European missionary activity
- Colonial administration and occupation (1662–1910)
- Types of paper & identification
- Deterioration & damage affecting paper
- Preventive conservation strategies for paper-based materials
- Investigative tools & techniques
- Testing paper for acidity, lignin, solubility
- Treatment planning & development
- Documentation of paper-based objects
- Dry surface cleaning treatments
- Humidification
- Washing
- De-acidification
- Stain reduction & removal
- Drying & flattening after aqueous treatment
- Pressure-sensitive tape removal
- Removal of auxiliary support
- Resizing after chemical treatment
- Tear mending
- Infilling of losses
- Retouching

The year ended with the outbreak of COVID-19 in China. Unaware of the enormous effect lockdowns would have on their second year, the students departed for their summer break before the commencement of their final year, in which they would complete their THC 805: Collections-based Practice (Internship) and THC 800: Mini-dissertation. The first year was challenging, to

say the least, but also exhilarating enough to energise all involved for the coming year. After the first year, Loubser and McGinn took stock and decided what worked and what needed tweaking for the next intake in February 2020. It was also time to seriously consider how this programme was going to be built into the flagship programme it had the potential to become.

Collaborations

The inaugural year was a success hugely due to collaborations with a wide range of individuals, who provided support in the form of teaching material, advice and moral support. The programme is especially grateful to Yale's IPCH, not just for making Aniko Bezur available for teaching part of the THC 803 module but also for their continuous support. McGinn was granted the opportunity to attend a workshop on photographic conservation in September 2019, and Markgraaf attended a symposium on conserving canvas at Yale in October 2019. IPCH committed to supporting and assisting in capacity development for THC in the form of assistance with curriculum development and teaching (in person and via digital lectures and demos), creation of a shared online repository of curriculum materials and literature (Google Drive), consultation on lab facility development (remote and in-person), and assistance and supervision of Yale postdoctoral associates in developing and supporting outreach components as part of their positions in South Africa. IPCH prepared and donated textile and fibre, plastics, as well as pigment reference material sets for THC. They are also assisting with analytical support on some of our ongoing research projects (the 'Rembrandt' in the UP Art Collection) and transferring knowledge in the process. Loubser was also negotiating the possibility of one of the students completing her internship for THC 805 with IPCH. Dr Aniko Bezur was subsequently appointed as a research associate in the Faculty of Humanities.

The programme, specifically Zambri along with Markgraaf and Johan Swart (Architecture), worked together with the Department of Architecture to come up with an archival solution for their drafts, plans and other materials. Zambri did a stellar job using her paper conservation skills to find a cost-effective solution for the architecture archives. Markgraaf was already involved in this collaboration and approached us to ask whether Zambri could assist because of her paper conservation background.

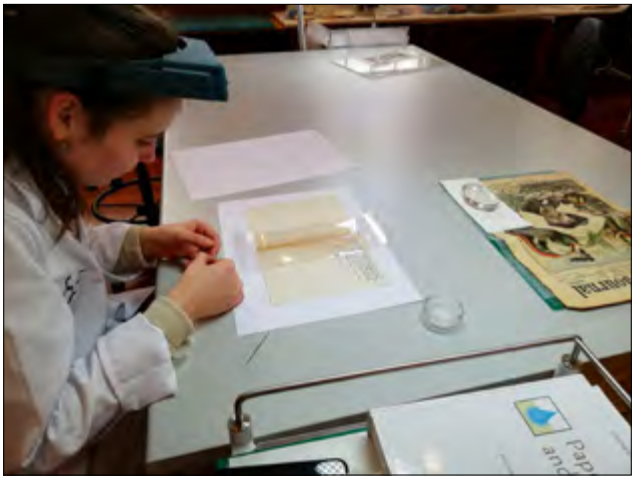

Figure 2.5: Emilia Zambri worked on an archival document, her paper conservation background, during THC 806 (photograph by Salomé le Roux)

The programme also collaborated with the UP Art Collection and UP Art archive to assist with the digitisation of reference material for research in the THC programme as part of the digital humanities drive. There was also an initiative to create a documentation app for local museums to standardise documentation in South Africa. This project did not come to fruition.

Javett-UP was founded as part of the University of Pretoria's research, teaching and learning resources. On their website, they state: 'The Javett-UP provides an exciting new space for learning about art: for research and for acquiring and sharing art conservation and restoration skills. It includes a conservation studio for practical work by students in sub-Saharan Africa's first master's degree in the conservation of tangible heritage (MSocSci) on offer at UP from 2019. The programme is funded by the Mellon Foundation.' THC would like to foster this collaboration and see it come to fruition. The programme is especially excited about a joint project to study and conserve the South African artist Alexis Preller's painting 'Discovery', which was acquired especially for the Javett-UP Art Centre and was installed with the idea to do an in-situ, public-view conservation project over the next few years, bringing subject specialists from all over the world and letting the THC students work under their supervision.

Two memoranda of understanding were entered into—one with Ditsong Museums of South Africa and one with UP Museums. These agreements give

access to collections, opening the way to using their specialists as guest lecturers and allowing students to do their internships under experienced mentors.

Challenges

For the course to be viable beyond the first year, the student intake had to be bigger in the second year. The interaction with possible students began early in the first year of the programme by engaging with the honours students from the departments of Visual Arts, Archaeology and Historical and Heritage Studies. Through Loreley Cairns, an MSc (Chemistry) student, awareness of the programme was also created at the Department of Chemistry.

The need for conservation training in southern Africa is immense. It is crucial to introduce some of the programme's modules as short courses that practising conservators and museum professionals can attend to enhance their skills or introduce advanced concepts and processes. The specialisation modules taught by invited guest lecturers lend themselves perfectly to this initiative. This would serve a dual purpose: (1) educating more locally based conservators and professionals and (2) generating much-needed third stream income.

As the programme is dependent on guest lecturers for most of the modules, the cost of running these modules is high. Over time, alumni and professional conservators from southern Africa can be included to teach prospective students. However, for these individuals to be able to build local knowledge and a research hub, the programme will require more equipment. The other expense that is consuming the programme funds is consumables. The conservation materials and consumables for the first year's paper conservation specialisation was around R100 000,00. Even though the equipment is a capital expense that will be available for the future, the consumables for each consecutive year's speciality will most likely be in the same range of R100 000,00. It is a good way of building a laboratory with the correct equipment and materials for a range of heritage objects, but the reality is that these running expenses will be mostly continuous.

During the first year, although the scarcity of conservation and museum facilities was known, there was a huge problem placing the students for their internship module. While most of the national museums were eager to accept the students, it would be unwise to place somebody in an environment where there would be no possibility of mentorship. For 2020, Zambri found an internship at a

building heritage conservator in Australia, Le Roux spent time with UP Museums (her bursary supplier) and would go to Yale's IPCH, while Hoeane was intended to intern at Ditsong Cultural Heritage Museum.

Third stream income

Even though students pay the programme fees, the real costs of presenting the course are much higher than for other courses in the faculty. It was evident that supplying the University's budget and finding alternative ways to fund the course once the Mellon Foundation grant came to an end would be crucial for the programme's survival.

The possibility of opening some of the THC 804 module, which deals with different materials and their characteristics, is an easy way to increase funds. However, there are also multiple additional benefits:

- The conservation profession will be enhanced.
- Mentors for internships will be created.
- Guest lecturers will be more accessible in South Africa.
- Trans-cultural knowledge and skills will be shared.
- Community outreach will be initiated.
- The short courses will serve as marketing opportunities for the programme.

Income can also be generated from service provision and contract research to the conservation and art market industries, provided the equipment is available in a laboratory. With the acquired XRF spectrometer and the limited imaging equipment, the programme has the tools to start building an African materials database and conducting provenance research in collaboration with UP Museums.

Guest lecturers

For the 2020 speciality module, THC 807: Conservation: Polychrome Surfaces, the programme was fortunate enough to be awarded a Fulbright Fellowship. In 2019, the position would have been filled by Prof Marincola, but she withdrew. Sandra Markgraaf (UP Museums), Maggi Loubser (THC) and Ekkehard Hans (private conservator) were preparing to cover the introductory parts of the

module and support the person who accepted the Fulbright Fellowship.

Figure 2.6: Emilia Zambri and Mabafokeng Hoeane had an introduction to polychrome mediums during THC 804 (photograph by Salomé le Roux)

The cost of guest lecturers will be one of the major expenses for the course annually. Currently, it is covered by a Mellon grant. Future funding for the programme needs to be considered as the current Mellon grant for honoraria and travel terminates at the end of 2021. As the programme does not have the skills to teach all the different modules in-house (and very few institutions in the world have all the skills), they were relying heavily on guest lecturers. This is an excellent opportunity to present students with the opportunity to learn from leaders in the field and give our programme exposure within South Africa and the rest of the world. Most of these guest lecturers have years of experience, and this gives them the opportunity to impart their knowledge to a new generation. It is beneficial to the students to hear from different voices and from different schools of thought to foster academic debate on important issues regarding conservation.

The programme would like to thank our guest presenters:

- Dr Rachel Baasch (Rhodes)
- Dr Avi Sooful (UP, Fine Arts)
- Prof Lize Kriel (UP, Fine Arts)
- Dr Stefan Simon (then Director of Yale's IPCH)
- Dr Alexander Antonites (UP, Archaeology)
- Ms Dominique Niemand (UP, Museum and Heritage Studies)
- Prof Karen Harris (UP, History)
- Mr Alexio Motsi (National Archive)
- Mr Janus Boshoff (Alternative Print Workshop)
- Mr Dennis da Silva (Alternative Print Workshop)
- Darren Alexander (Darren Alexander Photography)
- Alan Jeffrey (Brenthurst Library—retired)
- Mr Gerard de Kamper (UP Museums)
- Prof Patricia Forbes (UP, Chemistry)
- Dr Aniko Bezur (Yale's IPCH)
- Dr Farahnaz Koleini (private)
- Ms Nancy Child (Iziko)
- Ms Talita Fourie (South African Post Office Museum)
- Ms Mary Minicka (Western Cape National Archive)
- Mr Jaco Boshoff (Iziko Museums of South Africa)

The venues

THC was initially housed in room 1-8 of the Old Arts Building on UP's Hatfield Campus. The space was small and cramped, with Loubser and McGinn sharing the same desk in the room where lectures and demonstrations were held, next to temporary storage solutions for heritage objects. Lecturers had no privacy to coordinate and organise programme proceedings, and students did not have a space for self-study and assignment completion. The room also had no LAN, Internet, telephone lines or Wi-Fi signal. When the signal did make it through the thick walls, it was very weak, which influenced library access, web-based lectures, University intranet updates and information, and general research.

When we urgently needed laboratory space for THC 806, and neither the promised space in the Javett-UP nor the move to Van Wouw House had been

realised, Prof Karen Harris allowed the programme to use Old Arts 1-20, a UP Archives space. This was a temporary measure, and the students and lecturers made do with what was available, but because of the lack of laboratory equipment and the basics like running water, some of the teaching in THC 806 had to be limited to demonstrations.

The promised space in the Javett-UP was not realised because, due to inadequate planning on the architectural, construction and museum organisation side, the space was repurposed as a temporary storage and crating area. However, Van Wouw House turned out to be a satisfactory alternative that continues to welcome students and visitors. The programme was awarded the Van Wouw House in Clark Street, Brooklyn, by the end of October, but no equipment or cultural objects could safely be moved there yet as the building was not secure. The satellite campus also did not have AV facilities for lectures or any telephone or Internet connections. According to a UP contractor that was consulted by UP Facilities, the electricity infrastructure did not meet municipal specifications and needed to be upgraded. A proposal was written and submitted, and funds were awarded at the end of 2019. By February 2020, the money had not been transferred into the Facilities account yet, but Loubser, McGinn and other parties believed it would happen soon. Facilities submitted the necessary documentation to the municipality's heritage council and received permission to commence work on the heritage building.

Van Wouw House is a perfect home for the programme, although it is off-campus. It has space for a lecture room, a student work room, two laboratories (conservation lab and photography lab) and two offices. It also has an outside storage room, which was converted into a walk-in safe to accommodate artefacts and expensive equipment like cameras and microscopes. The photography lab needed a lot of work, from the basics of a coat of paint to figuring out a workable layout. The space was not big enough to accommodate large objects, but as a starting point, it worked. The programme already had a Canon D6 camera that was modified to capture IR and UV images, with one lens and five filters (visible light, UV, 700nm, 850nm and 1 000nm). There was also an objects table and basic colour-checking strips. The programme would need a high-performance computer, an easel for technical photography that can secure artworks and objects, and better light sources.

Despite the building providing adequate space for the students and lecturers, a conservation laboratory is not set up overnight. As there is nothing of the

kind in southern Africa, such a laboratory will be able to service museums and conservators across the entire region. It is crucial that the programme evaluate which equipment will give us the most flexibility and information for the least capital outlay, as well as the ability to train students on equipment that would be feasible for them to acquire and use in their final place of employment. Loubser and McGinn also had to be cognisant of the specific materials researchers would encounter most in Africa and prioritise accordingly.

The security at the venue had been an issue in the past, and even though a new alarm was installed, there was a burglary on South Africa's National Heritage Day 2020. Hopefully, our permanent presence will reduce the risk. The property is large, and as the programme grows, there might be the possibility of building a state-of-the-art conservation laboratory on the bottom terrace and keeping the house for lecturing and office space. This would overcome any issues with structural changes to the heritage building that may be necessary as the programme wants to implement more advanced conservation science techniques and equipment.

When the property was donated to the University by Anton Rupert, the understanding was that it would be used in a way that honours the memory of Anton van Wouw and advocates for the arts. Housing the Tangible Heritage Conservation programme in this building and having an investigation of Van Wouw sculptures as one of the key research areas is a perfect way to honour the memories of those involved. The house is being used as the envisioned hub of conservation knowledge of art and heritage objects.

Acquired equipment

The Mellon grant assisted in the acquisition of a Bruker Tracer5i X-ray fluorescence spectrometer. This is the basic tool used for the identification of the inorganic elemental composition of materials. Pigment chemical compositions in paintings can be identified and used in planning conservation treatments and understanding the materials used by a specific artist, eventually leading to attribution in concert with the provenance and history of an artwork. These instruments are routinely used to identify metals and corrosion products in sculptures and metallic objects and can identify toxins used in ethnographic collections.

Figure 2.7: Salomé le Roux analysed an Anton van Wouw sculpture (photograph by Gerard de Kamper)

This tool was a good starting point, but for the programme to establish itself as a conservation science laboratory, the equipment will have to be expanded over the next few years. The next piece of analytical equipment to be prioritised will be an instrument to identify organic material, such as an infra-red (IR) or Raman spectrometer that is non-invasive and non-destructive. This equipment measures the chemical bonds in an artefact and can identify organic pigments and binders, which the XRF cannot do. The Department of Chemistry at the University has a laboratory IR spectrometer, but the portable system can be used in non-destructive mode, eliminating the need for sampling.

Research focus

To initiate our vision of establishing conservation science as a formal field of research in southern Africa, the primary research focuses were: (1) building up a database of the materials and methods of African art, antique and contemporary;

(2) pesticides in collections; and (3) curriculum development in the field of conservation.

The first focus is based on the fact that artists use materials that are specific to a source and a time period of production. With analytical equipment and knowledge housed in THC and UP Museums, the programme was in a unique position to undertake detailed studies of different artists and their media and to build a database for southern African artists. Nothing of this kind exists currently. Apart from the greater understanding of the artistic method, this also has a curatorial application where preventative and restorative conservation can be designed based on scientific principles. This focus is addressed on multiple fronts. Le Roux conducts materials research and analysis while also looking at provenance and connoisseurship in order to attribute specific artworks to black South African artists, like Lucky Sibiya. Her aim is to bring together these three strains of research to understand artists' techniques, style and materiality. Once she has successfully mastered her methodology, she aims to apply her process to other neglected and often-forged South African artists in a PhD study. Loubser aims to propose a PhD based on building a database built on XRF analytical fingerprinting and linking different Anton van Wouw bronze sculptures to specific foundries and time periods. She also proposed a joint venture with UP Museums to conduct elemental analysis of the Mapungubwe Gold Collection (MGC) by XRF, not only to expand on previous pilot research but for UP to become the epicentre of a systematic scientific research programme dedicated to filling gaps in research on the MGC. It would be an opportunity for UP, as the stewards of this globally relevant gold collection, to develop and build a credible comparative database to further geochemical investigations on its key archaeological gold collection, which is due to be exhibited in the new Javett-UP Art Centre. Previous research in 1998 was sporadic and, for the most part, only applied to surface gold beads and results obtained from fewer than five gold samples. The potential for XRF would aid the characterisation of the trace composition or fingerprint of a much larger data set of about 207 gold samples from the MGC. XRF would also be able to confirm or expand on whether the MGC is indeed homogenous. In addition, the increase in gold theft, particularly in the museum context, is crucial, and the application of XRF would facilitate unique identification signatures for the MGC to mitigate the risks associated with curating and researching such an iconic and valuable gold collection.

Pesticides in collections (the second focus) have been proven to be hazardous

to both human health and the collections they seek to protect. Hazardous materials in museum collections are a well-known problem, and historically, many hazardous materials were incorporated into collections as pest-prevention systems. However, the historical documentation of these processes is sparse and incomplete (and, in some cases, non-existent), especially in Africa. Davison Chiwara proposed carrying out chemical analyses of organic collections in Zimbabwe's museums using XRF to determine the chemical properties of the pesticides and their effects on collections and human health. He proposes doing this as his PhD project. As Maggi Loubser is a specialist in XRF and has done this kind of work before, this is a very feasible project and could easily be expanded to other museums in South Africa and southern Africa.

In 2019, McGinn was pursuing her PhD research on curriculum development in the field of conservation using the THC as a case study. Through a review of available local training and consultation processes to engage with various stakeholders, the thesis identifies local conservation needs and challenges. A curriculum was developed in response to research findings, guided by a review of curriculum development theory in line with criteria for a transformed curriculum. The research contributes to archival knowledge on conservation as a profession in South Africa, a sector in which publication is scant. Additionally, although there are many programmes on heritage conservation internationally, few have been the subject of analysis and self-reflection with regard to their conception, curriculum development or adaptation, and the manner in which they are taught. The thesis addresses this knowledge gap and contributes an original body of knowledge on conservation education in South Africa and abroad. McGinn was awarded her PhD in 2021.

Conclusion

THC has a vision to establish conservation science as a discipline in sub-Saharan Africa. The programme also hopes to elevate preventative conservation practices across the continent, and we believe our unique combination of skills and collaborations place us in a strong position to succeed in fostering a generation of conservation practitioners with a scientific backing that can change the status quo in museums and elevate and promote the profile of conservators.

In the words of Luca Turin, a man who spent his entire career translating between different fields of science to explain the mystery of smell: 'We believe

that if you work strictly in one area, it is hard to make progress. But if you have the ability to translate a concept from its field, for use where it is unknown, it is always fresh and powerful. The limiting step is in your willingness to continuously translate, to forge strange languages to be yours, to live between, to be everywhere and nowhere.'

As programme manager for THC, Loubser is willing to be the translator and believes the programme can build strong cross-disciplinary bridges to elevate Tangible Heritage Conservation to the level where it deserves and needs to be to ensure the survival of our heritage for future generations.

The Lockdown Year

Introduction

> 'One day you will look back on this season and know that you are truly blessed, and not because things were perfect but because you found perfect grace in the worst of it.' — Morgan Harper Nichols

This American singer/songwriter/artist's words resonated with Loubser when she looked back on 2020. The year was a mess, but it gave the lecturers and students so many opportunities to shine, dig deep and find solutions. The lecturers, students and support individuals were there for each other and colleagues and, amidst social distancing, formed more meaningful connections born from the emotional needs of our students and colleagues brought about by the pandemic.

However, Loubser and McGinn looked back with pride on what they did accomplish.

At the end of 2019, the lecturers sat down and evaluated what worked and did not work in the first year of our new programme, and they decided how to implement changes in the second year. Loubser and McGinn's first challenge was the originally scheduled 3 February start of the academic programme, which was seemingly unrealistic. Some of the international students from Lesotho (Mabokang Mokotjo and Mampopi Namane) and Namibia (Henry Nakale) struggled to get their previous year's marks and arrange their bursaries and study visas. Thus, the year's schedule started on 17 February. Even though lectures had started, students had to go back to their home countries to sort out these problems. The lesson learned was that in the first two months of a year, student

administration focuses primarily on undergraduates, which led to the decision to always commence the programme in March.

Figure 2.8: Henry Nakale and Mampopi Namane inspected a ceramic piece during practicals in THC 804 (photograph by Mabokang Mokotjo)

Once the students, along with Laura Esser (German) and Daniéle Knoetze (South African), returned from their 'very early Easter break', it was merely a couple of weeks before South Africa went into level 5 lockdown. Within the first week of 'hard' lockdown, THC moved completely online. At that point, the students had to start THC 802: Science Fundamentals of Conservation. Teaching students from a humanities background chemistry is challenging in itself, and doing so online was probably one of the biggest teaching challenges of Loubser's career. The biggest problem Loubser encountered was the lack of two-way communication: she could not see in their eyes whether they understood the concepts and explanations. She had to adapt the syllabus and teaching material quickly to incorporate daily tasks and assignments, which gave insight into the students' levels of understanding. She fortunately also realised how much material is available online at this level. The style of teaching changed totally from a 'lecture-centred' approach (which is often the style used for introducing students to a new field) to a 'journey of knowledge', where Loubser suggested readings and videos for the students to work through at their own pace, then followed up with a theory lecture to ensure the necessary concepts were covered. Their comprehension of these concepts was then evaluated with an assessment in the

form of a quiz, tutorial or presentation by the students. All of this had to happen while the logistical challenges of Internet access, bandwidth, data and IT savvy were being addressed.

The need for Internet access led the two students from Lesotho to decide to remain in Tuksdorp, a UP residential area. Loubser had to motivate and convince the head of Tuksdorp to let these two students spend their COVID lockdown there. The Namibian student returned to Windhoek and commuted to a friend's place daily in a neighbourhood with better Internet coverage. The German student decided to spend the lockdown with her fiancé in Emalahleni, Mpumalanga, and the South African student lives in Pretoria, and her parents helped to upgrade her Internet access. None of us could foresee that the students from Lesotho would be unable to return home for seven months. Mabokang Mokotjo is a mother to two young children, so the sacrifice she made was enormous. Mampopi Namane eventually returned to bury her mother, whom she had not seen all year.

Figure 2.9: Laura Esser, Mabokang Mokotjo and Daniéle Knoetze mended a tear on an archival document (photograph by Isabelle McGinn)

The curriculum

The second-year students, who started the programme in 2019, had two modules, THC 805: Collections-based Training (Internship) and THC 800: Mini-dissertation. They proceeded with their mini-dissertations from their lockdown locations. Le Roux and Hoeane remained in Pretoria, whereas Zambri and her husband emigrated to Australia at the beginning of the year, where she got an internship with a heritage architecture company in Sydney but, unfortunately, was let go during the lockdown. Le Roux and Hoeane are both mothers to young children, so under lockdown, their research had to be balanced with child minding. McGinn was in the same position as she had to balance the new style of online lecturing with having two small children in the house.

Completing the necessary internship hours proved problematic, but fortunately, all three of them completed the requisite number of hours in the first year as part of their bursary commitments and personal career enrichment. Le Roux was scheduled to visit Yale University in May and June 2020 to complete an internship there and return to set up an imaging laboratory for THC, but that was cancelled. Loubser was still hoping that she could visit Yale University in 2021 or 2022, as she wanted to continue in the field towards a PhD. Hoeane's internship with Ditsong could not be realised, and McGinn approached Gerard de Kamper, curator for the UP Collections, to assist and let her complete the hours with UP Museums. She also participated in the Johannesburg Holocaust Centre internship in November and December 2020.

The research for the students' mini-dissertations was also affected by the COVID-19 lockdown. Libraries, museums, galleries, and archives were all closed, limiting the access they had to their study objects and pre-existing knowledge. Zambri eventually got electronic access to the Cockatoo Island Interpretation Strategy Plan and all the exhibits after Loubser wrote to the responsible individuals. Fortunately, Le Roux completed the technical studies on the UP objects in 2019, and she adjusted the scope of her study to include only these objects. De Kamper from UP Museums and Prof Karen Harris from UP Archives also assisted Le Roux with access in the late stages of lockdown to complete some minor changes. Hoeane was assisted by Ditsong National Museum of Cultural History, specifically Gertrude Seabela, the curator, to get access to objects under lockdown.

Figure 2.10: Students, Henry Nakale, Daniéle Knoetze, Laura Esser and Mabokang Mokotjo during the first day at the Johannesburg Holocaust Centre (photograph by Isabelle McGinn)

All three second-year students handed in their dissertations by 31 October 2020 and graduated in April 2021. The titles of their mini-dissertations are:

Salome le Roux: A technical survey of Lucky Madlo Sibiya's (1942–1999) materials and techniques employed in his carved and painted wood panel artworks (distinction)

Mabafokeng Hoeane: The spiritual significance and conservation of Dinkhotsa Badimo at the Ditsong National Museum of Cultural History

Emilia Zambri: Heritage and reconciliation within a post-colonial society, Cockatoo Island as a case study

The first-year students started on 17 February with THC 801: Conservation Principles and Strategies. One of the lessons learned from 2019 was that the students were somewhat overwhelmed by the volume of background reading for this module, and lecturers decided to present it as one-week sections every month instead of one block. This gave students more time to read and process the different topics presented by McGinn and a few guest lecturers. The topics were:

- Plagiarism—presented by Gerda Ehlers from UP Library Services
- Art appreciation: Survey of southern African art—presented by Avi Sooful from the Department of Visual Arts

- SA history: Early beginnings, interior encounters, and gold to sold—presented by Karen Harris from the Department of Historical and Heritage Studies
- What is heritage and why is it worth preserving?
- Change in collections: Causes and identification
- Writing the past: Media and themes
- Influences of social, cultural and historical periods
- Damage identification
- Working with collections: Prejudices and new practice
- Preventive conservation frameworks
- Mitigating threats through appropriate use & handling
- Codes of ethics and practice
- Decolonising conservation
- Research methodology
- Objects & their investigation

The students had one week of in-person lectures for THC 802: Science Fundamentals of Conservation before their Easter break, and from then on, it was online. As mentioned earlier, it was challenging for multiple reasons—the biggest being that the students did not have strong chemistry and mathematics backgrounds. These adaptations led to a change in Loubser's teaching approach. Students are now required to do self-study and learn basic concepts before each lecture, then ask questions and discuss gaps in their understanding. This style was very appropriate for 2020 because online chemistry teaching took longer than in the previous and following years. Yet students were adaptive and resilient, and lectures progressed at a comfortable pace for each student. Because of this, Loubser realised that some topics could be taught differently, which she subsequently did.

For THC 803: Research Methodology in Conservation, the previous year's partnership with Yale's IPCH with Aniko Bezur as lead lecturer was furthered. In this case, the switch to online teaching meant that Bezur did not need to travel to South Africa, and the relevant lectures were presented in the afternoon to accommodate the time zone difference. But it was challenging to teach practical topics such as imaging techniques, microscopy, X-ray fluorescence spectroscopy, infrared spectroscopy and chromatography without any practical component. Bezur did an incredible job sharing practical case studies, and where students

could not do any practical work, some online resources from the Rijksmuseum (https://www.rijksmuseum.nl/nl/scheikunde-lesmateriaal) were translated and used as case studies.

Prof Patricia Forbes from the Department of Chemistry presented a lecture on chromatography, but unfortunately, it was not possible to do the combined lecture and practical on infrared spectroscopy with Bruker as was done the previous year. The practical photography section also had to be scrapped as it was meaningless to do it online without any photography studio access. In hindsight, the first-year students of 2020 missed out on the practical aspects of THC 803, but the goal was for them to attend the next year's practical sessions. In the first year, during the THC 803 module, students were tasked with creating a mind-map of their proposed research focus. It was proven fruitful the following year, because the students started to realise which methodologies and techniques could be used in their second year of research. While being taught the methods and techniques, the students also gain a deeper understanding of the topics. In addition, it helps students commence their research much earlier than the start of the second year, when their time is divided between the pressures of writing a mini-dissertation and doing an internship.

Figure 2.11: Laura Esser and Mampopi Namane practised in painting on ceramic objects (photograph by Daniéle Knoetze)

THC 804: Mechanism of Decay and Stabilisation was the one module Loubser and McGinn were the most worried about in the context of online teaching, as this is the module where students learn the different kinds of conservation materials and do a large amount of practical, physical work on objects. They were very anxious about whether it was going to be feasible to do this module online. McGinn stepped to the fore with resolution. She designed and compiled an experimental discovery kit for each student. This was no small task because, under level 5 lockdown, it was almost impossible to buy most of the equipment the module needed, and some seriously inventive ways were found to obtain equipment and objects. Special thanks to Vian Kruger, who made magic happen, and to family, friends and kitchen drawers that revealed wonderful teaching objects. These kits probably cost the programme around R3 000 each, including couriering them to all the students at their respective lockdown addresses. As there were only five first-year students, it was executable.

The content of the student discovery kit is described in Chapter Five. It contains some basic tools and examples of each material: ceramics, glass, metals, plastics, paper, photographs, textiles and organic objects, as well as material to enable students to do simple exercises like making paper and different paints (oil, acrylic and water). One very useful tool was the USB microscope—when they were introduced, McGinn could guide the students by demonstrating or screen-sharing through an online meeting platform. The students could then replicate the process and share their results with the rest of the class in the form of online presentations. In this module, the students also increased their use of the WhatsApp group, and class discussions often spanned several hours. The excerpt below shows a student in Namibia asking for assistance and the entire class participating in finding solutions, thus putting their theoretical knowledge to practice.

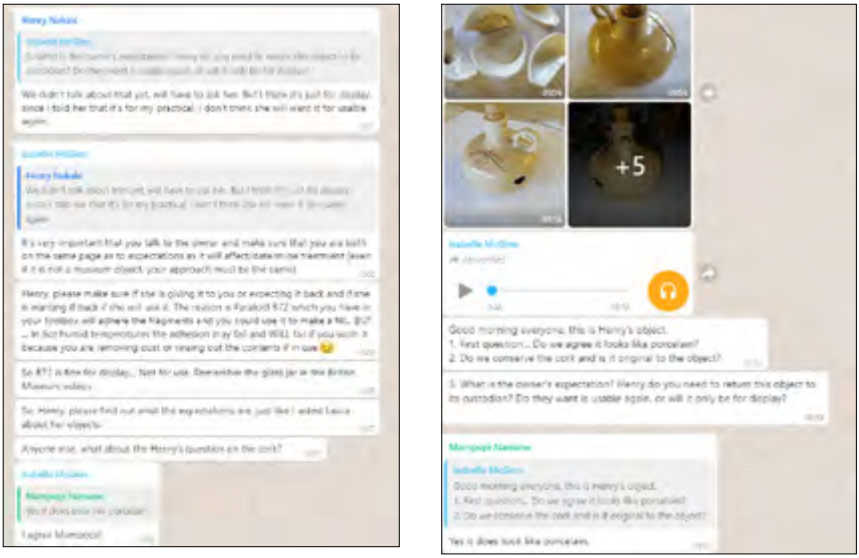

Figure 2.12: Screenshots of a THC conversation while students were in level 5 lockdown (screenshots by Maggi Loubser).

One of the consequences of the COVID-19 pandemic was that everybody moved online, and guest lecturers from abroad were comfortable teaching online. Anupam Sah from Chhatrapati Shivaji Maharaj Vastu Sangrahalaya (CSMVS) Mumbai taught the Inorganics 4: Stone topic of the THC 804 module, and the students really enjoyed his lectures. Some of the other parts of the module—specifically Inorganics 5: Metals, and all the organics sections—were taught by Nancy Child, previously from Iziko Museums in Cape Town, now working as a private conservator. Nancy had never taught online before, and Loubser and McGinn had to support her remotely to set up and learn to use Blackboard, the University's online platform.

As stated previously, it took a lot longer to cover the syllabus, and it was decided to stretch THC 804 over a much longer period, past the first semester all the way into September. This works a lot better than trying to complete it in the first semester, and Loubser wrote a motivation to change the syllabus accordingly and make THC 804 a year module.

The specialisation module of 2020 was THC 807: Conservation: Polychrome Surfaces. The University received a Fulbright scholarship to bring Jean Dommermuth, institute lecturer for the Conservation Centre at New York

University, to South Africa to teach this module in September 2020, but it turned out to be impossible due to travel restrictions and lockdown. As this is the hands-on restorative conservation module of the programme, it was decided to have the students start working on their dissertations early and move the module to 2021. Jean Dommermuth was scheduled to visit South Africa in August 2021.

This experience also made Loubser and McGinn rethink the entire speciality module. It is not truly elective, as stated in the study guide, because only one speciality is taught each year—depending on the availability of a specialist. These unknown aspects seemed to become a constant challenge with unknown cost implications. Thus, Loubser wants to motivate to change the syllabus to eliminate the three specialist modules from the curriculum and increase the THC 804 materials module as a year module, incorporating more restorative conservation for each of the materials taught, thereby giving the students a broader background.

In September 2020, one of the students, Mampopi Namane's mother passed away in Lesotho, and lectures were put on hold for a month to give the Lesotho students a chance to go home and reunite with their families for the first time in months. At this point, lectures had been continuous from mid-March. The Department of International Student Affairs was wonderful in its assistance in getting the students home and ensuring their visas were in place to return. Fortunately, around that time, the national lockdown restrictions became less rigid.

As our group is small and Van Wouw House is ideally suited for COVID-19 social distancing protocols, Loubser decided to bring the students back for in-person teaching at the end of October. Sandra Markgraaf introduced polychrome objects, as these were omitted from the THC 804 module because it would have been the speciality topic for the year. It turned out to be a very exciting section, which the students were grateful to attend in person for the month of November.

During the course of the year, it became evident that this group's writing skills were not on the same level as the previous cohort's. The University has academic writing programmes for postgraduate students, but Loubser and McGinn were of the opinion that THC needed a special writing approach. Loubser contacted Daniéle Knoetze, who, apart from a background in English language, academic writing and editing experience, also has a TEFL qualification (teaching English as a foreign language). She presented 30 hours of teaching, starting with group classes and continuing on a one-on-one basis to help the students develop their

letters of intent and project proposals. It worked so well that it was decided to approach her to teach the 2021 intake in their first orientation week.

From early October, both Loubser and McGinn were working from Van Wouw House full-time because the long-awaited renovations finally started. McGinn also received a few conservation commissions, and both of us were supporting the second-year students with their internship hours and finalising their dissertations. McGinn used the commissions to give the students the practical exposure they lacked during the year. Alexio Motsi from the National Archive also spent a week with the students doing some practical paper conservation.

Having been involved with the South African Museums Association (SAMA) for many years, McGinn is always in contact with museums and museum professionals to get students involved in the museum sector as part of the programme's community outreach. During this time, she was approached by Jordan Saltzman from the Johannesburg Holocaust Centre. They received funding to upgrade their archives and urgently needed hands to assist with the project as they had to spend the money by the end of December 2020. Loubser and McGinn approached the THC students and all the first-year students. Mabafokeng Hoeane from the second year and two students from the honours group in museum studies joined the project. Loubser approached Gautrain and was offered a reduced student tariff as part of Gautrain's student commute pilot project, which she had to subsidise with Mellon funding. This project turned out to be incredibly productive, and the students had the unique opportunity to engage with a real-life collection and be involved from the acquisition to condition assessment, sorting, and storage. They worked until 15 December and were approached to continue in 2021.

During the students' time at the Holocaust Centre, McGinn was also approached by Emma Fraser, a paper and book conservator from Dundee in Scotland, who was visiting family in South Africa and presenting a workshop at Brenthurst library. Fraser agreed to spend two weeks with our students—a week in November 2020 and a week in February 2021.

Through these interventions in the final two months of the year, the class of 2020 probably did more hands-on conservation than the previous year's students. They did miss out on the analytical methods practical during the THC 803 module, but they received the exposure in 2021 when the third intake of first-year students was completing THC 803.

Chapter 3 is a report written by Daniéle Knoetze and Laura Esser on their

experiences of 2020 as first-year students in the programme.

Collaborations

SAMA Train the Trainer 4, 5 and 6

The fourth and fifth Train the Trainer workshop presented by SAMA, the Cultural Heritage Agency of the Netherlands, Museum Bronbeek and Atelier Van Beemen, supported by the Dutch Embassy in Pretoria, was hosted by Ditsong Museums of South Africa and the Tangible Heritage Conservation Programme at the University of Pretoria from 9 to 12 March 2020. It was the first time that THC hosted an event of this nature in Van Wouw House. It was a great privilege to have 20 conservation professionals from all over South Africa, as well as Alexandra van Kleef, project manager at the Dutch Cultural Heritage Agency and lecturers Ineke Joosten, Esther Meijer and Roosmarijn van Beemen using our facilities for the training. Jan Huesken and Daniel Smit from the Dutch Embassy also joined. This was the last activity at Van Wouw House before the South African COVID-19 lockdown started.

The sixth Train the Trainer workshop presented by SAMA and the Cultural Heritage Agency of the Netherlands, supported by the Dutch Embassy in Pretoria, was an online programme with a large contingent of lecturers from the Rijksmuseum in Amsterdam. Both Loubser and McGinn attended. These Train the Trainer workshops were invaluable to THC, not just in expanding knowledge, but also in building a network of international collaborators and possible future lecturers, co-supervisors and external examiners.

NICAS - Netherlands Institute for Conservation, Art and Science

Through our contact with Kate Seymour from Stichting Restauratie Atelier Limburg and Amsterdam University, THC was put in contact with NICAS and invited to participate in their project week in November 2020. Our students were also invited to attend the sessions. It was an eye-opener for the students being exposed to the standard and range of work undertaken in these professional conservation laboratories.

NICAS subsequently invited Loubser to serve on the international advisory committee for their International Research Infrastructure for Heritage Science

programme, which is also funded by the Mellon Foundation. The invitation stated:

'The International Advisory Committee consists of international experts in the domain of the conservation of cultural heritage. These researchers will represent the disciplinary scope of the program, but also the culturally diverse outlooks on conservation and heritage. The Committee will form the backbone of the program, convening at key moments to shape the content of the program and to provide guidance for the research associates. They will provide institutional links to cultural heritage organisations around the world and give input on the structure of the program and help shape its outcomes.'

Loubser has been serving on the interview panel for the appointment of research associates to the project and attends certain conferences and colloquia, as well as spending one or two residency periods at the Rijksmuseum. With the current travel restrictions, it is hard to know when the residency periods will occur. Loubser hopes that her participation in this project may help to bring an African and developing world perspective to the International Research Infrastructure programme, which would otherwise be very North American and Eurocentric.

Global Consortium for the Preservation of Cultural Heritage (GCPCH)

The University of Pretoria volunteered to be the next host of this series of annual meetings that originated in 2016 in New Haven, Connecticut, USA, after the Global Colloquium of University Presidents. Unfortunately, due to the COVID-19 pandemic, the October 2020 meeting had to be postponed to October 2021.

As host of the next meeting, UP chairs the steering committee, and after discussions and a vote, Loubser became the de facto chair of the committee, which consists of:

Maggi Loubser:	University of Pretoria
Kristine Juncker:	*Smithsonian Institution—stepped back.*
Alison Gilcrest:	Yale IPCH (Yale University)
Tor Broström:	Uppsala Universität
Florian Knothe:	The University of Hong Kong
Ivan Selin:	Smithsonian Institute and Yale University

Stefan Simon:	Rathgen-Forschungslabor
Denise Lim:	Yale IPCH
Karin Weil:	Universidad Austral de Chile
Christine Kreamer:	Smithsonian Institute
Marinda Maree:	University of Pretoria
Dana Moffett:	*Smithsonian Institute—stepped back*
Alexander Johnson:	University of Pretoria
Mary Cassar:	University College London
Maartje Stols-Witlox:	University of Amsterdam
Anupam Sah:	CSMVS Mumbai
Krassimira Frangova:	Royal Danish Academy for Fine Arts
Susan Keitumetse:	University of Botswana
Isabelle McGinn:	University of Pretoria
Michael Mason:	*Smithsonian Institute—stepped back.*
Kevin Dumouchelle:	Smithsonian Institute
Youngjae Kim:	Korea National University of Cultural Heritage (KNUCH)
Seungtae Nam:	KNUCH

In discussion with some of the role-players, and due to the postponement of the 2020 meeting, a proposal was formulated to start on some research projects and use the 2021 meeting as a feedback session on the past two years' work, with actual outcomes instead of just lectures and discussions. We also envisage publishing a special edition of a peer-reviewed journal with the conference proceedings.

Another tabled proposal that was accepted was to invite the chair for the next meeting to join the steering committee and for the current chair to stay on until after the next meeting to introduce some sense of continuity. At the Mumbai meeting, KNUCH voiced their interest in hosting the next consortium gathering, and they were formally invited, accepted and incorporated into the current steering committee. The possibility of sponsoring a part-time secretary was also discussed, and although the idea gained a lot of traction, the economic climate was not conducive to this. Logistical planning for the October 2021 meeting was underway from the middle of 2020. The idea was to be able to host a hybrid conference with a combination of in-person and broadcast sessions at the Javett-UP.

As part of our academic contribution to the GCPCH meeting, Salome le Roux (PhD candidate) and Loubser joined the Yale IPCH project entitled 'An investigation on how the current COVID-19 pandemic has impacted cultural heritage and conservation training programmes throughout the African continent'.

As the first part of the project, Le Roux and Loubser worked on compiling a comprehensive database of professionals and students in the heritage field in Africa. The pathways to heritage appointments in Africa are very different from those in the USA and Europe, and we wanted to ensure nobody was excluded because they were not associated with an official academic programme. Denise Lim, a social scientist employed by Yale's IPCH, designed the survey but also acquired our input to make it relevant to the African audience. At the end of 2020, the project was still in the development phase, but all involved were convinced that a pilot study could be ready by October 2021.

Iziko-UCT CCA Preventative Conservation week 2020

For the third year in a row, THC was invited to participate in the Iziko-UCT CCA Preventative Conservation Week. As a direct result of McGinn and Le Roux's presentation at the workshop in 2019, San-Mari van der Merwe registered for the THC programme to commence in 2021. Loubser and McGinn asked the 2020 first-year students to present on their experience of the THC programme with the hope that the presentation will again lead to students registering for THC. This workshop was also hosted online in 2020, which allowed for conservation specialists from around the globe to present—another example of how the new way of doing things brought about by COVID-19 actually improved the experience for the delegates/students.

Angels, Ancestors, Alchemy and the Arts in Africa

This International Colloquium was hosted by the Department of Humanities Education (Art Education) in partnership with the School of the Arts from 29 to 31 October 2020. THC presented two papers in the session on 'African spirituality, alchemy and science, health and healing'. Mabafokeng Hoeane and McGinn presented 'The spiritual significance and conservation of Dinkhotsa Badimo in Sesotho and Tswana cultures', and Loubser and Le Roux presented 'Alchemy

or science, the materiality of the artist revealed through analytical techniques'. The presentations were then reworked as articles and published in participating journals.

Flexible Futures Conference 2020

The conference focused on virtual higher education innovation and was presented on 4 August 2021. Loubser presented a paper titled 'Teaching conservation science online, to students without a science background'.

Challenges

THC prepared a funding application with Javett-UP and UP Museums for the UNESCO Diversity of Cultural Expressions programme. Unfortunately, we were not successful, but this document was largely incorporated as the blueprint for the academic leg of Javett-UP and the School of the Arts and Javett-UP collaboration. Sadly, the Javett-UP conservation studio had not yet materialised although it was needed for the GCPCH meeting in 2021 and was intended to be the studio for visiting conservators.

The experiences of the lecturers and students during the first two years indicated that course and name changes were needed. In 2020, Loubser and McGinn were preparing a proposal for the UP Teaching and Learning Committee regarding some adjustments to the syllabus. Firstly, it was noted that the name of the course, Tangible Heritage Conservation, should have just been Heritage Conservation. By the end of 2020, two out of three completed dissertations were focused on the intangible aspects of conservation, and in the 2021 group, this trend continued. The divide between tangible and intangible is an artificial one, especially in the African context where continuous work is underway to incorporate indigenous knowledge and transform our curricula to be truly inclusive.

The other changes THC wanted to propose were discussed earlier. THC 804: Mechanisms of Decay and Stabilisation was listed as a first-semester course, but as experienced in 2020, it would be much better to spread it over the entire first year. The so-called electives—speciality modulesTHC 806, THC 807 and THC 808—are not truly electives, as the students are forced to 'choose' the module presented in their first year, which is dependent on the specialist THC

can secure. The speciality modules will always have severe cost implications because of the need to host an individual for a four- to six-week period. Both Loubser and McGinn felt it would be more productive to extend THC 804 to a year module, drop the THC 806, 807 and 808 modules, and incorporate more detail on restorative conservation for all the materials covered in THC 804.

With regard to challenges of funding, even though the Mellon grant is ending in 2023, funding for guest lecturers and equipment was already depleted in 2020. In 2019 and 2020, only four of sixteen bursaries were awarded. From the second intake, two of the students had Lesotho National Manpower Development Secretariat bursaries. In 2020, THC was able to award six bursaries for students to start in 2021, while a seventh was kept for a student from Namibia to commence her studies in 2022—she was unable to attend from 2021 as she was under contract at Museums of Namibia until October 2021.

Loubser was actively looking into alternative funding options. Yale IPCH support is ongoing and will be for some time to come. They support us with lecturers, resources, external examiners, and a lot of guidance on our syllabus and equipment. New relationships with NICAS have opened up new possibilities, and Loubser had also been in conversation with the Dutch Embassy in South Africa to link up with some of their exchange programmes. Through the GCPCH links with the Smithsonian Institute, the programme is also receiving many offers to teach, especially now that online teaching is an option and travel is not an additional expense.

Another proposal currently under investigation is to open the subheadings of THC 804: Mechanisms of Decay and Stabilisation as short courses through CE@UP (Enterprises UP) with a four-fold purpose. First, it would bring in third stream income by having individuals enrol for the short courses. Second, it would be a way to market the THC programme across Africa, as 2020 proved that these courses can be presented online. Over time, and if the numbers are feasible, we could investigate the option of identifying possible 'centres of excellence' across South Africa and the rest of sub-Saharan Africa, which, with our support, could host practical workshops to complement the online courses, thus harking back to the idea of a 'spoke-and-wheel' presentation as per the initial Mellon proposals.

Thirdly, a possible outcome could be that people in full-time employment could do these short courses and build up credits towards THC so that they can complete the remainder of the contact modules at a time that is acceptable

to their employers—the second year's internship and dissertation can be done remotely. The fourth and last purpose would be to provide much-needed training to people currently working as heritage professionals in southern Africa.

We are actively pursuing funding possibilities for expanding our imaging laboratory and acquiring more analytical equipment.

Third stream income

Isabelle McGinn has been bringing in a steady stream of conservation commissions from both private and institutional clients. Apart from some crucial third stream income, these projects serve as excellent case studies for students to work on real objects under McGinn's supervision.

Figure 2.13: Laura Esser and Isabelle McGinn piece together a ceramic bell for a commission (photograph by Daniéle Knoetze)

The venue

Although the funding for the necessary renovations to Van Wouw House was allocated at the start of 2020, it took until late August for the work to start. To date, the electrical wiring was replaced, a safe room was installed for object storage, the thatch roof in the studio was sealed from the inside to prevent

shedding and IT infrastructure was installed (that is, network points, Wi-Fi points and a server cabinet in the office). In 2020, it was too expensive to lay a cable from existing UP Internet points to Van Wouw House, so there is still no Internet installation. A fibre contract had to be negotiated, and IT advised us that the most cost-effective option conforming to their standards was a Level 7 FTTB/Metro Fibre 200MB/s line at R8 000 per month. THC had to find the funds, so it was decided to consider a Level 7 FTTH/Openserve 200MB/s line at R1 500 per month, although it did not have the service guarantees of the other contract. Loubser still had to find a budget for the contract, as Mellon funding cannot be used for infrastructure. This had to be resolved urgently as the new intake of students started on 1 March 2021 and the Wi-Fi package would not have allowed us to stream lectures without interruptions.

Other outstanding issues on the renovation project were repairs to the ceilings and walls where contractors worked, repair/replacement of rotten wooden window frames, replacement of kitchen cupboard doors and the repair of the access-control bell and magnetic lock on the entrance gate. There were numerous other issues, but the budget was depleted, so THC is continuously addressing these needs with maintenance contractors at UP. One major issue for which urgent budgeting was necessary was repairing the thatched roof. There were numerous leaks, and the thatch needed combing and fixing in various spots.

Alumni

It is THC's intention to remain in contact with alumni and build a network of conservation professionals in the Southern African Development Community (SADC) region and further afield. THC also intends to stay involved in the research projects the alumni do in their places of work after qualifying, especially Lesotho's Department of Culture and the Lesotho State Library where Mokotjo and Namane, respectively, are already employed, as well as the National Museum of Namibia where Henry Nakale is employed. Loubser is also co-supervising a PhD student, Davison Chiwara from Midlands University in Zimbabwe, and the analytical work they will be doing using X-ray fluorescence will be invaluable to Zimbabwe museums and probably lead to long-term collaboration. Le Roux has just been appointed as an assistant lecturer at THC, and in 2020, it was still hoped that she would visit Yale's IPCH and assist with the set-up of THC's own photographic laboratory.

Conclusion

2020 was a year of challenges but also many highlights. The programme was clearly going from strength to strength, and Loubser and McGinn believed that they were successfully laying the foundation for a long-lasting and productive research and teaching hub, which will hopefully help to generate many centres of excellence in conservation throughout southern Africa over the next decade.

The Busiest Year

Introduction

The third year of operation was probably the busiest year to date. The first three students graduated in April, while the new intake consisted of nine students. In 2021, Salomé le Roux, from the first group, was appointed as an assistant lecturer, and Daniéle Knoetze was appointed as a research assistant. Without the help of these two extra pairs of hands, the year would have been extremely difficult. The COVID-19 pandemic continued, and with great circumspection, the new intake of first-year master's students was accommodated back at Van Wouw House in person. The group was small enough that the facilities could host them and maintain social distance during intensive practical sessions with good ventilation. Sadly, the next COVID-19 wave struck and teaching reverted to the online mode, literally overnight! After 2020, it was much easier to go fully online, as Loubser and McGinn had developed mechanisms and procedures during the first wave and adapted their teaching methods to make online teaching more effective.

The students

The 2021 intake consisted of nine students, which pushed the facilities to its limits, especially with two additional students doing the THC 804 module: Mariet Conradie, registered for non-degree purposes, and Gerhard Hugo, as an 'internship' for an overseas conservation programme. Six of the nine students were awarded Mellon Scholarships, while the others were either self-funded or held bursaries from the NRF or UP.

The nine students were:

Nancy Collett, Hannes Elsenbroek, Carmen Joubert, Nkami Manyike, Marinda van der Nest, Loreal Vos, San-Mari van der Merwe, Jabu Ntuli and Yanga Dlaba.

Figure 2.14: Neil Harris demonstrates on a formal dress jacket of a royal engineer (ca. 1850) to students (from the left) San-Mari van der Merwe, Marinda van der Nest, Loreal Vos, Nancy Collett and Carmen Joubert (photograph by Isabelle McGinn)

The second-year students were all cleared to complete their research, and they all submitted in time to graduate in April 2022. Of the five students in the programme's second intake, four achieved distinctions. The students and their dissertation titles are listed below:

- Laura Esser: 'A case study of Diane Victor's soot drawings: how they are made, and what can be done to increase their longevity' (distinction). Supervisor: Isabelle McGinn, co-supervisor: Soyeon Choi (Yale IPCH).
- Mampopi Namane: 'Assessment of preservation and conservation practices in Lesotho National Archives'. Supervisor: Isabelle McGinn, co-supervisor: Mary Minicka (Western Cape Archive).
- Mabokang Mokotjo: 'Conservation and analysis of a Setlokoa cowhide dress' (distinction). Supervisor: Isabelle McGinn, co-supervisor: Nancy Child (Iziko).
- Henry Napandulwe Nakale: 'Oranjemund shipwreck: a composition analysis of the pewter artefacts and their conservation aspects' (distinction). Supervisor: Maggi Loubser, co-supervisor: Jaco Boshoff (Iziko).

- Daniéle Knoetze: 'The art of "looking": A technical analysis of Alexis Preller's Man in the Sun' (distinction). Supervisor: Maggi Loubser, co-supervisor: Karel Nel (Norval Foundation).

There were challenges getting Knoetze's topic finalised as her first two study proposals could not be realised due to access problems, but Dirk Oegema and the Pretoria Art Museum stepped in and welcomed us to work on their collection at any time. In addition, involving Karel Nel, who is probably South Africa's biggest Preller expert, as co-supervisor helped her make up for lost time and enabled a timely completion.

Loubser was also continuously aiding and working with Davison Chiwara, whom she is co-supervising for his PhD in museum studies.

Assessment methods

After the first year of the programme, Loubser and McGinn were continually revising assessment methods to ensure that students did not just regurgitate lecture material but that each assignment was designed as a learning opportunity in itself and helped to broaden the students' insight into the practical application of theory in the field of conservation. The focus on written reports, although they are tedious to mark, improves students' academic writing skills, preparing them for their mini-dissertation in their second year. However, it was identified that the students struggle with academic writing at the master's level, so during the introduction week of the year, students received various forms of guidance. The students had to attend compulsory UP library orientation, plagiarism avoidance assistance, and academic writing guidance from TEFL specialist Daniéle Knoetze. Knoetze was also brought in to aid students in initiating their research proposals at the end of the year.

Online teaching provided a wonderful opportunity to have two world leaders in their field teaching the two elective modules, THC 807, polychrome objects, and THC 808, archaeological objects. It was necessary to present the 2020 group's speciality, THC 807, in 2021, because COVID-19 prohibited the teaching of THC 807 in 2020. The bulk of THC 807's theory was taught by Jean Dommermuth from the Institute of Fine Arts, New York University, who was awarded a Fulbright Scholarship to come and teach THC 807 in South Africa. However, she could not travel and presented the theory online. Fortunately, the students were able

to return to in-person lectures, and a local team consisting of Sandra Markgraaf (Art-Revive), Salome le Roux (THC), Angela Zehnder (Iziko) and Ekkehard Hans (private conservator) handled the practical sessions in the mornings while Dommermuth taught the theory in the afternoons. Jean Dommermuth and the Fulbright programme did indicate their willingness to carry over the award to a time when travel is easier, and Loubser hopes that Dommermuth will be able to present the polychrome module again in person in 2022.

THC 808 was mainly taught by Rae Beaubien, a research associate from the Museum Conservation Institute (Smithsonian Institution) and the University of New Mexico. The local content and perspective were presented by Jaco Boshoff from Iziko Maritime Archaeology, Nancy Child (previously from Iziko Maritime Archaeology), and Tim Forsmann from UP Archaeology and the South African Heritage Resources Agency (SAHRA).

Figure 2.15: Students Nancy Collett, Hannes Elsenbroek and Carmen Joubert remove a ceramic object from a simulated burial site in THC 808 (photograph by San-Mari van der Merwe)

In 2021, THC 803 was again presented by Dr Aniko Bezur from Yale's IPCH and Loubser, but this time, they were assisted by Le Roux, who showed a keen interest

in analytical chemistry and analysis in the field of cultural heritage.

The programme would also like to acknowledge and thank the other guest lecturers:

- Karin Harris: UP Historical and Heritage Studies
- Avi Sooful: UP School of the Arts
- Patricia Forbes: UP Chemistry
- Gerard de Kamper: UP Museums
- Cuan Hahndiek, Natasha Higgitt and Elijah Katsetse: SAHRA
- Neil Harris: Private textile conservator
- Nancy Child: Private (previously from Iziko, where she taught organic materials and metals and co-supervised)
- Anupam Sah: CSMVS Museum Art Conservation Centre, Mumbai

Figure 2.16: Yanga Dlaba practising inpainting on a ceramic bowl during THC 804 (photograph by Isabelle McGinn)

Collaborations

Yale's Institute for the Preservation of Cultural Heritage (IPCH)

As was the case in 2020, Yale's IPCH continued to support us by acting as guest lecturers and external examiners for assignments and a dissertation and again permitting the students to access their two weekly colloquia. This is a

fantastic opportunity for the students to get insight into what practical projects conservators in the USA are doing.

NICAS - Netherlands Institute for Conservation, Art and Science

Also, through Loubser's position as an international advisory committee member of the Netherlands Institute for Conservation, Art and Science (NICAS), the students were invited to follow their monthly colloquia. These are conservation science-based, so they are usually optional, and Loubser advises the students when the topics are relevant to the syllabus or their particular field of research. As the time difference between the Netherlands and South Africa is minimal, the class often watches the colloquium as a group after a lecture.

Javett-UP

Loubser was in numerous talks with Javett-UP about collaboration and the Conservation Studio in Javett-UP that had not materialised until 2022 due to numerous factors. However, the new management of Javett-UP was positive at the start of 2022, and Loubser believed THC would begin managing some formal collaborative projects. The School of the Arts made R30 000 available for a workshop to be presented by THC at Javett-UP on basic preventative conservation titled 'How to care for your treasures'. The local community was invited to attend.

Prof A Johnson endlessly battled to get the Javett-UP Conservation Studio ready for the envisaged in-person GCPCH in October 2021. THC and relevant individuals from the School of the Arts were very frustrated, but funds were made available again, technical services reduced their excessive specifications, and the project was proceeding as of writing.

Internships and community service

Arising from the horrible Jagger Reading Room Fire at the UCT Library in April 2021, an urgent call for support went out to the conservation community. McGinn and four of the first- and second-year students responded to the call and rushed down to assist in the salvage operation. Jabu Ntuli, Daniéle Knoetze and Laura Esser travelled from Pretoria, whereas Henry Nakale was already in Cape Town

doing an internship at Iziko Maritime Archaeology Unit. They received great praise for their knowledge and skills, which meant they could be more than just 'pairs of hands' but could actually apply their knowledge in triage tents where decisions were made on sorting material brought out of the burnt and water-damaged collection. A similar call went out early in 2022 for assistants to a visiting German paper conservator, and consequently, Ntuli and Knoetze got the opportunity to return and start on some of the conservation work at UCT.

Figure 2.17: Jabu Ntuli surface cleaning draught plans at UCT. The lentil bags were a make-shift paper weight, as the department at UCT did not have the necessary paper conservation equipment (photograph by Daniéle Knoetze)

Other conservators who opened their studios to the students for internships were Sandra Markgraaf (UP conservator and owner of ArtRevive), Jaco Boshoff (Iziko Maritime Archaeology Unit), Mary Minicka (Western Cape Archive), Lucy Blumenthal (Fine Art Restoration & Conservation) and Grace Welsh (Fine Art Restoration). Emma Fraser, a book and paper conservator from Scotland, was in South Africa visiting family and spent two weeks with some of the 2021 second-year students.

As part of THC's outreach programme, Loubser also allowed Gerhard Hugo to attend THC 804 in lieu of an internship for his MSc in world heritage conservation

at the University College Dublin. Because of COVID-19, Loubser and McGinn did not feel organised enough to take him on as an intern, but as the THC 804 module is very practice-oriented, it was thought to be a good alternative.

Also, as part of THC's outreach and collaboration, when Javett-UP urgently had to move the Preller Discovery of the Sea Routes Around Africa painting, the THC students were called upon to assist with emergency consolidation and moving the very large painting. Knoetze, Esser, and Elsenbroek assisted Sandra Markgraaf with the consolidation and move to the Eduardo Villa Museum.

Student employment

One of the students, Laura Esser, who graduated in April 2022, was offered a contract with the Brenthurst Library in Johannesburg. Emilia Zambri, one of the first graduates, is currently employed at the Museum of Applied Arts and Sciences in Sydney, Australia. Mampopi Namane is still employed by the Lesotho State Library, and Mabokang Mokotjo is with the Department of Culture in Lesotho. Henry Nakale recently joined Windhoek Museum in Namibia. Daniéle Knoetze obtained a contract at UCT to continue the conservation of the salvaged items from the Jagger Library fire.

Future course structure possibilities

A motivation was made to the teaching and learning committee and the faculty board to deactivate the so-called elective modules (THC 806, 807, 808), which were never truly elective. In addition, finding the specialists and funding every year was going to remain a challenge. THC 804: Materials, Mechanisms of Decay and Stabilisation of Artefacts took a lot more time than the designated credits allowed to do justice to all materials. Consequently, it will also be deactivated and replaced with a new core module, THC 810, running the entire year to accommodate updated attributes and credits for all the above content.

Another 'experiment' in 2021 was to allow a student, Mariet Conradie, to register for the THC 804 module (which takes the most time of all the modules and is spread over the entire year as each component is covered by another guest lecturer) for non-degree purposes. She completed the module and subsequently registered for the full degree in 2022, enabling her to do only THC 801, 802, 803 and the elective, so in effect, she needs to take less than six months off from

work. The second year consists of the internship and dissertation and can be done remotely. This enables a working conservator to do the master's in the required time but with minimum study leave. This is an important market to tap into because many potential students are already in senior positions in museums and have an influence on the personal development plans of junior staff. Even if they retire in the next ten years, they can also be part of THC's accelerated training programme to present basic conservation training across sub-Saharan Africa.

During the Global Consortium for the Preservation of Cultural Heritage (GCPCH) meeting, Loubser and McGinn were again reminded of the urgency of accelerated conservation training in Africa. Discussions were initiated with Hermien Dorfling at CE@UP to present the THC 804 (future THC 810) module as a series of short courses that could be attended by practising conservators. The stakeholders just need to formalise a way in which these students can accrue credits towards the full degree if they wish to do so.

Loubser and McGinn hope to keep the THC alumni in the fold, support them in forming centres of excellence in our neighbouring countries and let them develop training programmes with our support. Conservators in Africa enter the profession through very different pathways, such as archaeology, museum studies, tourism, history, art, etc., and do not necessarily have the skills or background for the work they do.

Global Consortium for the Preservation of Cultural Heritage

Organising this conference, held from 27 to 29 October 2021, took up a lot of time in 2020 and 2021. Loubser and the organising committee realised it was a blessing that it had to be fully online as the conference proceedings would reach participants who would not have been able to attend otherwise. The meeting was a mixture of daily topical lectures and, at the end of each day, a round table discussion involving all that day's presenters.

A lot of new voices were brought in by the steering committee: the Netherlands Institute for Conservation, Art and Science (NICAS), the Academic Conservation Education Sharing Site (AcCESS), and Conservation Science Education Online (CSEO). They all hoped to use the GCPCH as a springboard to advance their initiatives—mostly born from needs arising due to COVID-19. This also broadened the scope for the GCPCH and proved to serve the organisations

well in their future endeavours towards sustainability.

Le Roux and McGinn were indispensable in making this GCPCH meeting a possibility. As output, Loubser, McGinn and Le Roux plan to publish the conference proceedings as an e-book through the University of Pretoria's Emerging Scholars Initiative Press.

Academic output of lecturers

- ***PhD thesis***
  - Isabelle McGinn completed her PhD dissertation titled 'More than Staples and Glue: Conservation, Heritage and the Making of a Curriculum'.
- ***Journal articles***
  - De Kamper, G. and I. McGinn. 2021. 'Of Unknown Men: Rembrandt or Not? A South African Provenance Story'. De Arte 56 (1).
  - Hoeane, M. and I. McGinn. 2021. 'Making a Case for the Spiritual Significance of Dinkho tsa Badimo as Sacred Ceramics in Museum Collections'. Pharos Journal of Theology 102 (Special Edition 1).
  - Loubser, M. and S. le Roux. 2021. 'Art? Science? . . . Alchemy: The Materiality of Spiritual Expression in Artistic Creation Revealed through the Analytical Techniques of a Heritage Conservator'. Pharos Journal of Theology 102 (Special Edition 1).
- ***Conference papers***
  - Loubser, M. 2021. 'The Use of Handheld XRF to Identify Foundries Used by the Sculptor Anton van Wouw (1862–1945)'. 70th Annual Denver X-ray Conference, 2–6 August 2021 (Invited Speaker).
  - Loubser, M. 2021. 'Handheld XRF to Identify Foundries Used in Sculpture'. Swedish X-ray Conference (Kemistutbildarna), 20–22 September 2021 (virtual) (Invited speaker).
  - Loubser, M. 2021. 'The XRF Is Still a Dumb Machine'. Swedish X-ray Conference (Kemistutbildarna), 20–22 September 2021 (virtual) (Invited Speaker).
  - McGinn, I., L. Esser and D. Knoetze. 2021. 'Paper at a Distance: Conservation in the Time of the Covid-19 Pandemic'. Mod Dons: Modern Conservation, Modern Constraints, Modern Conveniences, 4–7 October 2021 (virtual), Institute of Conservation, UK, Book and

Paper Group annual conference.

- ***Public interviews***
  - Maggi Loubser. Round table discussion on 'Education and profession realities in different global contexts'. AcCESS (Academic Conservation Education Sharing Site). 18 June 2021.
  - Maggi Loubser. RSG 'Stuur die Goggas in'—Interview, Radio Sonder Grense. 13 August 2021.
  - Maggi Loubser. RSG 'Wat is Kulturele Erfenis en Hoekom is die Bewaring daarvan so Belangrik?'—Interview, Radio Sonder Grense, Martelize Brink. 24 September 2021.
  - Maggi Loubser. 'How Does an Analytical Chemist and Material Scientist Land in a Heritage Conservation Programme?'—Loyola University Chicago. 18 November 2021.
- ***Other academic endeavours***
  - Maggi Loubser co-supervises Davison Chiwara from Zimbabwe with Prof Siona O'Connell on his PhD dissertation titled 'Collections Conservation Practices and Possibilities of Contamination by Hazardous Pesticides: Towards a Non-pesticide Approach of Conserving Organic Artefacts at the Natural History Museum of Zimbabwe'.
  - Maggi Loubser co-supervises Sydney Ngetu on his MSc (Chemistry) dissertation titled 'Comparison of Performance Characteristics of Natural Calcined Clay versus Fly Ash in Pozzolanic Cements Based on Reactive Silica Content of the Respective Pozzolan Materials'.

Proposed PhD projects

Three of THC's alumni considered continuing with their PhDs once there is an optimal place in the School of the Arts. The first is Salomé le Roux, who wants to continue her research on Lucky Sibiya; the second is Mabokang Mokotjo, who wants to continue her study on the conservation and analysis of a Setlokoa cowhide dress; and the third is Henry Nkale, who would like to continue his work on the Oranjemund shipwreck project and try to get funding to move the collection from its inaccessible position in the mine to a previously identified building in the town of Oranjemund. Related to Mokotjo's research, THC is looking for funding to have a dress commissioned for the National Museums of

Lesotho and the entire manufacturing process filmed as part of living heritage conservation.

Funding

The Mellon grant runs until 2023, but in practice, the last two years' funding consists mostly of the programme coordinator's salary and the six remaining student scholarships. There is R45 000 allocated for materials and R25 000 for equipment maintenance in 2022, and in 2023, there is only R45 000 for materials. Fortunately, because THC did not use budgeted travel funding for 2020 and 2021, Loubser was able to stretch the budget into 2022 and hopefully 2023, but alternative funding will be needed if the programme is to continue past 2023. For example, UP does not supply Internet to Van Wouw House, and THC has a fibre contract for close to R1 000 a month.

From experience, the largest expense in the programme is honoraria and travel expenses for visiting lecturers. Another great need is funding to assist students in doing their internships. Hosts identified are typically happy to have them, but THC needs to assist with transport and accommodation costs. There are also costs involved when Loubser has to travel to students' study locations for assistance with analytical work (as was the case with Nkale's research in Namibia and Chiwara's research in Zimbabwe).

Loubser identified the possibility of a 'winding down grant' that specifically addresses these issues and the idea of expanding THC's reach into Africa via centres of excellence.

Loubser also tried to tap into some other relationships built over the first three years. She was in discussion with the Dutch embassy to bring out one of the NICAS associates to teach textile conservation in 2022, which would also serve as the associate's immersion experience as part of the NICAS Mellon International Infrastructure Development for Heritage Conservation. This way, NICAS will fund half the costs, and hopefully, the Dutch embassy will fund the other half. The associate from NICAS, Annelena de Groot, presented textile conservation at THC in 2022.

In her discussions with the embassy, Loubser tried to slot this exchange into a longer-term programme. The relationship with the Dutch, specifically their Train the Trainer initiative, also enabled the identification of a co-supervisor for one of the 2021 students (Hannes Elsenbroek), and she, Lise Havermans-Steyn, also

expressed the possibility of an internship in the Netherlands.

THC also finalised the visit of Salome le Roux to Yale's IPCH in 2022. She would learn more analytical techniques and investigate their imaging lab setup to improve THC's own photography studio. She was awarded an honorarium from Yale's IPCH, but her travelling costs were self-funded.

Upgrading the programme's equipment

Upgrading the photography studio and acquiring a Raman or IR spectrometer to compliment the XRF spectrometer were still on the priority list, but with the distractions of COVID-19 over the past two years, THC did not want to motivate this while there were so many 'life and death' issues at hand. Also, it would be preferable that Le Roux spend her time at Yale working on different equipment techniques before Loubser motivates for large capital expenses.

The XRF spectrometer has already contributed to two master's dissertations and one PhD dissertation and also assisted a fourth-year student in metallurgical engineering with her project, which generated some third-stream income. However, the third-stream income has not been what we hoped for, but 2020 and 2021 had many limitations, so hopefully, as people become more aware of the programmes' capabilities, THC will be utilised more often.

Conclusion

Loubser was of the opinion that the exponential growth in students (not just bursary holders) is enough evidence of the programme's potential. THC is systematically making a name for itself internationally through conferences, student dissertations (external examiners), collaborations with associations like IPCH, GCPCH, NICAS, AcCESS, CSEO and local bodies like the South African Museum Association (SAMA). The private commissions McGinn brings in from private as well as institutional clients are growing evidence of the reputation of the programme's restorative conservation. The fact that institutions like UCT and the Johannesburg Holocaust and Genocide Centre reached out and requested our assistance also underlines this. Thus, 2022, the busiest year that turned into a very successful period, proved THC's capabilities and passion for cultural heritage conservation.

Chapter Three

First Years' Perspectives

Laura Esser and Daniéle Knoetze

Introduction

Intangible values that we ascribe to heritage cannot be dissociated from the material. As a result, a shift in conservation theory and practice took place over the last few decades—from the conservation of materiality to the conservation of value and belief systems. This is our perspective of the first year of attending Tangible Heritage Conservation during COVID-19 lockdowns.

Van Wouw House

Figure 3.1: The front exterior of the Van Wouw House (photograph by Daniele Knoetze).

Van Wouw House is located off-campus in a residential area in Brooklyn, Pretoria. It is a Norman Eaton-designed house that was home to the sculptor Anton van Wouw (1862–1945). The entire house is used for the THC programme and includes a large laboratory with natural light, a lecture room, a second-year students' studio, an imaging lab, a kitchen and Loubser and McGinn's offices. The house was donated to the University of Pretoria by Anton Rupert in 1974, and declared a national heritage building in 1989. Our favourite spots are the veranda and the garden!

Figure 3.2: The 2020 intake of students (photography by Henry Nakale)

The team

Henry Nakale, from Namibia
Mampopi Namane, from Lesotho
Mabokang Mokotjo, from Lesotho
Laura Esser, from Germany
Daniéle Knoetze, from South Africa

THC 801: Introduction

This module focuses on the importance of understanding the use of cultural heritage and the value ascribed to it. The ways in which values and uses of heritage change and fluctuate from culture to culture become clear. Understanding this makes the idea of universality problematic within the field of conservation. Reading materials, lectures and videos are given to the students to grant them the knowledge they need to engage with collections and communities and to teach them how to safeguard cultural heritage. With this platform, the roles and responsibilities of custodians, conservators and curators in the conservation decision-making process become clear. With a focus on the ethical issues related to conservation, we as students develop an understanding that conservation is not an easy, straightforward task but rather a complex duty that must be respected as such. Finally, students started examining conservation and the care of cultural elements. This included investigating traditional methods of maintenance and the repair of cultural heritage materials, while constantly being aware of the elements' context before and after interventions.

THC 802: Chemistry

THC 802 covers the basics of chemistry, focusing on organic chemistry. It may sound scary at first, seeing as most of us had not done chemistry since grade 9, but it ended up being a lot of fun! The approach to the module is very practical, as you can see in the pictures. We worked with models and colours, and nobody got left behind when something was not understood. Even though we covered most of this module in online classes during the lockdown, everybody managed.

Figure 3.3: Maggi Loubser presenting THC 802 (photograph by Henry Nakale)

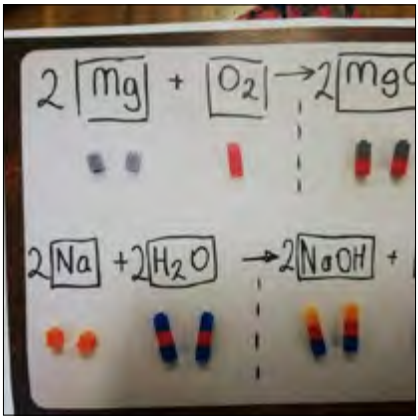

Figure 3.4: Maggi Loubser visualising redox reactions in THC 802 (photograph by Laura Esser)

THC 803: Analytical methods

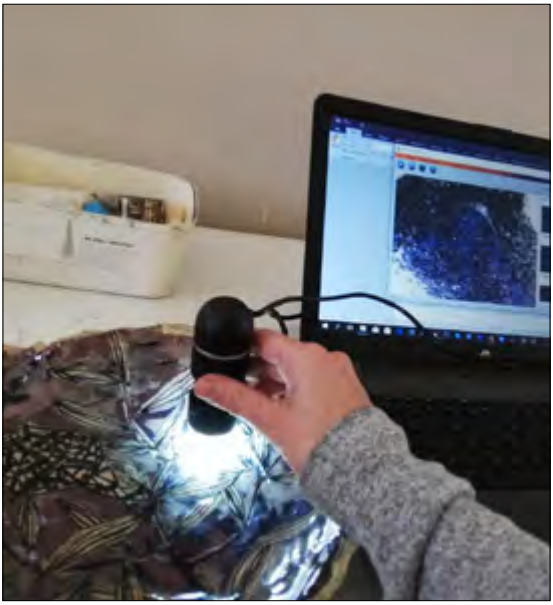

Figure 3.5: Daniéle Knoetze looking at a ceramic object with a USB microscope (photograph by Laura Esser)

This module was presented by Aniko Bezur and Loubser. It covered techniques for analysing materials by identifying elements and atoms, as well as providing a closer look at the surface of an object and what is underneath it. The main topics included microscopy, technical photography, chromatography and spectroscopy. We learned about invasive and non-invasive techniques and how they can be applied to museum objects and artworks. This module was enjoyed by all of us as it opened our eyes to the science behind working as a conservator and what techniques can be used to identify pigments, varnish or adhesive, among many other things. At the end of the module, we had a big assignment in which we categorised the techniques we learned so that we would be able to find appropriate techniques for our future research and work. Generally, all assignments given in this programme serve as future reference guides.

THC 804: Materials

Figure 3.6: Tools and materials from our discovery kits (photograph by Daniéle Knoetze).

Figure 3.7: Daniéle Knoetze, Mampopi Namane and Henry Nakale working on heritage objects during THC 804 (Photographs by Isabelle McGinn)

This module entailed taking what we had learned so far into the 'lab'. Due to COVID-19, we could not go to the laboratory, but Isabelle McGinn put together a toolkit with all the necessary equipment and materials we needed to continue with our practical work online. With her guidance, we could start exploring and practising on objects covered in THC 804 (stone, glass, ceramics, metals, organics, books, paper and photography). In every practical assignment, we had to keep track of what we were doing through photos. Not only did we

learn what an object (for example, a ceramic vessel) is made of, but also of the chemical processes behind it, preventive care, treatment, damage identification, documentation and labelling. This module involves a lot of practical work, including treating commissions, museum objects and objects we brought from home.

Figure 3.8: Top left Laura Esser cleaned a granite rock (photograph by Daniéle Knoetze); bottom left is broken glass shards from a cup (photograph by Laura Esser); and, right is organic and photographic materials (photograph by Laura Esser).

Figure 3.9: Left, Laura Esser filled a crack in a ceramic cup (photograph by Daniéle Knoetze); right, Laura Esser worked on a Thembi Nala Uphiso (photograph by Daniéle Knoetze)

In THC 804, materials including ceramics, glass, stone, organic materials, paper, books and photographs are discussed. Unfortunately, due to COVID-19, we have not yet had the opportunity to discuss plastic and textiles. Most of the lectures given in this module had to be presented online. To be able to practise at home, each student received a toolbox with basic conservation equipment and tools, as well as materials relevant to each topic covered in this module. All previous modules were considered and included in THC 804 and played an important role in understanding the materials and conservation processes. Parts of the module were presented by Nancy Child (organic material and metals) and Anupam Sah (stone), which gave us the opportunity to connect with conservators from all over the world.

Figure 3.10: Left, Mabokang Mokotjo, Laura Esser and Mampopi Namane made storage containers for ceramic coasters (photograph by Daniéle Knoetze); right, ceramic shards used to practice labelling, damage identification and microscopy (photograph by Isabelle McGinn)

Figure 3.11: Left, ceramics included in the discovery kits (photograph by Laura Esser); middle, broken ceramic bowl during treatment (photograph by Daniéle Knoetze); right, ceramic bowl before treatment due to yellow and brittle adhesive (photograph by Daniéle Knoetze).

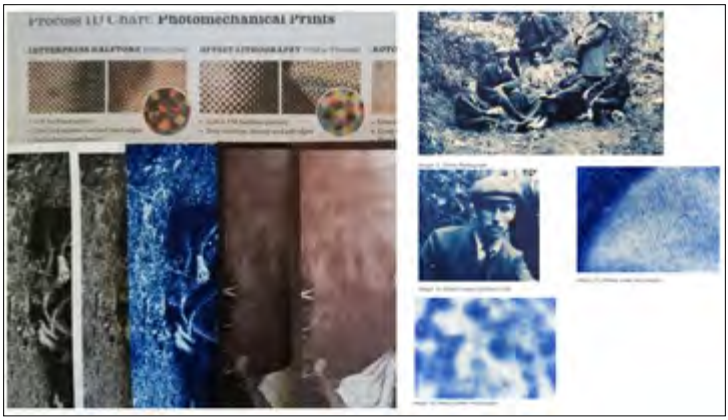

Figure 3.12: Examples of different photographic processes (photograph by Laura Esser)

Figure 3.13: Left, an excerpt from paper-making assignment as examples of how different mediums write on self-made paper (screenshot by Daniéle Knoetze); middle, Mabokang Mokotjo prepared drawings, paintings and prints for her archival fascicule (photograph by Isabelle McGinn); right, Torn and self-made paper with writing in different medium (photograph by Laura Esser)

Figure 3.14: Left, archival fascicule in the making (photograph by Laura Esser); middle, documents and photographs for a group project - Laura Esser's personal family archive was made into a fascicule (photograph by Laura Esser); right, prints and paintings for the individual fascicules of each students to be used as reference material (photograph by Isabelle McGinn).

Conclusion

To conclude, what we as future conservators have learned this year is to understand how objects and artefacts are embedded within social, cultural, religious and political attributes. They are not innocent; they do not stand alone, but rather carry the weight of the societies that created them. They carry meaning, stories, memories and histories. This knowledge helps with conveying the artist and the community's identity to a larger audience. These artefacts and the art that fills our lives are embedded within these histories and must be investigated and respected. Careful consideration of whose history is being preserved and

the way in which cultural heritage is being conserved is crucial and should be constantly challenged and questioned.

This year has been challenging to say the least. Despite this, our online classes have become our safe space and something we all looked forward to. It made the world feel a little less crazy. We have met so many amazing people despite the lockdown. These connections will forever influence us as young conservators.

Chapter Four

Modules' Layouts and Assessments

Isabelle McGinn and Maggi Loubser

Isabelle McGinn wrote the modules' purposes, outcomes and content which is included in the THC study guide, and handed out to each student at the start of their two year degree. Students are made aware of what they need to achieve within each module and how each module fits into the bigger picture curriculum.

Modules Layouts

Year one

THC 801: Conservation Principles and Strategies

Purpose of the module

Although the course is focused on the conservation of tangible forms of heritage, it has become increasingly obvious that the intangible values that we as people ascribe to heritage cannot be dissociated from the material. This has caused a shift in conservation theory and practice over the last few decades, from the conservation of materiality to the conservation of value and belief systems and a new role in the careful management of change. This general introductory module looks at understanding the significance, value and use of cultural heritage, how these changes around the world and calls for universality are highly problematic, and how communities engage with collections and the impetus to safeguard them. Furthermore, the module looks at the roles and responsibilities of custodians, conservators and curators in the conservation decision-making process and the practical, professional and ethical issues related to conservation within relevant ethical and philosophical frameworks with reference to local and African indigenous practices and belief systems, as well as relevant legislative frameworks (legislation, conventions and charters of conservation).

The module also examines the nature and history of the care of cultural elements and of conservation, including traditional methods of maintenance

and repair of cultural materials, and provides an understanding of the use of contextual elements both before and after the conservation interventions.

Articulation with other modules in the programme

THC 801 is an introductory module which grounds the students in the concepts of heritage and the evolution of heritage and conservation, laying the basis for understanding the challenges involved in conserving heritage in different social, economic and political environments, as well as instilling the requirements for ethical conduct and the role and responsibility of conservators in the preservation of heritage.

Module outcomes

At the end of the THC 801 module, students are expected to:

- define heritage in its broader context locally and globally and discuss its changing roles in reflecting but also shaping contemporary society;
- define conservation and describe its importance to cultural heritage institutions;
- understand the role and responsibility of heritage custodians and conservators, in particular, in promoting the longevity of heritage according to ethical and legislative guidelines;
- understand the ethics and philosophy of conservation and how these have changed over time and are influenced by past, current and future use of heritage;
- understand that the preservation and conservation of heritage is influenced by environmental, social, cultural, ethical, economic and political climates and events and that these change over time; and
- argue and advocate for the preservation of heritage within the ethical and legislative frameworks.

Module content

- Introduction to conservation: What is conservation? Role of the conservator

- THC introduction: What is heritage, and what is cultural significance?
- Introduction to South African art history
- Introduction to South African history
- The relationship between collections management, curation and conservation
- Development of conservation
- Roles and responsibilities of custodians
- Ethical/philosophical frameworks
- Competencies of conservators & code of ethics
- Heritage legal frameworks—international and RSA
- How conservation affects interpretation and research
- Working with contested heritage

THC 802: Science Fundamentals for Conservation

Purpose of the module

This introductory chemistry module is specifically tailored to enable students with no previous science background to gain a greater insight into the chemical processes present in the practices and techniques used in conservation. Module content focuses on major conservation issues, including material types, environment, cleaning and deterioration.

Articulation with other modules in the programme

THC 802 is an introductory module which grounds the students in the concepts of chemistry and material science, laying the basis for understanding heritage objects and their base materials, but also the diversity of materials, tools and techniques available to the conservator for the treatment of heritage objects as outlined in THC 804. This allows a deeper understanding of action and consequences and how materials have degraded and changed over time, as explained in THC 804, but also how heritage objects, once treated, will change, act and react in future as students enter their specialist module.

Module outcomes

At the end of this unit, students will be expected to have gained a working familiarity with basic scientific concepts and how these affect the behaviour of materials, objects, treatments and research potential of objects over time.

Module content

- Introduction to chemistry / Why do conservators need chemistry?
- Laboratory health & safety
- Introduction to the lab & practical setup
- Principles of matter & materials
- Atoms, molecules & ions
- Periodic table of the elements
- Atomic structure & chemical bonding
- Reactions & chemicals equations
- Phase transformations
- Liquids & solutions
- Interpreting the teas solubility chart
- Functional groups
- Mineral chemistry
- Hazards & awareness
- Projects

THC 803: Research methods and methodology in conservation

Purpose of the module

This module focuses on the research involved in conservation, aspects of collections-based research including documentation of artefacts, photography, the preparation of research projects, writing project proposals and academic writing for publication. This module has both theoretical and practical components where students will examine, document and carry out analyses on a variety of museum objects.

Articulation with other modules in the programme

THC 803 exposes the students to research in the field of conservation, looking at research methods, tools & equipment and what information they can provide on a particular material or the construction of an object, as well as how to approach research design and research methodology in conservation.

Module outcomes

At the end of this unit, students will be expected to have gained a working familiarity with basic scientific concepts and how these affect the behaviour of materials, objects, treatments and research potential of objects over time.

Module content

- Objects/collections-based research
- Practical assignments/research project with selected objects
- Documentation of selected objects
- Condition assessments
- Discussion & formulation of research questions, the analytical approach
- Writing a research proposal
- Refining a research proposal
- Object documentation
- Imaging techniques: UV-Vis-IR photography
- Principles of experimental design, destructive vs. non-destructive analysis
- Sampling & sample handling
- Hazard awareness
- Imaging techniques: X-rays
- Microscopy: Polarised light, stereo, confocal, scanning electron microscopy
- X-ray techniques: XRF, XRD, PIXE, SEM-EDS, synchrotron radiation
- X-ray techniques: FTIR, micro-Raman, UV-Vis and near-infrared absorption, reflectance and fluorescence, as well as laser-based techniques
- Chromatography: Thin layer & liquid chromatography
- Magnetic resonance microscopy
- Data handling & interpretation

- Advanced techniques (self-study & presentation)

THC 804: Materials, mechanisms of decay & stabilisation of artefacts.

Purpose of the module

THC 804 introduces students to the wide range of materials and objects to be found in heritage repositories. The unit is collections-based, and after a broad exposure, students will be assisted in the identification of a specialist area and supervisor for the ensuing research component, which includes the collections-based practicals/research and mini-dissertation.

This module has both theoretical and practical components where students will learn to differentiate between material types, isolate different component parts of composite objects, and learn about the technology used in fabrication. Students are immersed in the conservation process, looking at handling, exhibition and storage guidelines of each material type, identifying possible causes of deterioration and damage, minimising such damage through the construction of appropriate mounts and enclosures, and responding to damage by stabilising the artefact through basic remedial treatments.

Articulation with other modules in the programme

Drawing on the principles of chemistry and materials science explored in THC802, and how to look beyond the visual surface aspects of objects, THC 804 exposes the students to the great variety of materials used in the manufacture of heritage objects.

Module outcomes

At the end of this unit, students will be expected to have gained a working familiarity with a variety of organic and inorganic materials encountered in heritage collections and objects, as well as being able to document such objects, apply preventive conservation guidelines and provide recommendations for appropriate handling, storage, transport and exhibition of these materials. Additionally, students are expected to be able to carry out basic surface cleaning treatments appropriate for these materials as the first step towards remedial action.

Module content

- Preventive conservation (handling, storage, transport and display)
- Surface cleaning
- Archaeological collections
- Clay, adobe and low-fired ceramics
- Glazed ceramics
- Porcelain and glass
- Plaster, gesso and lime
- Stone
- Metals
- Leather, skin & hide
- Horn, tooth & shell
- Quills and feathers
- Hair, wool and natural textiles
- Wood bark and grass
- Paper
- Books
- Photographs
- Natural history specimens
- Contaminated collections

THC 806: Conservation: Paper & archival collections

Purpose of the module

The introductory principles of remedial conservation will be explored within the specialisation of paper and archival collections, from treatment options and evaluation to the final decision-making processes for appropriate treatment options for cleaning, stabilisation and conservation of artefacts. Paper and archival collections include artefacts on paper-based substrates including manuscripts, sheet music, maps, architectural and technical drawings, archival records, books, and ephemera such as flyers, posters, advertising and photographs. The complexity of treating this group of artefacts lies in their layered structure where different materials can act in conflict with one another.

Articulation with other modules in the programme

Drawing on the principles of chemistry and materials science explored in THC802, and how to look beyond visual surface aspects of objects, THC 806 exposes the students to the great variety of materials used in the manufacture of heritage objects.

Module outcomes

Upon completion of this unit, students should be able to attend to the assessment and documentation of paper-based objects unsupervised, correctly identifying materials, correctly identifying damage and its causes, and proposing appropriate preventive conservation guidelines.

Although the time allotted for practice is insufficient to instil the breadth of knowledge necessary to be fluent in all conservation treatment options and their consequences, students are expected to understand the materials well enough to propose initial basic treatments for remedial action and to be aware of their limitations. It takes years of practice and confrontation with multiple scenarios to develop a trained eye and hand, and practice will have to extend beyond this module.

Module content

- History of books, manuscripts and paper in the African context
- Paper manufacture & identification
- The development of the codex in Africa
- Islamic manuscript tradition in Africa
- European missionary activity
- Colonial administration and occupation (1662–1910)
- Types of paper & identification
- Identification of decorative papers & the techniques of their manufacture
- Identification of media on paper (drawing, print & photograph)
- Deterioration & damage affecting paper

- Preventive conservation strategies for paper-based materials
- Investigative tools & techniques
- Testing paper for acidity, lignin & solubility
- Treatment planning & development
- Documentation of paper-based objects
- Dry surface-cleaning treatments
- Humidification
- Washing
- Deacidification
- Stain reduction & removal
- Drying & flattening after aqueous treatment
- Pressure-sensitive tape removal
- Removal of auxiliary support
- Resizing after chemical treatment
- Tear mending
- Infilling of losses
- Retouching

THC 807: Conservation: Polychrome surfaces

Purpose of the module

The introductory principles of remedial conservation will be explored within the specialisation of polychrome surfaces, from treatment options and evaluation to final decision-making processes for appropriate treatment options for cleaning, stabilisation and conservation of artefacts. Polychrome surfaces include any substrate to which a decorative layer has been applied. They include paper, canvas, cloth, board, wood and metal substrates with applied preparatory layers of ground, paint, varnishes and/or lacquers. The complexity of treating this group of artefacts lies in their layered structure where different materials can act in conflict with one another.

Articulation with other modules in the programme

Drawing on the principles of chemistry and materials science explored in

THC802 and how to look beyond visual surface aspects of objects, as covered in THC 804, in THC 806, the students are exposed to the details of polychrome objects in specific.

Module outcomes

Upon completion of this unit, students should be able to attend to the assessment and documentation of polychrome objects unsupervised, correctly identifying damage and its causes and proposing appropriate preventive conservation guidelines.

Although the time allotted for practice is largely insufficient to instil the breadth of knowledge needed to be fluent in all conservation treatment options and their consequences, students are expected to understand the materials well enough to propose initial basic treatments for remedial action and to be aware of their limitations. Developing a trained eye and hand takes years of practice and confrontation with multiple scenarios, and practice will have to extend beyond this module.

Module content

- Assessment and documentation of polychrome objects
- Supports (rigid, canvas and auxiliary)
- Ground and underdrawings
- Pigment and paint materials
- Consolidation and facing
- Surface cleaning
- Removal of patches, stickers and old linings
- Deformations and planar distortions
- Solvent cleaning
- Lining and strip lining techniques
- Restretching
- Retouching
- Varnishing

THC 808: Conservation: Archaeological collections

Purpose of the module

The introductory principles of remedial conservation will be explored within the specialisation of archaeological collections, from treatment options and evaluation to final decision-making processes for appropriate treatment options for cleaning, stabilisation and conservation of artefacts.

Module outcomes

Upon completion of this unit, students should be able to attend to the assessment and documentation of archaeological objects unsupervised, correctly identifying damage and its causes and proposing appropriate preventive conservation guidelines.

Although the time allotted for practice is largely insufficient to instil the breadth of knowledge needed to be fluent in all conservation treatment options and their consequences, students are expected to understand the materials well enough to propose initial basic treatments for remedial action and to be aware of their limitations. Developing a trained eye and hand takes years of practice and confrontation with multiple scenarios, and practice will have to extend beyond this module.

Module content

- Definition of archaeological conservation
- Archaeological conservation ethics
- Processes of archaeological conservation (that is, pre-excavation considerations, on-site conservation, laboratory conservation and long-term conservation of artefacts)
- Fieldwork: Conservation guidelines, rescue conservation
- Agents of decay in archaeological environments (for example, water, oxygen, acidity, alkalinity, salts, temperatures, organisms, etc.)
- Conditions in archaeological environments (for example, absence of oxygen, absence of water, presence of water, salts and other residues, etc.)

- Understanding the condition of archaeological artefacts affected by several factors (namely, prior use, burial conditions, excavation, recovery methods, analysis and curation)
- Identification of archaeological materials: bone and ivory, leather, wood, shell, glass, ceramics, copper, iron, gold, lead, silver, tin, alloys
- Archaeological techniques of preservation
- Retrieval of artefacts from deposits (including animal and human remains)
- Lifting, moulding in situ, including conditions of burials
- Marking and labelling artefacts of different materials
- Post-excavation assessments
- Examination and cleaning
- Introduction to archaeological conservation documentation and photographic recording
- Condition assessments
- Investigative cleaning, microscopy and chemical analysis
- Preventive packaging
- Stabilisation

- Description, physical characterisation, chemical characterisation and structural characterisation of materials
- Interventive conservation: This involves examination, cleaning, stabilisation, repair and restoration. In archaeological conservation, this is the last resort and, in most cases, should be reversible.
- Desalination
- Consolidation
- Adhesion
- Gap filling
- Permits and permit applications
- Dealing with human remains
- Chemical analysis, visible light, infrared, ultraviolet, radiography

Year two

THC 805: Collections-based practice (internship)

Purpose of the module

Practice forms an integral part of interventive conservation and entails applying theoretical knowledge on treatment evaluation and development, decision-making and honing bench skills. This is a compulsory module in year 2 of the master's programme. The focus should be on interventive/remedial conservation training in the field of specialisation. This may also apply to general preventive conservation practice or heritage management with a strong conservation focus, as it is recognised that not all students desire to be interventive conservators and some may be more theoretically oriented. Training is carried out under supervision within a museum collection or in private practice with an approved conservator-restorer and contains the practical component of the mini-dissertation.

Articulation with other modules in the programme

THC 805 draws on the knowledge and skills gained in all the year-1 modules: THC 801, THC 802, THC 803, THC 804 and THC 807.

Module outcomes

At the end of this unit, students will be expected to have gained a deeper sense of confidence in what they have learnt and be able to apply them in dealing with the preventive conservation of a variety of materials, but also, more specifically, in attending to the various needs of polychrome surfaces, including assessment and documentation, handling, and a variety of techniques for the stabilisation and remedial treatment of polychrome surfaces. Students focusing on remedial conservation are expected to be able to carry out basic surface cleaning treatments appropriate for these materials as the first step towards remedial action.

Students working in an allied field or on more theoretical projects will still be expected to show conservation projects that they have undertaken. In addition

to regular reports, a portfolio of work carried out will be submitted and signed off by the course coordinator.

Module content

The content and focus of your internship will be discussed during a meeting between the course manager and the relevant institutional supervisor or practitioner and will depend on the institution/practitioner's requirements.

THC 800: Mini-dissertation

Students are to submit a mini-dissertation of 20 000–30 000 words on an approved conservation-based topic.

Module Assessment Layout

These assessment layouts are flexible for each year depending on the guest lecturers and available materials. These tables are reflective of 2020 and 2021.

Module	Assignments	Deadline	Relative %
HC 801: Conservation Principles & Strategies			
	Biographical object		15
	Class Quiz 1 - Damage ID		10
	Presentation - Preventive Conservation Frameworks		50
	Class Quiz 2 - Handling		10
	External Mark		15
Total Module Mark			100
THC 802: Science Fundamentals for Conservation			
18 Credits			
Class Assignments			
	Safety Quiz		n/a
	Quiz 1		5
	Periodic Table of Elements		5
	Quiz 2		5
	States of Matter		n/a
	Lewis Structure Worksheet		n/a
	Exothermic Endothermic Worksheet		n/a
	Redox Number Worksheet		n/a
	Redox Reactions		n/a
Module	**Assignments**	**Deadline**	**Relative %**
Essay	Nature of Matter in the Context of Conservation? Essay		20

Presentations	Present Pigments in Terms of Composition, Uses, Problems etc.		5
	External Mark		
Total Module Mark			100
THC 803: Research Methodology in Conservation			
	Mindmap of Project		10
	Poster on Analytical Techniques		45
	External Mark		45
Total Module Mark			100
THC 804: Materials, Mechanisms of Decay & Stabilization of Artefacts			
25%			
Practicals			
Class Assignments	Surface Cleaning Homework (35 pts)		15
	Cleaning Practical (5pts)		10
	Stone (5pts)		10
	Textiles (30pts)		30
	Furniture (100pts)		35
Subtotal			100
25%			
Metal Conservation			
Class Assignments	Metal 1: Identification (50pts)		20
Module	**Assignments**	**Deadline**	**Relative %**
	Metal 2: (50pts)		10

	Metal 3: (50pts)		20
	Metal 4: (50pts)		20
	Metals Week Paper (100pts)		30
Subtotal			100
25%			
Organics	Organic Chemistry (150pts)		25
	Organics 1 (30pts)		15
	Organics 2 (30pts)		15
	Organics 3 Chicken Bones (150pts)		25
	Ivory, Bone, Antler and Horn Test (100pts)		20
Subtotal			100
25%			
Ceramics	Labelling & Numbering (10pts)		10
	Porosity (5pts)		5
	Manufacture (5pts)		5
	B&W Consolidation and Adhesion (35pts)		25
	Porcelain Restoration (60pts)		55
Subtotal			100
Total Module Mark			100

Chapter Five

Discovery Kits

Isabelle McGinn and Salomé le Roux

Introduction

The discovery kits for THC 804 were established out of necessity when first-year master's students had to investigate different materials from home during South Africa's level 5 lockdown. The discovery kits were compiled by Isabelle McGinn and Maggi Loubser and were couriered to each student. Students were able to explore different materials with different tools and equipment, and then write assignments accordingly.

Contents List

Top Tray

Documentation:	
• 1x flashlight • 1x UV flashlight • 1x UV examination glasses • 1x seamstress's measuring tape • 3x pairs purple nitrile gloves • 1x magnet	

Tools:	
• 1x HB pencil • 1x black archival pen • 1x bamboo stick with 1 sharp and 1 flat end • 2x kebab sticks • 1x sable hair • 1x golden Taklon size 3 • 1x flat golden Taklon • 1x stencil brush • 1x hake brush • 1x mop brush • 1x synthetic makeup brush	
• 1x fine point tweezers • 1x self-locking fine point tweezers • 1x curved point tweezers • 1x flat tweezers • 1x size 3 scalpel handle • 2x packets of 11 scalpel blades for size 3 handle	

Paint & numbers:
• 1x watercolour set • 1x gouache tube • 1x oil tube • 1x acrylic tube • 1x small glass dish • 1x 2ml matt acrylic glaze in 5ml tube • 1x 2ml 10% B72 acrylic in 5ml tube • 1x 2ml 20% B72 acryilic in 5ml tube • 1x 2ml 50% B72 acrylic in 5ml tube

Lower bin

Documentation:
• 1x optivisor • 1x USB digital microscope x1600 magnification • 1x spring scale
Material samples & specimens:
1x bag of ceramic samples • low-fired earthenware fragment • glazed earthenware fragment • porcelain fragment • plaster **1x bag ceramic objects** • unglazed terracotta • glazed terracotta • hand painted terracotta • porcelain • glass

1x bag of natural specimens

- 1x feather
- bamboo mat
- 2x wood samples
- 2x tanned leather samples
- 3x shell
- 1x bone object fragment

1x bag of metal samples

- 1x copper coin
- 1x patinated copper plate
- 1x brass plate
- 1x copper alloy object
- 1x silver object
- 1x 9ct gold-plated earring
- 1x aluminium 'gold'
- 1x nickel
- 1x aluminium foil
- 1x aluminium coin
- 1x tin
- 1x iron
- 1x galvanised steel fragment
- 1x steel teaspoon
- 1x plastic tub for making polishing paste
- 1x small packet of calcium carbonate powder for making polishing paste

1x bag of polymer samples

- polyethylene
- polypropylene
- polyurethane
- 1x polystyrene fragment
- 1x polystyrene yoghurt tub
- 1x silicone fragment
- vulcanised rubber
- 1x nylon stocking fragment

1x bag of textile samples

- wool
- X
- silk
- linen
- cotton
- X
- X

1x bag calico for dyeing

1x bag of paper samples

- coconut husk
- handmade plant fibre x3
- blotting paper
- paper with laid lines
- parchment
- vellum

1x bag of 5 photography samples & ID sheets • silver gelatine print matt • silver gelatine print gloss • cyanotype • albumen • salted paper print	
1x bag paper making • embroidery hoop • netting	
1x plastic tub	

Chapter Six

Students' Theses Titles and Abstracts

Salomé le Roux

Graduates of 2020

Salomé le Roux

Title: A technical survey of Lucky Madlo Sibiya's (1942–1999) materials and techniques employed in his carved and painted wood panel artworks

Abstract: The study aims to achieve an understanding of the artist's materials and techniques used by Lucky Madlo Sibiya when he created his carved and painted wood panel artworks. A survey of the artist's materials and techniques is of great importance because he is represented in multiple institutional, corporate and private collections—including the University of Pretoria. His carved and painted wood panel artworks are also reaching an age (at least 20 years old, as 2019 is the twentieth anniversary of his death) when they would soon require conservation and restoration if not stored and displayed according to sound conservation conditions and standards. For best-practice conservation and restoration, in-depth knowledge of the materiality of an artwork is needed. In order to reach an in-depth knowledge of the materiality of Sibiya's carved and painted wood panel artworks, the survey intends to examine and document through the combination of various historical, visual and analytical techniques artworks with unrefuted provenance. The analytical techniques used are popular in heritage conservation because they are non-invasive and non-destructive. They include provenance studies, visual examination, technical photography, X-ray fluorescence and Fourier-transform infrared spectroscopy. In combination, the techniques should reveal the materials and techniques Sibiya employed. This knowledge will be used to safeguard and preserve this part of South African art heritage.

Link: https://repository.up.ac.za/handle/2263/78370

Emilia Zambri

Title: Heritage and reconciliation within a post-colonial society, Cockatoo Island a case study

Abstract: Heritage conservation and management has its own challenges and opportunities. If done correctly, it has the potential to re-establish the thread of continuity with a previous time. Most prominently, heritage conservation and management has the ability to facilitate legislative change and promote reconciliation and social reconstruction in a sustainable manner. It is this research paper's intention to re-imagine the conservation and management process at a post-colonial heritage site with a shared history and meaning. Keeping this objective in mind, Cockatoo Island is discussed as a suitable heritage site and case study for the paper. The investigation into the case study will be undertaken by taking inspiration from Roha W. Khalaf's article, 'Cultural heritage reconstruction after armed conflict: Continuity, change, and sustainability'. The study will reframe Khalaf's concepts of cultural continuity, change and sustainability by investigating its application to the discussed heritage site's conservation and management processes. The synergies between Khalaf's conceptual ideas could strengthen the connections between indigenous communities and their heritage sites. Further, these synergies could also facilitate the social reconciliation of post-colonial communities, especially in the context of shared history and meaning.

Link: https://repository.up.ac.za/handle/2263/78339

Mabafokeng Hoeane

Title: The spiritual significance and conservation of Dinkho tsa Badimo at the Ditsong National Museum of Cultural History

Abstract: There is a lot of published literature in the disciplines of archaeology and anthropology on ceramics that, among other things, focuses on their typologies, dating sequences, manufacture and trade with reference to groups of people that inhabit the southern African region. Additionally, several studies have focused on the use of ceramic objects, including figurines, in the ritual practices of these societies. However, the emphasis has been differential and skewed as it has largely been focused on certain cultures such as that of the Zulu group or linked to archaeological sites to the exclusion of other groups. For example, there is scant literature that focuses on the description or discussion of

ceramic vessels by the Basotho-Batswana people of southern Africa, who, like the Zulu, have an active ceramic tradition including the manufacture and reverence of spiritual ceramic vessels. The thrust of this dissertation is therefore to widen our understanding and knowledge of the spiritual significance of African ceramic vessels by focusing particular attention on how these Sotho-Tswana groups practice this tradition with the ultimate objective of encouraging the appropriate recognition and preservation of traditional African ceramic vessels.
Link: https://repository.up.ac.za/handle/2263/78164

Graduates of 2021

Daniéle Knoetze

Title: The art of 'looking': A technical analysis of Alexis Preller's *Man in the sun*
Abstract: The study aims to achieve a deeper understanding of the materials and techniques used by Alexis Preller in his early work, *Man in the sun* (1936). A survey of the artist's materials and techniques is of great importance as this information can guide conservators so that appropriate conservation actions can be applied in the future. Furthermore, by investigating Alexis Preller's *Man in the sun*, a greater appreciation and understanding of the painting's anatomy will be achieved. This work intends to examine and document the materiality and techniques used by Preller through the combination of various historical, visual, and analytical techniques. The analytical techniques used are a preferred response when dealing with the conservation of oil paintings on canvas because of their non-invasive and non-destructive nature. These techniques include provenance studies, visual examination, technical photography, and X-ray fluorescence. In combination, the techniques should reveal the materials and techniques Preller used in *Man in the sun*.

Laura Esser

Title: The (im)permanence of fading smoke: A conservation case study of Diane Victor's soot drawings
Abstract: The South African artist Diane Victor explores soot as a medium, using candles to create magnificent artworks on paper and, more recently, on stone and glass. The artist interview with Diane Victor, which forms the main

part of this talk, explores the artist's intent regarding the stability and longevity of her soot drawings, as well as Diane Victor's technique, packaging, transport, and exhibition preferences. Documenting artist intent through interviews with living artists has gained increasing attention and importance in the field of contemporary art conservation. Artist interviews can help conservators better understand the artist's techniques and the processes involved in creating a particular artwork: what the artist intends for the work of art as it ages, what is important to the artist with regard to a particular work of art, as well as how the artist would view interventive treatment to conserve or restore a particular work they created, among other things.

Mampopi Namane

Title: Assessment of preservation of paper records at the Lesotho National Archives

Abstract: This paper aims to assess the state of preservation of paper records at the Lesotho National Archives (LNA). The LNA was established in 1958 when Lesotho was a protectorate of Britain. Museums, libraries and archives are all collecting institutions, and although their collections may be of different material types, their collections are all associated with historical, social, artistic, scientific and research 'value', to name a few. Archival institutions around the world are mandated with housing some of the oldest records and are working tirelessly to retain the information contained within these records. This mandate comes with many challenges, and although these may seem independent of one another, there is some common ground, particularly in African countries where these challenges commonly stem from the financial hardship some countries are facing in addition to a lack of awareness of the importance of cultural heritage.

The challenges of archival preservation in the LNA mostly stem from a lack of financial backing and a non-existent archival policy. The LNA is committed to preserving its records for future use, but the preservation is not addressed in a uniform manner. Currently, the Lesotho State Library, which houses the LNA, operates with no allocated budget, and this makes it difficult for the archives to source outside means for funding independently because the government has been unable to pay subscription fees to associations such as the International Council on Archives (ICA). The storage facilities in the LNA are built in such a

manner that mediocre preventive conservation is achieved; there is a broken HVAC system, no compliance to a preventive conservation framework and a lack of skills, devaluing what protection was partially offered by the building. If the prevailing situation continues, the deterioration currently observed will worsen, and there is a strong risk of both information and material loss.

Mabokang Mokotjo

Title: Investigation of artisanal tanning in Lesotho communities using a Setlokoa cowhide dress as a case study

Abstract: Cowhide dress (*mose oa khomo*) used to symbolise Basotho women's traditional attire, but recently it has only been associated with a small group of women who participate in initiation ceremonies. *Seshoeshoe*, a modern cloth and European print developed over time with different styles, is now generally considered 'traditional'. As a result, the intangible cultural heritage of crafting *mose oa khomo* and other Sesotho material cultures is disappearing. Basotho used to produce leather and cowhide products in large numbers and had their methods of leather preparation, tanning and conservation. However, with the introduction of Christianity, industrialisation and urbanisation, traditional customs, including attire, have increasingly waned. And the decline in the traditional use of cowhide and leather products has resulted in an alarming abandonment of the associated skills. It has resulted in the gradual extinction of indigenous knowledge as part of intangible heritage.

The research uses a Setlokoa cowhide dress as a case study to understand the skills behind the crafting of *mose oa khomo*. It further investigates the traditional conservation methods and the significance of *mose oa khomo* in Sesotho tradition, including the symbolic meaning of the patterns of beads and copper rings used to adorn the dress. Interviews, observation and literary sources revealed that leather preparation and tanning is no longer gender-based among the Basotho. It is no longer only done at *khotla* but has become primarily a communal activity done jointly by men and women. In addition, *mafura a lefehlo* (fat prepared with sour milk) and red ochre are used for tanning, softening and conserving leather products and have not been documented to date.

Furthermore, this research's case study was my paternal grandmother's initiation graduation and wedding dress, which she later used during crucial initiation ceremonies. Since there is no doubt that hide preparation and

tanning is rapidly disappearing because it is currently rarely done, this study has documented the current methods used in leather manufacturing and conservation. A condition assessment was done on the case study with signs of deterioration identified and possible treatment options suggested based on current conservation methods used to preserve and restore leather, glass and copper objects since the case study contains these three materials. This research forms the basis for conserving Sesotho material culture as it is the first study to document cultural objects traditionally produced in the country and aims to investigate Lesotho's intangible and tangible cultural heritage for conservation.

Henry Nakale

Title: Oranjemund shipwreck: A composition analysis of the pewter kitchenware and their conservation aspects

Abstract: This dissertation deals with the condition and possible conservation treatment of the pewter objects at the Oranjemund Shipwreck Collection. The Oranjemund shipwreck is one of the oldest and most intact wrecks ever to be discovered in sub-Saharan Africa. This study is largely informed by archival research, interviews and X-ray fluorescence spectroscopy. This study is situated within the framework of safeguarding and preserving underwater cultural heritage and is guided by the UNESCO 2001 Convention for the Protection of Underwater Cultural Heritage. It was established that the collection of pewter objects in the Oranjemund Shipwreck Collection is in a fair condition and presents a very simple class with no pieces of status or any decorations. Unfortunately, the National Museum of Namibia has no qualified conservators, and because of this, its conservation department is not functional. Therefore, most of the objects in the Oranjemund Shipwreck Collection are not optimally cared for. The researcher thus recommends staff training on conservation and acquisition of proper storage facilities for the Oranjemund Shipwreck Collection.

Graduates of 2022 Proposed Titles

Nancy Collett

Home sweet museum: Investigating the crossover between museum and residence at the Lindfield Victorian House Museum

Hannes Elsenbroek

An examination and discussion of the conservation decision-making process using Anton van Wouw's *Cattle grazing near Pretoria Zoo* as a case study

Carmen Joubert

Temporality in South African modern art and the role of conservation in its experience

Nkami Manyike

Should we burn or conserve? A case study of the *Moxwera wa Babaso* newspapers

Marinda van der Nest

An analysis of paper made from the dung of elephants, rhinoceros and other wild herbivores to develop conservation guidelines

Loreal Vos

Challenges in contemporary mixed media collections: Storage and preventative conservation of South African artists' books at the Jack Ginsberg Centre for Book Arts

San-Mari van der Merwe

I want to tell you my name: Augmented reality as a conservation method for *Between words and images* by Ernestine White-Mifetu and Tony Giselle Stuart

Jabu Ntuli

Identifying challenges in the conservation of South African photography based on three case studies: Looking at why these challenges exist and how they can be remedied

Yanga Dlaba

A technical analysis to determine polychrome surfaces on selected tenth-century Schroda figurines

Chapter Seven

Students' Assignments

Carmen Joubert: THC 801

Carmen Joubert, for her first assignment on a biographical object, meant to introduce the students to each other, wrote about her great-grandmother's suitcase that she has used constantly during her life. She was part of the 2021 intake of students.

My suitcase

Figure 1: A vintage Basset travel trunk from the 1930s. It is an Air Force blue rectangular suitcase, roughly 0,8 m x 0,5 m in size. The suitcase itself is made out of hardboard. It has a unique locking mechanism made of metal, with a wooden handle. It belonged to my maternal great-grandmother.

'Our battered suitcases were piled on the sidewalk again; we had longer ways to go. But no matter, the road is life.'—Jack Kerouac, *On the Road*.

I chose my suitcase as my autobiographical object. A dusty blue case that has become one of the most significant objects in my life as the child of a diplomat. Not only has it been one of the few constants throughout my travels, but it has

also become a symbol of the values I have gained. I have used it over the years to carry my personal possessions from place to place, no matter the distance.

My suitcase connects me to the past, present, and future. My ancestors, French Huguenots, sailed to South Africa between 1688 and 1691, mainly to flee from religious persecution. During this time, suitcases stood as a symbol of change and travelling towards the unknown—something I have had my fair share of throughout my life. With the unpredictability and turmoil of modern society, a suitcase is something that cannot be replaced by technology. This is perhaps one of the most comforting aspects of the suitcase—being an element that ties me to the past and simultaneously transcends time simply because its form directly follows its function. It is my totem, an anchor tying me to reality.

Even though I do not have a strong connection to my ancestors, I know that settling somewhere new can be difficult. As the daughter of a diplomat, I have lived in five countries—most recently India, where I completed my honours degree and my younger sister ended her high school career. From a young age, I've had to learn to look forward to big changes and adapt to create positive and valuable experiences. This mostly led to my sister and I building a lot of moving-box forts, an essential step in the unpacking process. But it also gave us perspective on what we carry when we move.

'Though we travel the world over to find the beautiful, we must carry it with us, or we find it not.'—Ralph Waldo Emerson, *Emerson's Essays*. What fits into a small suitcase? What's important to you? Sometimes, it becomes too heavy and so we have to repack our belongings so they fit, discarding what is no longer needed and finding new ways to arrange what matters. In the same way, we make and remake the luggage we carry to fit our new, built world. I've found that this doesn't only apply to what we pack—what I carry inside my suitcase—but also to identity. Marcel Proust writes in the fifth volume of *In Search of Lost Time*: 'The real voyage of discovery consists not in seeking new landscapes, but in having new eyes.' Travel has allowed me to gain new insight into so many different cultures. It has gifted me with new ways of seeing and experiencing without preconceived ideas and judgements. But these new eyes and cherished fragments of the world I carry with me in my suitcase, a special form of uncertainty in who I am, were brought along with them. When I was younger, I thought I was Peruvian, and when we came back to South Africa from our posting in Uruguay, I couldn't identify with anyone in my primary school. My life has been a process of constant cultural recalibration, something that might create what seems to be a confused

suitcase to the normal tourist—a jumbled mix of untidy memories. The niche and mysterious samples of an obscure collector.

Evolving suitcase contents mirror evolving identities because with adaptation comes a change in what version of me I attach myself to. I can see many of my own qualities in my suitcase—a hardened exterior that can withstand many climates and tumbles, even falls. Sometimes the contents stay protected, and other times they become damaged by the rain or lost and forgotten. My suitcase has some enviable qualities too; it shows every mark and scratch, every etched memory exposed and remembered exactly, every stain from a once-resting Chai cup on a train from Delhi that was delayed by hours, every scuff from a clumsy traveller on a packed bus in Italy in the hot summer.

Every imperfect memory carved into it creates an irreplaceable object woven with countless moments that give it a sense of place. It belongs somewhere, to someone who very often feels misplaced.

'Wherever you go becomes a part of you somehow.'—Anita Desai. Only my suitcase can carry what is most important to me. My little suitcase has become a symbol of the valuable experiences and lessons I have picked up from my travels. It is the most significant part of every trip. In the same way, one of my favourite films, *The Darjeeling Limited,* directed by Wes Anderson, depicts suitcases as a symbol of the characters' journey. Three brothers reunite for a quest on the Darjeeling Express to find their estranged mother after their father passes away. With their father's passing, great emphasis is put on his physical belongings such as his glasses, which the older brother insists on wearing even though they give him a headache. As well as the glasses, the suitcases that once belonged to him also accompany them on the trip. They are authentic calf-leather, 'classical style' 60s suitcases decorated with his initials, J.L.W., and a series of tropical motifs: giraffe, rhinoceros, antelope and palm trees. One of the brothers, Francis, says towards the end of their journey, when they have come to realise that the trip wasn't really about finding their mother at all but rather to gain self-awareness and self-acceptance: 'Dad's bags aren't gonna make it.' They don't, and only the essentials remain. Before the event where they leave their father's suitcases behind, their train gets lost and one of the brothers asks how far off course they are. One of them replies: 'Who knows? We haven't located us yet.' Maybe I haven't located myself yet either, but I can trust my suitcase to keep track, and that has a lot of value. Once the luggage in *The Darjeeling Limited* sheds its meaning as a metaphor for the brothers' emotional baggage, these suitcases become a clear

and significant symbol of what they gained on their journeys.

'The journey itself is my home.'—Matsuo Basho. I can build a home out of my suitcase. My suitcase is my comfort, my constant through all these years of travel. I can't imagine not travelling, not having to settle somewhere new, not having to fight to fit in and make connections and then say goodbye just as things felt 'complete'. Because in those areas of insecurity and discomfort and change, that's where my suitcase lives. My suitcase can be picked up in the hazy realm at any time, ready for a new expedition. In the past, present and future, my suitcase makes a home for me.

Salomé Le Roux: THC 801

Salomé le Roux was one of the first three students to register for the THC programme. She completed her degree in 2020 and is continuously studying South African artists' materials. She was also appointed assistant lecturer on a yearly contract.

Introduction

The Kingdom of Benin and its people have an emotional, spiritual and contextualising relationship with their art objects. This essay attempts to demonstrate that the art objects, such as the Benin bronzes, have a long existence in the history of the Kingdom of Benin and are an intrinsic part of its social and political structures, as well as its cultural and spiritual practices.[1] First, the context is set. A brief history of the Kingdom of Benin is discussed, in order to situate the production and use of the Benin bronzes. Thereafter, the concept of Benin art is elaborated on, as it sprang from the brief history discussion. Once the context has been set, a discussion of the British punitive expedition of 1897 and how the Benin bronzes came to be in museums around the world is established. At the end, before concluding the argument, I make my case for the restitution of the Benin bronzes. The argument is based on the intangible aspects of tangible cultural heritage and their importance in the formation of identity and legitimacy of the Benin people. Even though it is not within the scope of this essay to provide possible restitution solutions, the conclusion touches on various possibilities for the restitution of cultural property and heritage.

Context

A short history of the Kingdom of Benin

Benin is a kingdom in Edo State, Southern Nigeria, West Africa. Its capital is called Benin City, and even though the kingdom, the capital and the art are known as 'Benin', the people call themselves, their kingdom, their language and their city 'Edo' (Ben-Amos 2003).

1 For the purpose of the essay, I refer to the Benin plaques as either the Benin bronzes or plaques. The plaques are known as the Benin bronzes, even though they are in fact brass objects.

Figure 1: Representation of the territory of the Kingdom of Benin at the height of its power (Blier 1998:44)

In the fifteenth century, when Portuguese explorers, on their quest to find a route to India, came into contact with the Kingdom of Benin, they found a powerful and prosperous civilisation (Ben-Amos 2003). Little is known about the history of the Kingdom before contact with the Portuguese, but oral histories and traditions of the area suggest that the dynasty was initiated in or before the fourteenth century (Ben-Amos 2003).[2] From the mid-fifteenth to the end of the sixteenth century, the Kingdom of Benin, under the rule of five consecutive warrior kings, or obas—Ewuare, Ozolua, Esigie, Orhogbua and Ehengbuda—became a force to be reckoned with.[3] According to Paula Ben Amos (2003), this was the period

2 According to Werner Gillon (1984: 248), oral histories and traditions refer to 'an old "dynasty", that of the Ogiso . . . whose rule over the city of Benin is said . . . to have begun about A.D. 900'. However, according to these oral histories and traditions, in the twelfth century, a rebellion ended the Ogiso, and a new king from Ife, Oranmiyan, was sent to Benin at the request of the city elders (Gillon 1984: 248).

3 The Kingdom of Benin, after contact with the Portuguese and at the height of its power, covered an estimated 10 400 km2. Figure 1 represents an idea of the reach and size of the Kingdom of Benin in the late sixteenth century.

in which the obas 'extended the boundaries of the kingdom and established the core institutions, rituals and art forms that were to characterise the kingdom through the remaining centuries of its independence.'

The oba inherits spiritual powers from his predecessors as well as his royal possessions, such as the royal relics, regalia, insignia and paraphernalia (Ben-Amos 2003). [4] The first of the warrior obas, Ewuare, is credited for the creation of the layout of Benin City, the organisation of the chiefly associations, the centralisation of politics and administration, and the artistic organisation in the Kingdom of Benin (Ben-Amos 2003). Regarding the first attribution, Benin City was divided into two parts, the oba's area, called Ogbe, and the town at large, Ore n'Okhua, with the oba's palace, Eguae-oba, at the centre of Ogbe and Benin City (Ben-Amos 2003).

From traveller's reports, writings and recollections, the Eguae-oba of the oba was the 'hub of the nation', with many visitors, dignitaries and travellers describing it as being 'a vast complex covering several hectares, containing not only the residential quarters of the king and his numerous wives and offspring but shrine rooms, council chambers, work spaces for guild members, and extensive storage areas for the ritual paraphernalia, tribute and other property of the king' (Ben-Amos 2003).

The Eguae-oba was intricately decorated with depictions of his exploits and feats—his status imagery. According to two accounts—one from 1686 by Dapper, a seventeenth-century traveller, and the other by British forces in the nineteenth century—the Eguae-oba was described as having 'beautiful long galleries with pillars covered with cast copper, on which are engraved the pictures of their war exploits and battles . . . [and] lintels and rafters of the council chambers and residential areas were lined with sheets of brass covered with geometric repoussé designs' (Ben-Amos 2003, Blier 1998: 60). Cyril Punch, a British trader and traveller to Benin in 1889, described what he saw at the palace of the oba: 'mostly statuettes and plaques in deep relief, portraying scenes in the history of Benin and commemorative tablets of dead kings' (Ben-Amos 2003).

This period of expansion and cultural, social and political development is especially depicted on the 'low-relief plaques that apparently once adorned the palace walls' (Ben-Amos 2003). This brings the discussion to the third

4 The oba was considered a divine king—he was simultaneously human and god and stood in a special and direct relationship with the ancestors and other Benin deities (Ben-Amos 2003).

creation attributed to Oba Ewuare, the artistic organisation. Oba Ewuare and his successors were patrons and promoters of the arts by initiating and sustaining policies and procedures of its development and promotion. After contact with the Portuguese, and the subsequent importing of coral beads, red cloth, headgear, and brass bars, the artistic practices of Benin guilds and crafters expanded (Ben-Amos 2003).

After trade with the Portuguese faded, the Kingdom of Benin continued trade and commerce with other Europeans, especially the Dutch, French and English. Prosperity continued until about the late seventeenth century, when an oba died without an heir, and nine subsequent claimants and kings could not establish their legitimacy. The first to do so, at the beginning of the eighteenth century, was Oba Ewuakpe, and later Oba Akenzua I, by establishing a legitimate line and introducing primogeniture to the royal house (Ben-Amos 2003). Again, through political, economic and artistic means, the obas of the eighteenth century brought about authority, peace and trade. The arts, especially, flourished and were used to depict the recovery of the royal house and its divine connection and dependence on spiritual powers of validity. Ben-Amos (2003) describes various examples, such as

> elaborately carved ivory tusks set on brass memorial heads on the royal ancestral altars and altarpieces; a rectangular tableau depicting the king in his most elaborate attire at the main divine kingship rituals, a clear reflection of the concerns of the time. A number of singular objects were also created: a magnificent cast-brass stool decorated with motifs signifying mystical power and alluding to the great 16th-century king, Esigie; a series of brass masks (examples, London, BM) used in a ceremony honouring Ododua, the founder of the royal dynasty; a sceptre (New York, Met.) depicting the monarch who overthrew the most powerful rebel chief; and a brass head (London, BM) depicting birds surmounting a human head, recalling the mystical powers of the forest that support the kingship.

By the end of the nineteenth century, the Kingdom of Benin's territory was threatened from the north, the east and the coast. The Kingdom was an obstacle to the British expansion into the interior of Western Africa, and after the ambush

and murder of a British envoy on their way to the oba, the British launched the punitive expedition of 1897 (Ben-Amos 2003). The Kingdom of Benin lost its independence, and the oba was exiled. However, when Oba Eweka II attained the title and status of oba in 1914, Benin was reinstated as a centre of art production (Ben-Amos 2003).

Benin art

Figure 2: The Benin plaques displayed in The British Museum, London (Bailey 2018)

Throughout the various rulers' reigns, the oba was the primary patron of the arts. He commissioned art objects of brass, ivory, iron and wood for his Eguae-oba and shrines and ceremonial dress and objects of coral beads, cloth, metal and leather for use in the annual cycle of royal rituals.[5] According to Ben-Amos (2003), the estimated 1 000 brass plaques that adorned the Eguae-oba's walls 'portray a variety of court figures – warrior chiefs, priests, musicians, kings, officials and servants – as well as such animals as leopards, snakes and crocodiles, symbols of the oba's ferocious power.' Figure 2 shows the various imagery on the plaques, which are displayed in the British Museum. The most prestigious craftsmen in the Kingdom of Benin were the brass casters. In the lost-wax technique, the commissions included 'commemorative heads, elaborate tableaux and figures

5 Chiefs and priests were permitted by the oba to acquire and own similar dress and objects, but of inferior quality and intricacy (Ben-Amos 2003).

of horsemen and messengers for the royal ancestral altars and plaques depicting court life and royal triumphs for the palace walls' (Ben-Amos 2003).[6]

There is no doubt that the creation of the brass plaques required a high level of skill and artistic ability. The significance of the brass material in the plaques is important. The brass is considered enduring, permanent and powerful, and it is associated with inherent power that can ward off evil and bad luck. It is thus well-suited to preserving, protecting and treasuring the accomplishments of obas, the politically and culturally significant events and moments, and to enforcing their permanence as a people (Ben-Amos 2003). The prevailing iconography on the Benin plaques makes specific references to the social and political power and status of the Kingdom and obas to those who would view them on the Eguae-oba walls (Layton 1991: 75).[7] Figure 3 is a representation of an oba flanked by his aids and servants. The diminished sizes in relation to the oba are reflective of their social status and rank. The title of the plaque, as given on The British Museum website, is indicative that the plaques lack their history, understanding and significance.

For the people of Benin, Benin art is intricately intertwined with their history.

The art objects created are a means to preserve, protect and treasure their past. This relationship between Benin art and Benin history is most prominent in the brass plaques (Ben-Amos 2003).[8] During the latter part of the twentieth century, the plaques are interpreted as depicting events, scenes and moments from their past. The plaques are used to reconstruct the history of Benin as captured in the collective memory of these objects (Gillon 1984: 259). As observed by Dapper and Punch (referred to earlier), the link between art and history in Benin was a well-established tradition in their culture. However, it is understood that the extent to which the plaques represent specific, named individuals, as opposed to general types, is unclear, and the portrayal of specified individuals and general types may have fluctuated (Ben-Amos 2003).

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6 The lost-wax technique is described as follows: 'a molten metal is poured into a mould that has been created by means of a wax model. Once the mold is made, the wax model is melted and drained away. A hollow core can be affected by the introduction of a heat-proof core that prevents the molten metal from totally filling the mold' (The Editors of Encyclopaedia Britannica 2018).

7 For example, the leopard was the king of the jungle, and in order to show the oba's strength and divinity, he is the only figure depicted overpowering a leopard (Layton 1991: 78).

8 Interestingly, according to Ben-Amos (2003), the phrase '"to cast a plaque" can be used metaphorically for the creation and establishment of a tradition and monument.'

According to Gus Casely-Hayford (2012), the plaques are historical documents that depict 'everyday and mythological scenes, images of great political, military and ceremonial importance.' They are also 'symbolic of the enduring continuity of historical narrative' (Casely-Hayford 2012: 211).

How Benin was looted

According to William Fagg (1978: 10), in 1892, the British demanded that the Kingdom of Benin should terminate the practice of human sacrifice and allow mutual trade. However, by 1896, when it was evident that Oba Ovonramwen would not consent, Consul Phillips led an envoy to Benin City, despite being warned that the oba could not receive them due to the celebration of an annual festival.[9] On 4 January 1897, led by diehard war chiefs, not under the command of the oba, the envoy was ambushed, killing all but two individuals (Fagg 1978: 10, Casely-Hayford 2012: 234). Thus, in 1897, a decisive moment in the history of British colonialism, the British embarked on a military campaign in the Kingdom of Benin (Casely-Hayford 2012: 208). By 18 February 1897, 1 200 soldiers from Britain and Simonstown in South Africa captured the Kingdom of Benin with force and violence (Fagg 1978: 10). Casely-Hayford (2012: 208) states that '[t]he invasion led to the annihilation of the Benin monarchy and its court, the trial of the Oba – the head of state – the removal and execution of senior court dignitaries, the razing to the ground of the royal compound and the torching of a number of principal towns.' An estimated 2 000 objects were looted, sold and distributed to Western museums (Casely-Hayford 2012: 234).

Figure 3: Made by Edo, Benin Plaques, to century. Brass, 510 x 380 x 110 mm. The British Museum, London (Benin Plaques sa)

An estimated 900 plaques were seized and looted by the British in 1897 (Casely-Hayford 2012: 210). The so-called 'European discovery' of the intricate,

9 Fagg (1978:10) states that the festival was a celebration in memory of the oba's father and ancestors.

complex and mysterious Benin art objects amazed and confused Europeans (Casely-Hayford 2012: 208). European views of Africans in general did not permit reasoning that a 'primitive' culture could create these objects. It is evident that the removal and subsequent looting of the Benin plaques have robbed them of the understated meanings they once expressed. The establishment of the chronology, use, function and significance of many Benin bronzes is debated and questioned as they were not excavated under controlled conditions (Gillon 1984: 270). The objects were robbed of their history, cultural utilisation, and symbolism of status, wealth and power.

The case for restitution

An information kit created by UNESCO titled 'Promote: The Return or the Restitution of Cultural Property: Committee – Fund – UNESCO Conventions' (2001: sa) observes that plundering and pillaging another country is a long-accepted tradition. It states that during colonial times, 'the practice of theft of cultural property became even more widespread, and practically systematic, no longer necessarily linked to war or military occupation' (Promote... 2001: sa). By doing this, cultural property and heritage became scattered across the globe, to the sole benefit of Western collections.

Why, then, with the above paragraph in mind, the understanding of the (albeit short) history of the Kingdom of Benin, and the awareness that the people of Benin had a special and specific relationship with their art objects, do members of the international museum community, through statements such as the 'Declaration on the Importance and Value of Universal Museums'[10] contest the restitution of the Benin bronzes? It is evident that these leading museums are trying to evade their responsibility of returning cultural property and heritage, as well as protecting the prestige and status of their collections. The declaration states that restitution of cultural property and heritage disregards the importance and respect granted to history and the object (Schuster 2004: 4). However, with special regard to the Benin bronzes, the object's importance and significance is

10 In 2002, the Declaration on the Importance and Value of Universal Museums was signed by the leading museums in Europe and North America. In it, they claim that they are universal museums that cherish, safeguard and promote the cultural property and heritage of all peoples of the world (Schuster 2004: 4). The document stressed the very important roles of representation, comprehension and knowledge formation that museums claim they play.

undeniably altered by not being a part of the Benin culture. Another point the declaration makes, which is echoed by Peter-Klaus Schuster (2004: 4), is that cultural property and heritage often obtained their infamy by being displayed in so-called 'universal museums'. However, this argument is flawed, because the world has become globalised and the Kingdom of Benin would not have existed in a vacuum with the world forever oblivious to the existence of their artworks.

In addition, these leading museums advocate for globalisation and that, due to globalisation, individuals from Benin are able to visit the museums and 'visit' their own culture. This is an essentially Eurocentric point of view and one that appears to be oblivious to economic situations in developing countries. UNESCO observes that cultural property and heritage are 'irreplaceable testimony to the culture and identity of a people' (Promote... 2001: sa). Thus, the signatories of the declaration are indirectly stating that, as long as the Benin bronzes remain in the 'universal museums', the people of Benin can visit the museums, at great expense, to experience the testimony to their unique culture and identity as a people.

The next important point to be made is that the looted Benin bronzes fall under the category of war booty seized on behalf of Britain and subsequently sold and distributed across the world. Claims for restitution based on this premise are governed by the Geneva Convention and national and international property law (Schuster 2004: 5). However, as the history of the punitive expedition of 1897 is well-known, I find it confusing that the negotiations and bilateral discussions on the restitution of the art objects are taking so long.[11] It is evident that the fact that the objects are claimed for restitution based on the tangible objects' intangible emotional and spiritual significance to *a group* outweighs the 'universal museums' prerogative to retain the objects.[12]

Closely related to this point is one of the fundamental problems with the

11 When stakeholder parties (in this case, the Western museums and the Kingdom of Benin) are unable to come to an agreement on the obligation and moral responsibility to return cultural property and heritage, the international community has proposed solutions. The international community, with the aid of UNESCO, created a legal framework and highlighted the importance of cooperation during the process of restitution (Promote... 2001: sa).

12 When stakeholder parties (in this case, the Western museums and the Kingdom of Benin) are unable to come to an agreement on the obligation and moral responsibility to return cultural property and heritage, the international community has proposed solutions. The international community, with the aid of UNESCO, created a legal framework and highlighted the importance of cooperation during the process of restitution (Promote... 2001: sa).

restitution of the Benin bronzes: 'Universal museums' and the justification and ethics for conservation are based on Western attributions of qualities and purpose (Vogel 2003: 653). In other words, Western interpretive lenses and meanings are ascribed to art objects that do not fundamentally adhere to the same concepts, conventions and understandings. The museum and conservation individuals become too locked into the perspectives of their own culture. In line with Stuart Hall (in Klopper 1996: 34), if the Benin bronzes were to be returned to their country of origin, the people of Benin would have 'the means to speak for themselves for the first time' since the brute destruction of their culture. They would speak for themselves and their cultural property and heritage in their own language and voice.

The restitution of the Benin plaques is firmly rooted in identity politics (Wood 2012: 122). In an everyday setting, identity is the way in which individuals 'make sense of themselves, of their activities, of what they share with, and how they differ from others' (Brubaker and Cooper 2000: 4). 'Identity' is to conceptualise 'all affinities and affiliations, all forms of belonging, all experiences of commonality, connectedness, and cohesion, all self-understandings and self-identifications' (Brubaker and Cooper 2000: 2). Hypothetically, a child on a field trip to a 'universal museum' can achieve the type of identity formation and identification of oneself to others through exploring different exhibitions. A child on a field trip to a current Nigerian or Benin museum in Nigeria would not be able to achieve the same sense of self, identity and belonging. According to Paul Wood (2012: 122), 'this identification overrides all other arguments and counterarguments, and has the further effect of rendering counter arguments hollow, even before they are articulated.'

Conclusion

After establishing a short history of the Kingdom of Benin and the people of Benin's relation to their art objects, especially the Benin plaques, it is plain to see that the interaction with and display of the plaques have political, social, spiritual and contextualising values and significances. The plaques were removed by force and brute strength by the British during the punitive expedition of 1897, without any regard to their artistic, cultural and historic importance. Based on the notions that the plaques are functional and legitimising entities for Benin culture and

spirituality, there can be no doubt that the Benin bronzes should be returned. However, the process cannot be as simple as that. The counter-argument for restitution is fundamentally based on their safe-keeping, knowledge-granting capabilities and accessibility. If the Benin plaques were to return to the full ownership of the oba and the Benin monarchy, the plaques would probably very seldom be seen, and they would not be available for further study and research. In my humble opinion, the Benin plaques would have to be returned to a Nigerian museum or institution, whether it is in Lagos or Benin City.[13] The plaques could also then become part of a travelling exhibition, because museum conservators have the knowledge and means to keep them safe. The most important characteristic of the restitution of the Benin bronzes is open, multilateral dialogue without egoistic arrogance and attitudes of compromise on the sides of all stakeholders. However, the outcome will far outweigh the difficulties in this process.

13 A lot of preparation still needs to be done for such a return of objects, which does not necessarily have to include all Benin plaques. Nigerian institutions would need support and assistance with multiple aspects.

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Laura Esser: THC 801

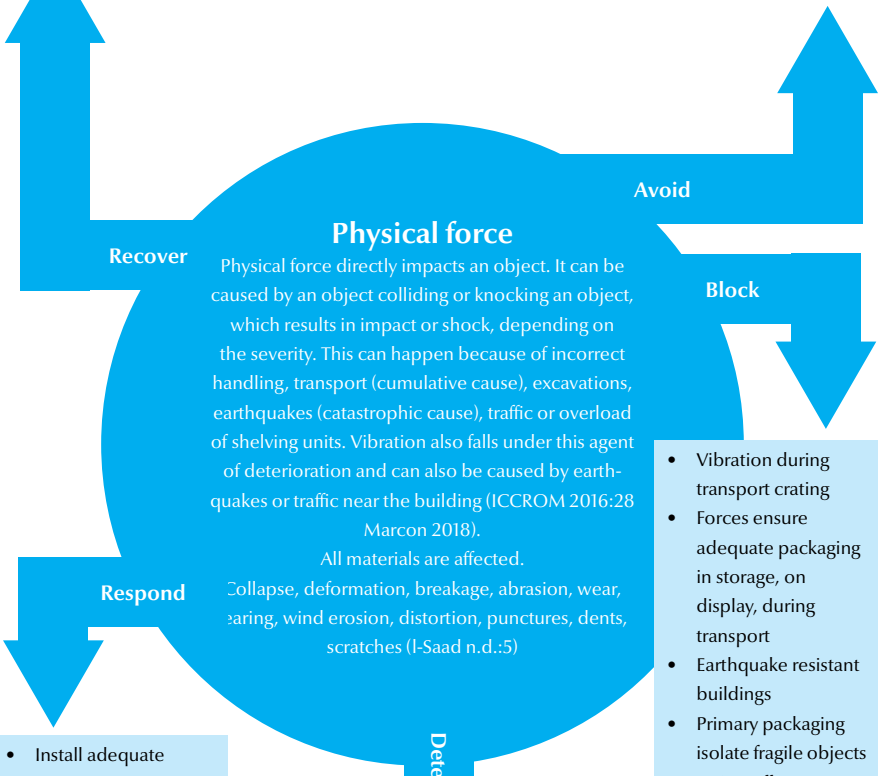
Laura Esser, who started the programme in 2020, graduated in 2021. She is a German national who has completed all her studies in South Africa. She is a prospective paper conservator. This assignment was a summary of the agents of deterioration of museum and cultural heritage objects.

Introduction

The agents of deterioration are a list of threats that cause change to cultural heritage objects. The assignment's aim is to create cheat sheets with the necessary information contained on a single page. The agents of deterioration are: physical force; fire; water; pests; pollutants and contaminants; radiation; incorrect temperature; incorrect relative humidity; dissociation; thieves, vandals and displacers; and inherent vice.

- Depends on the severity of the impact/
- shock that the object received

- Avoid transport of fragile objects
- Avoid untrained transport agencies
- Avoid vibration during transport cushioning and crating plan
- transport/movement of objects and assess obstacles
- Avoid inadequate shelving units
- Avoid crowded shelves to ease access (Marcon, 2018)



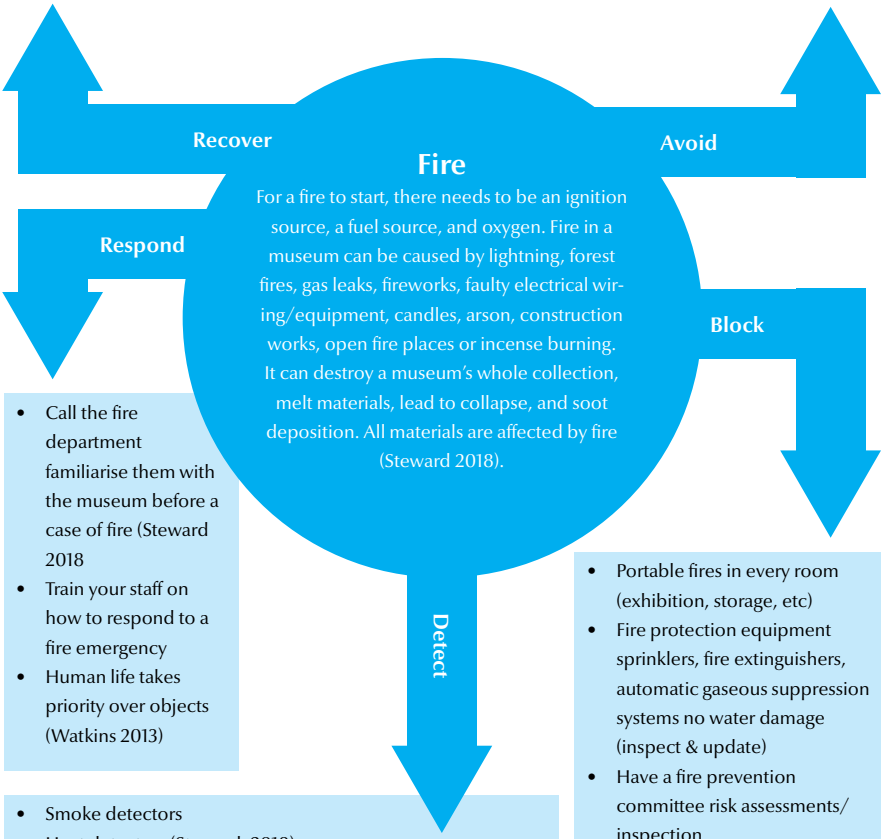
- Vibration during transport crating
- Forces ensure adequate packaging in storage, on display, during transport
- Earthquake resistant buildings
- Primary packaging isolate fragile objects
- Train staff in handlingand storage techniques (Marcon 2018)
- Display artefacts behind barriers/ in cases or cabinets (Postaluseum n.d.)
- Put padding underneath storage furniture to absorb vibration

- Install adequate shelving
- Do not place objects too close together
- Keep unstable objects isolated
- Redesign packaging (Marcon 2018)
- Introduce/enforce handling procedures for objects (Roper 1989

- Crowded storage areas give each object adequate space
- Tipping indicators, shock detectors
- Document any damage but also every movement of an object (Marcon 2018)

- Fire causes irreversible chemical reactions (l-Saad n.d.:9)
- The longer soot is on an object, the harder it becomes to remove

- Avoid using multiple adaptors/extension cords
- Avoid open flames (Steward 2018)
- Avoid space heaters
- Avoid faulty/open wiring should be in conduits
- Avoid having trees, bushes, shrubs close to your building
- wildfires will not be able to reach the building (Watkins 2013)
- Avoid shelving units/display cases are easily set alight use
- chemically inert (non-reactive), fireproof shelving (Roper 1989)



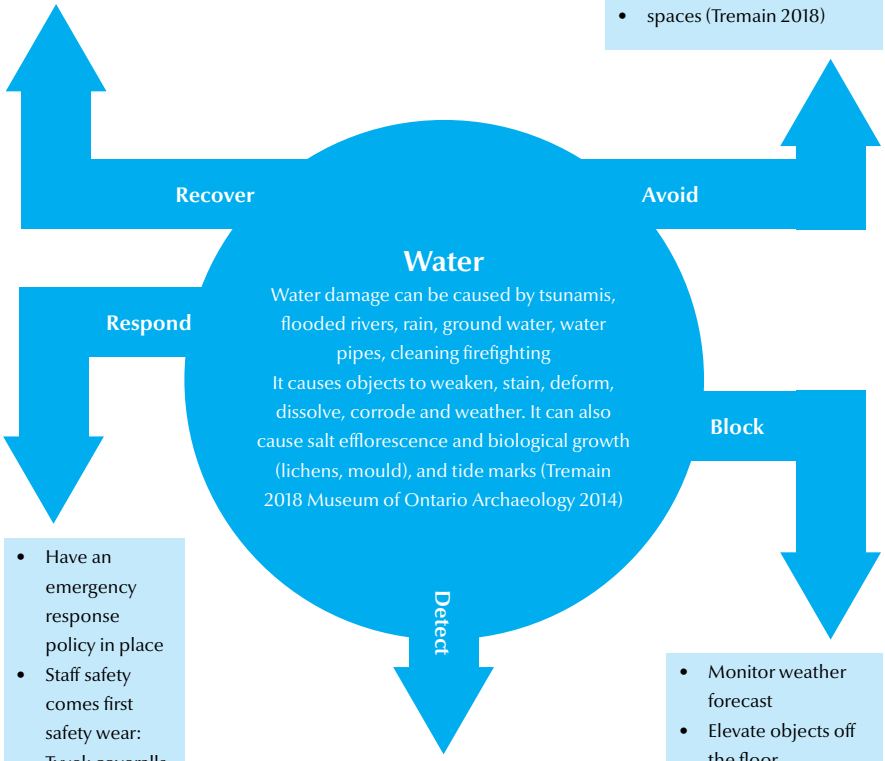
- Call the fire department familiarise them with the museum before a case of fire (Steward 2018
- Train your staff on how to respond to a fire emergency
- Human life takes priority over objects (Watkins 2013)

- Portable fires in every room (exhibition, storage, etc)
- Fire protection equipment sprinklers, fire extinguishers, automatic gaseous suppression systems no water damage (inspect & update)
- Have a fire prevention committee risk assessments/ inspection
- Implement fire safety policies and procedures (e.g., no smoking, no open flames) (Steward 2018)
- Use enclosures provide some protection, fire retardants (Roper 1989)

- Smoke detectors
- Heat detectors (Steward, 2018)
- Know and minimise possible sources of fire ignition (Pioneer Air Museum 2014)
- Detect any faulty wiring have it checked out by an electrician
- Detect any flammable liquids in the building/conservation lab/storage store appropriately
- Identify hazardous objects (cellulose nitrate films) and store safely, away from other objects (Steward 2018)

- Pests and mould prefer warm damp environment ventilation is key
- Building and objects are in danger
- Wooden storage units might collapse
- Pigments and adhesives may dissolve
- Ceramics and papers may be unstable (Tremain 2018)

- Avoid buildings too close to bodies of water
- Avoid buildings with a history of flooding
- Avoid fountains water features in and around museum
- spaces (Tremain 2018)



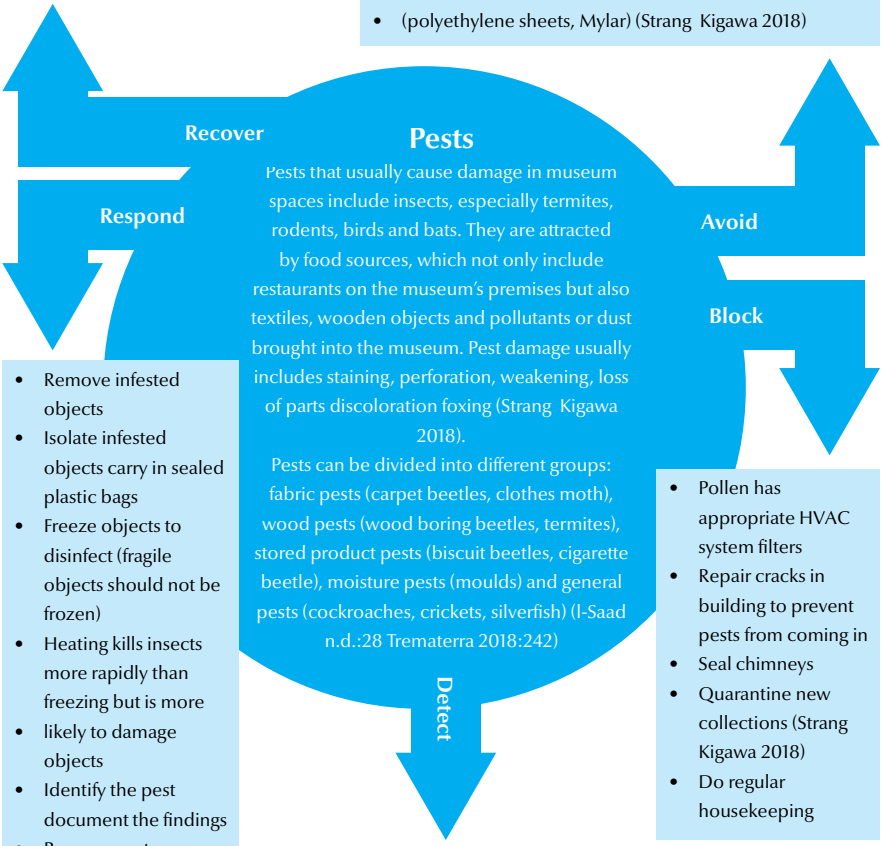
- Have an emergency response policy in place
- Staff safety comes first safety wear: Tyvek coveralls, respirators,
- gloves, rubber boots, hard hats
- Identify source of waterblock it/revert it
- Ventilate buildings to prevent mould
- Dehumidifiers (Tremain 2018)

- Have a risk assessment (in and outside of buildings)
- Install water detectors
- Inspect the building for previous water damage/flood lines (water stains)
- Differentiate between immediate action risks (leak) and that do not need immediate
- action (Tremain 2018)
- Detect any burst/leaking pipes or plumbing (Museum of Ontario Archaeology 2014)
- Inspect and remove dirt from gutter sit can store humidity/water

- Monitor weather forecast
- Elevate objects off the floor
- Emergency kit: sandbags, window/door seal (polyethylene sheeting), pumping equipment
- Have an emergency evacuation procedure
- Train your staff assign positions (Tremain 2018)

- Not all damage can be repaired
- Clean objects remove dead pests/ eggs/waste/larvae/nests (Canada CA)
- Stains n textiles/leathers can decrease their strength
- Fungi can produce acids corrosion and etching (Strang Kigawa 2018)

- Avoid objects in the open
- Avoid unsealed containers
- Avoid cluttered/organised storage
- Avoid water features in museum vicinity uncontrolled rH
- Avoid dust build-up
- Avoid food/food waste thrown out near the museum/ storage
- Avoid use of non-treated wooden shelves inorganic materials
- (polyethylene sheets, Mylar) (Strang Kigawa 2018)



- Remove infested objects
- Isolate infested objects carry in sealed plastic bags
- Freeze objects to disinfect (fragile objects should not be frozen)
- Heating kills insects more rapidly than freezing but is more
- likely to damage objects
- Identify the pest document the findings
- Remove pest as soon as possible
- Anoxia removes oxygen out of air in airtight chamber (Strang
- Kigawa 2018, l-Saad n.d.:30f.)

- Pollen has appropriate HVAC system filters
- Repair cracks in building to prevent pests from coming in
- Seal chimneys
- Quarantine new collections (Strang Kigawa 2018)
- Do regular housekeeping

- Install mouse and fly traps, sticky traps, light traps inspect regularly
- Regular pest inspections look for faecal deposits, chewing, nests
- Inspect organic objects textiles, wooden objects, books and papers
- Train staff
- Integrated pest management helps to prevent and resolve pest problems pesticide last resort (l-Saad n.d.:30f.)
- Keep all spaces sanitary (Canada CA)

- Remove dust particles, efflorescence or erosion compounds as carefully as possible
- Stains cannot be easily removed from fragile/porous objects (Tétreault 2018)

- Limit source of pollution from inside the building
- Avoid setting up a museum space in areas with heavy air pollution
- (highways, inner city centre, industrial areas)
- Avoid use of adhesives, rubber bands
- Avoid using storage shelves/display cases they gas-off pollutants
- (Tétreault 2018)
- Avoid skin contact with the objects' oils can cause damage (nitrile gloves)
- Avoid storing different materials next to each other wood and plastics
- off-gas chemicals (Roper 1989)

Recover

Respond

Pests

Pests that usually cause damage in museum spaces include insects, especially termites, rodents, birds and bats. They are attracted by food sources, which not only include restaurants on the museum's premises but also textiles, wooden objects and pollutants or dust brought into the museum. Pest damage usually includes staining, perforation, weakening, loss of parts discoloration foxing (Strang Kigawa 2018).

Pests can be divided into different groups: fabric pests (carpet beetles, clothes moth), wood pests (wood boring beetles, termites), stored product pests (biscuit beetles, cigarette beetle), moisture pests (moulds) and general pests (cockroaches, crickets, silverfish) (l-Saad n.d.:28 Trematerra 2018:242)

Avoid

Block

Detect

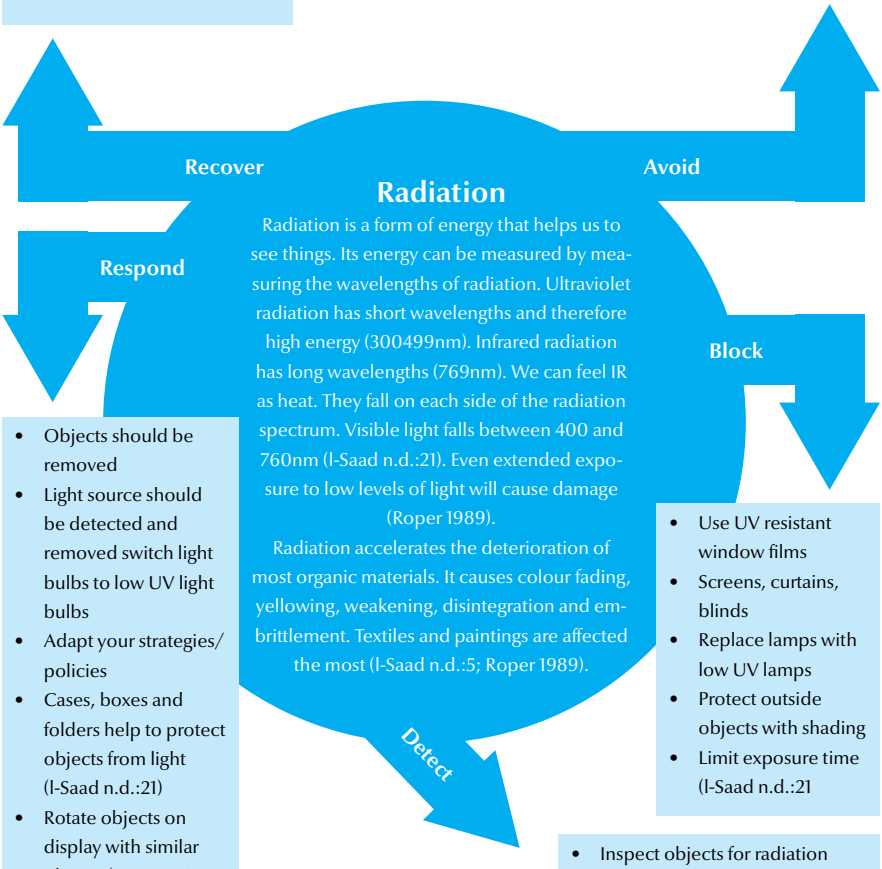
- Discover source of pollutants (Canada CA)
- Keep storage, shelves, display cases, exhibition spaces clean
- Install seals around doors and windows weather strips
- Use cabinets or containers to store/ exhibit objects
- Cover stored objects with dust covers
- Store objects emitting gaseous pollutants separately
- Install pollution filters in your HVAC system (l-Saad n.d.:27)

- Inspect objects regularly for dust
- Discoloration powdering are indicators pollutants
- Pest activity may be a sign of dust accumulation
- Install gas particle, water vapour and oxygen absorbents
- Inspect and replace HVAC filters

- Pollutants by installing appropriate filters in HVAC system exchange regularly
- Do not place objects directly in front of HVAC exhaust
- Have airtight display cases
- Do not use untreated wood for storage or display have a protective barrier
- Chemical storage units, cooking facilities should have a local exhaust
- Some museum objects may emit pollutants themselves store in sealed boxes (old plastics emitting phthalates and acids, cellulose nitrates (films) and residual fumigants l-Saad n.d.:25)
- Know what is in your collection
- Block visitors from touching objects
- Block dust from coming with visitors by installing dust trap mats (Tétreault 2018)

- Light damage cannot be recovered unless new materials is used
- Light damage is cumulative (I-Saad n.d.:21)

- Avoid direct sunlight
- Avoid having the lights on at all times as all lamps emit UV radiation (I-Saad n.d.:21)



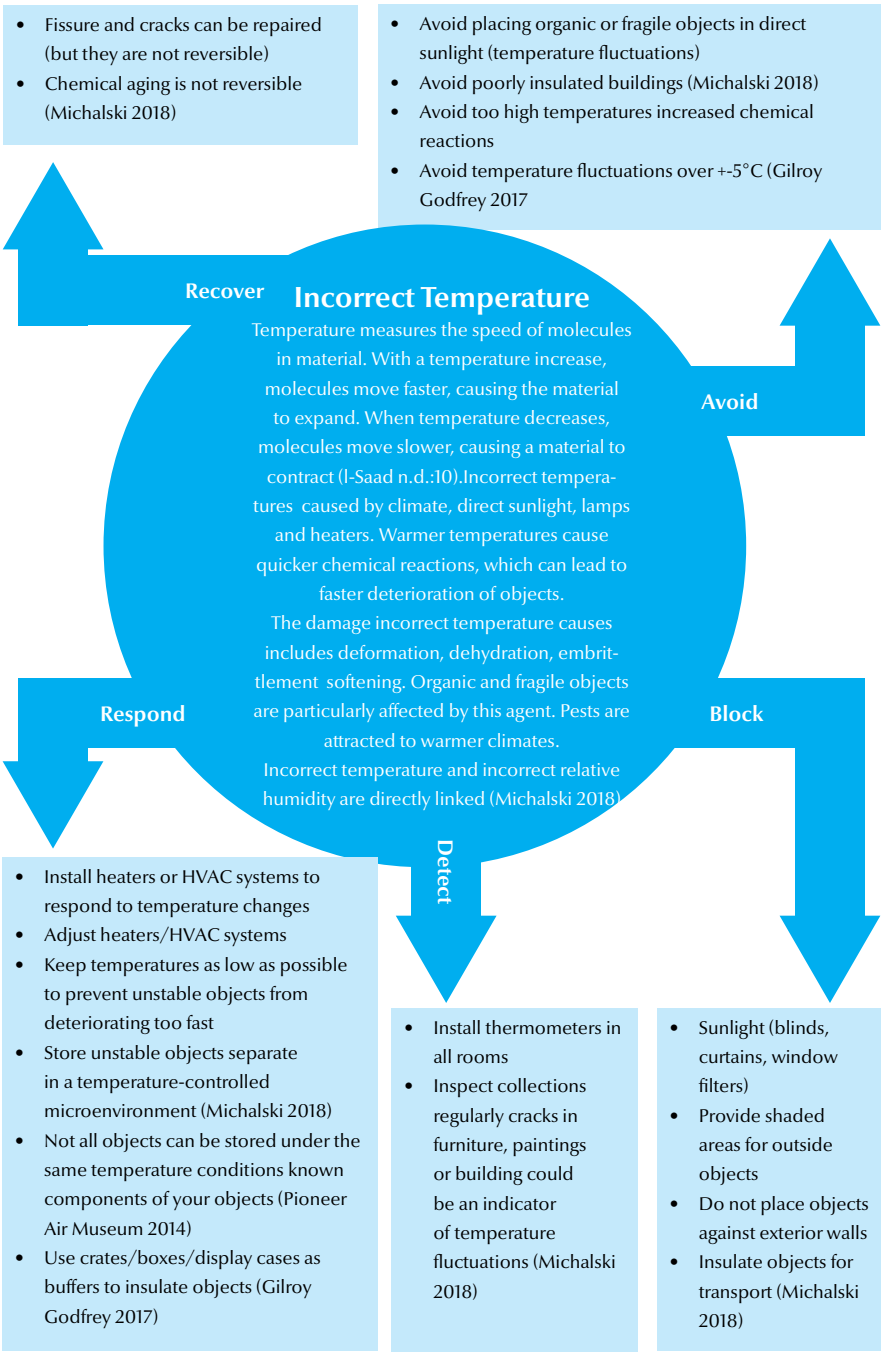
- Objects should be removed
- Light source should be detected and removed switch light bulbs to low UV light bulbs
- Adapt your strategies/ policies
- Cases, boxes and folders help to protect objects from light (I-Saad n.d.:21)
- Rotate objects on display with similar objects (Pioneer Air Museum 2014)

- Use UV resistant window films
- Screens, curtains, blinds
- Replace lamps with low UV lamps
- Protect outside objects with shading
- Limit exposure time (I-Saad n.d.:21

Light standards:

- 50 lux for light sensitive objects: dyed organic materials, textiles, watercolours, photographs, tapestries, prints/ drawings, manuscripts, leather, wallpapers, biological specimen, fur, feathers
- 200 lux for less light sensitive objects: undyed organic materials, oil/tempera paintings, wood
- 300 lux for non-light sensitive surfaces: metals, stone, ceramics, glass (I-Saad n.d.:22)

- Inspect objects for radiation damage
- Install visible light and UV meter measure illuminance on objects (the strength of
- visible light, measured in lux) (I-Saad n.d.:21)
- Install thermometers to detect infrared radiation
- Install cloth samples (Blue Wool) and inspect them for fading (I-Saad n.d.:22)


Fissure and cracks can be repaired (but they are not reversible)
Chemical aging is not reversible (Michalski 2018)
Avoid placing organic or fragile objects in direct sunlight (temperature fluctuations)
Avoid poorly insulated buildings (Michalski 2018)
Avoid too high temperatures increased chemical reactions
Avoid temperature fluctuations over +-5°C (Gilroy Godfrey 2017
Recover
Incorrect Temperature
Temperature measures the speed of molecules in material. With a temperature increase, molecules move faster, causing the material to expand. When temperature decreases, molecules move slower, causing a material to contract (I-Saad n.d.:10).Incorrect temperatures caused by climate, direct sunlight, lamps and heaters. Warmer temperatures cause quicker chemical reactions, which can lead to faster deterioration of objects.
The damage incorrect temperature causes includes deformation, dehydration, embrittlement softening. Organic and fragile objects are particularly affected by this agent. Pests are attracted to warmer climates.
Incorrect temperature and incorrect relative humidity are directly linked (Michalski 2018)
Avoid
Respond
Block
Detect
Install heaters or HVAC systems to respond to temperature changes
Adjust heaters/HVAC systems
Keep temperatures as low as possible to prevent unstable objects from deteriorating too fast
Store unstable objects separate in a temperature-controlled microenvironment (Michalski 2018)
Not all objects can be stored under the same temperature conditions known components of your objects (Pioneer Air Museum 2014)
Use crates/boxes/display cases as buffers to insulate objects (Gilroy Godfrey 2017)
Install thermometers in all rooms
Inspect collections regularly cracks in furniture, paintings or building could be an indicator of temperature fluctuations (Michalski 2018)
Sunlight (blinds, curtains, window filters)
Provide shaded areas for outside objects
Do not place objects against exterior walls
Insulate objects for transport (Michalski 2018)

- Mould damage cannot be recovered it eats away the material
- Corrosion removes the original surface material (Michalski 2018a)
- Glass is extremely sensitive to humidity can get glass disease

- Avoid water features, dripping water, any sources of external water (Michalski 2018a)
- Avoid fluctuations above 5% (I-Saad n.d.:13)
- Avoid RH below 30%objects may become brittle
- Avoid RH above 65%mould growth (I-Saad n.d.:13)
- Avoid too many people in a room (I-Saad n.d.:17)
- Avoid sensitive objects exposed to spotlight, sunlight, air vents, exterior walls, doorways (I-Saad n.d.:17)

Recover

Avoid

Incorrect relative humidity (RH)

Humidity measures the amount of water in the air at a given temperature. Relative humidity measures the percentage of water the air is able to hold at a given temperature. The warmer the air, the more moisture it can hold (I-Saad n.d.:11). The reason for incorrect relative humidity include climate, ground water, inadequate air ventilation and micro-climates, human respiration and perspiration (Michalski 2018a).

It causes deformation, cracking, flaking, weakening, corrosion, mould growth or staining (I-Saad n.d.:6). Organic materials are especially affected because they absorb and give off water.

Respond

Block

- Install humidifiers or dehumidifiers (installed or portable)
- If problem persists, consult engineering consultant about building-wide systems
- Passive control silica gel (for high humidity problems) (Michalski 2018a)
- When setting up a standard for RH and temperature, take into consideration your local climate and condition and nature of your collection (I-Saad n.d.:16)

- Seal cracks and holes to prevent moisture from coming in
- Moisture from entering packaging use polyethylene sheeting to block it
- Block rainwater and groundwater from entering your building or gathering close to it (Michalski 2018a)

Detect

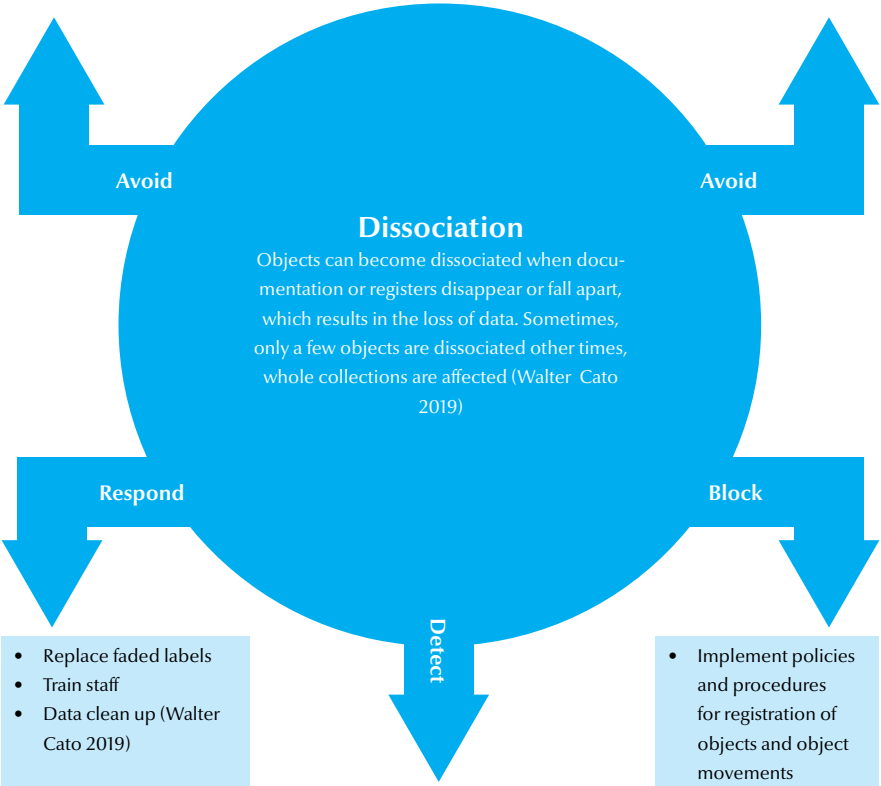
Examples:

- (too high too low)
- Metal corrosion
- Dyes fading
- Swelling/warping of wood and ivory
- Paper can cockle or buckle
- Canvases may slack
- Above RH of 65%mould growth, insect activity
- Shrinkage, warping, cracking of wood and ivory
- Shrinkage, stiffening, cracking, flaking of photographs and leather
- Desiccation of paper and adhesives and basketry fibres (I-Saad n.d.:12).

- Install humidity detectors psychrometers detect RH (I-Saad n.d.:14)
- Install hygrometers (for RH and temperature) inside of display cases and cabinets
- Gather your data and interpret
- Inspect collections (e.g., swelling in ceramics if humidity is too high, cracking if humidity fluctuates) (Michalski 2018a)

- Ask users to point out dissociated objects to the collections manager
- Document dissociated documents and dissociated data (Walter Cato 2019)

- Avoid placing organic or fragile objects in direct sunlight (temperature fluctuations)
- Avoid poorly insulated buildings (Michalski 2018)
- Avoid too high temperatures increased chemical reactions
- Avoid temperature fluctuations over +-5°C (Gilroy Godfrey 2017



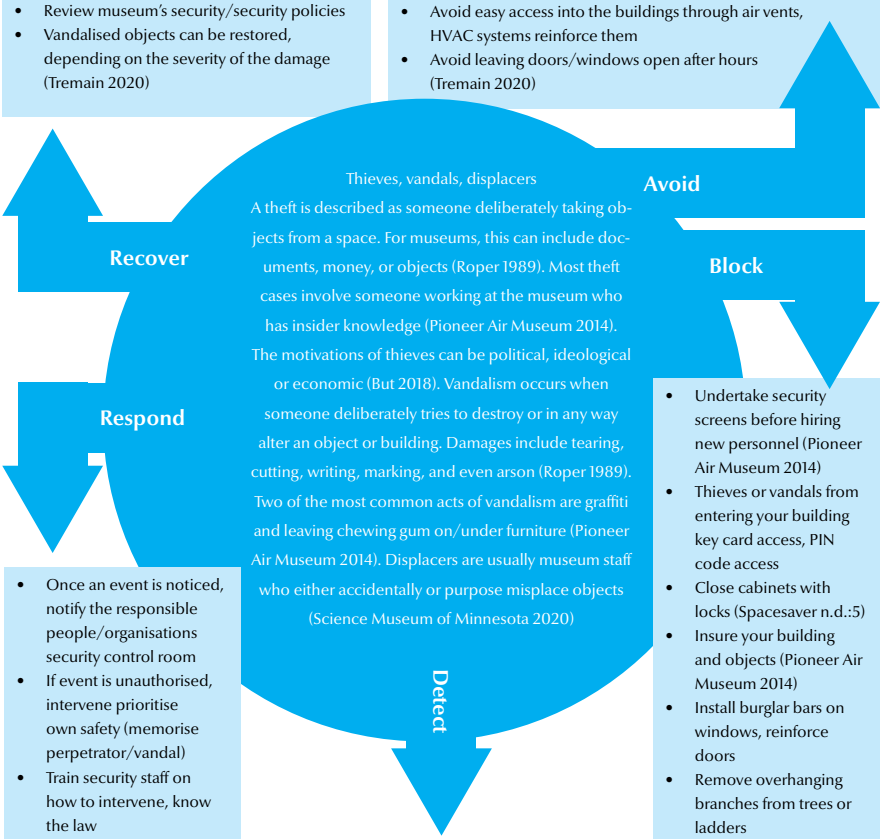
- Replace faded labels
- Train staff
- Data clean up (Walter Cato 2019)

- Undertake regular inventories (Walter Cato 2019)

- Implement policies and procedures for registration of objects and object movements
- Implement a consistent standard of labelling
- Implement a consistent database (Walter Cato 2019)

- Report stolen objects to the police
- Report vandalised objects/collections to the police
- Give description and documentation to the police
- Stolen objects are not likely to be recovered
- Review museum's security/security policies
- Vandalised objects can be restored, depending on the severity of the damage (Tremain 2020)

- Avoid cover for thieves around your buildings (hedges, bushes, trees too close to the building)
- Avoid dark areas around your buildings have a well-lit space, especially doors, have vandal proof lights
- Avoid opportunities to get to higherup windows/entrances from outside the building
- Avoid easy access into the buildings through air vents, HVAC systems reinforce them
- Avoid leaving doors/windows open after hours (Tremain 2020)



- Undertake security screens before hiring new personnel (Pioneer Air Museum 2014)
- Thieves or vandals from entering your building key card access, PIN code access
- Close cabinets with locks (Spacesaver n.d.:5)
- Insure your building and objects (Pioneer Air Museum 2014)
- Install burglar bars on windows, reinforce doors
- Remove overhanging branches from trees or ladders
- Provide additional security during renovations
- Secure displays and objects with proxy alarms, passive infrared motion detectors
- Have shatter-proof display cases (Tremain 2020)
- Secure loose papers from theft/displacers by binding them into volumes (Roper 1989)

- Once an event is noticed, notify the responsible people/organisations security control room
- If event is unauthorised, intervene prioritise own safety (memorise perpetrator/vandal)
- Train security staff on how to intervene, know the law
- Call the police secure and restrict access to the area (Tremain 2020)

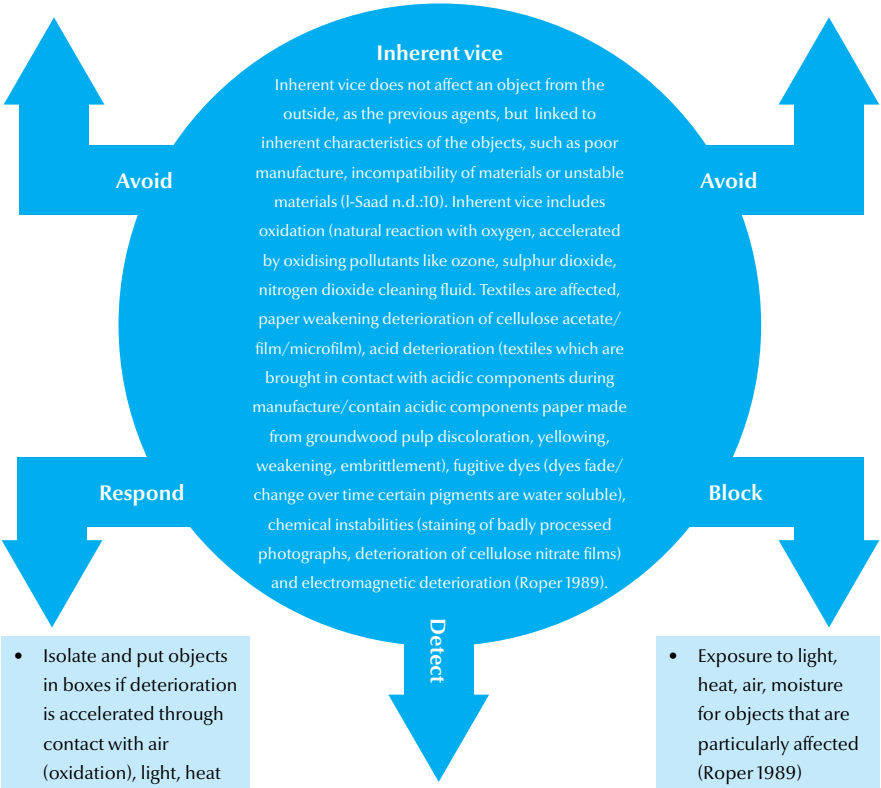
- Keep track of who is accessing objects/collections (Spacesaver n.d.:5)
- Install security cameras (CCTV), alarms
- Employ security personnel (Pioneer Air Museum 2014)
- ny damage to the building and repair it
- install glass-break detectors
- ire security guards for all rooms and areas in the museum (visitor entrance, exhibition spaces, staff entrance, loading bay, study rooms, office areas, maintenance rooms) (Tremain 2020)

Security policy

- Access control/key control
- Building security
- Security guard duties
- Security screening
- Emergency preparedness & response
- Camera policy
- Extra-curricular activities

- Most of the damage cannot be recovered unless the material of the object that is causing the accelerated deterioration is removed not always possible (e.g., ink on paper Roper 1989)

- Avoid incorrect storage and display
- Avoid frequent use (an der Reyden 1995)



- Isolate and put objects in boxes if deterioration is accelerated through contact with air (oxidation), light, heat or moisture (acid deterioration, fugitive dyes)
- In some objects, deterioration/ destruction is inevitable (cellulose nitrate films Roper 1989)

- When doing inventories, check for objects that may have inherent vice
- When new objects are coming into your collection, check if they show inherent vice or may be susceptible to it

- Exposure to light, heat, air, moisture for objects that are particularly affected (Roper 1989)

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Henry Nakale: THC 802

Henry Nakale was the first male student the programme welcomed in 2020. He is from Namibia and works at Windhoek Museum.

Introduction

Physical deterioration of paper has been an issue for many museums, libraries, archives and private collections around the world, although there are other challenges that these institutions are faced with as far as the preservation and conservation of paper is concerned. This review is centred around tear-mending, looking at the principles of mending structural damage to paper and providing a summary of current practices which include options for recipes. Several tear-mending options are available, a few of which are briefly described in this assignment. Valuable documents and books were examined individually, and the best conservation treatments were chosen based on their use, state and worth. New techniques of tear-mending have been developed over the years and have been adapted to successfully repair different tears in different types of paper and books. This review also unpacked different necessities required in paper treatment: these include a lack of information on several adhesives used in mending tears, which affects the process of decision-making; impacts of tears are also not addressed.

Chemistry of paper

Papers are made using hands (handmade) and modern machines. Most papers today are made from indigenous plant material. Fibres and leaves are extracted for paper manufacturing. Some chemicals are added for texture, depending on the type of paper to be produced.

General principles of tear mending

Paper is the most common medium for recording information, and it is very resistant to ageing if it is well-manufactured. But due to its characteristics and manufacturing components, some paper grades are very likely to deteriorate, especially the acidic papers manufactured between the mid-nineteenth and

twentieth centuries (Zervos and Alexopoulou 2015).

Many papers, archives and paintings face very harsh conditions, which can lead to their deterioration, and most of them end up fragile and unusable. There are several factors that accelerate the pace at which these materials deteriorate, such as pH, raw materials and how they were manufactured. External factors like the climatic conditions, pollution and biological activities also play a significant role in controlling the rate of deterioration. Deterioration causes tears in many papers and loss of valuable information (Lee et al. 2010, Zyska 1996). One thing that we conservators need to bear in mind is that the way paper tears is directly related to how it is manufactured. And as mentioned above, paper is made from wood fibres, where wood chips are mixed with water and chemicals. Wood fibres are then separated, and a soupy mash called pulp is made. The water is squeezed out, so when the pulp moves on the conveyor belt, the wood fibres line up in the same direction that the belt is moving, which aligns the fibres and gives the paper a grain. The grain is what causes the paper to tear straight in one direction. Paper gets ripped with grain tears in the direction of its fibres.

The general standards for repairing tears in paper, particularly using Japanese pulp, are stated by Zerovos and Alexopoulou (2015: 81) and are used by most conservators these days. Let us look at how the Japanese papers are manufactured. Japanese papers are produced using long, solid fibres removed from the inner bark of different indigenous Japanese plants. Their properties (mechanical quality, weight, pH, shading, fibre length, dimensional security and protection from maturing) are perfect for paper repairing. Another option for Japanese paper is the Chinese manufactured paper, Xuan, which is produced using bast fibres.

For paper-mending, glue is used, including methylcellulose, carboxymethylcellulose, starch glue, unsupported Archibond and hydroxypropyl cellulose. Methylcellulose may have a lower holding quality; however, it is favoured because of its better protection from both biodegradation and synthetic corruption. The mash utilised for fixes can be like cotton material (unbleached, without any added substances). Many conservation laboratories utilise faded synthetic pulp, which is widely accessible. A few conservators and researchers, like Vodopivec (1997), prescribe the addition of up to 30 to 40% unbleached fibre to the leaf-casting mash, with respect to its use of coloured pulp since they contain metal particles, for example, Fe and Cu (Zervos and Alexopoulou 2015: 81). A vacuum (suction) table is regularly used in paper preservation; the vacuum

is used mainly for local treatments and for filling losses of paper. Another machine used in paper treatment is the leaf-casting machine. As pointed out by Zervos and Alexopoulou (2015: 82), leaf-casting is used for filling losses of paper with paper pulp. Leaf-casting is certainly not a mass-production technique; however, for artefacts that can withstand water, it tends to be a lot quicker than the manual strategies and elicits better outcomes.

Tear-mending or paper repair

Mending is joining splits or tears or reinforcing cracks in a paper support using an adhesive material. The main purpose of mending is to restore the aesthetic of paper and preserve its physical integrity. In paper conservation, mending of structural damage can be accomplished with either Japanese paper or pulp but it mostly depends on the nature of the damage and type of paper. Zervos and Alexopoulou (2015: 80) discussed the Japanese paper method in detail; according to them, the Japanese papers are thin, handmade papers extracted from various indigenous Japanese plants, and their properties (weight, colour, pH, and stability) make them ideal for mending tears and losses. For example, Tenguijo, which is a thin specialist Japanese paper made from kozo, alkaline water and neri, is mostly transparent and is widely used in archival conservation and lighting designing. It is very light and weighs about 7 to 11 g/m^2.

When filling lacunas, as described by Zervos and Alexopoulou (2015: 80), the original damaged paper is placed on a light table with a polyester sheet over it, and on top of it, a sheet of Japanese paper is placed. Both the Japanese and original paper should be placed parallel and in one direction. Use a refillable pen, filled with a mixture of alcohol and water. When the contour becomes wet and soft, remove the patch by pulling and glue the original on with paste, methylcellulose or a mixture of the two. They further discussed paper pulp, which is prepared from the Japanese paper, linen and cotton textile, and they recommended adding 30 to 40% unbleached fibres to the leaf-casting pulp. This can then be added to the lacunae with a leaf-casting machine.

A case study of mending sprung tears

Bernier (2004) discussed treatment tips for mending sprung tears in her study of gelatine silver prints. She argued that long tears in gelatine silver prints—

especially the ones running in the grain direction—fail to realign and mend successfully, but a new technique was developed to overcome such challenges. A concave support board is the solution to this problem, whereby the convex surface can be employed to apply mending tissues to the back of the tears. This procedure is most successfully used to mend oversized maps (Bernier 2004). In her study, Bernier (2004) used aerial photographs that were treated in 2002 at the document conservation lab. The double-weight gelatine silver prints measured 24 x 36 in and larger and had sprung long tears measuring four inches and more. Several alignment techniques were employed to align the tears but only the concave support board yielded satisfactory results.

The concave support board was made from corrugated plastic boards and draped with polyester webbing. According to Bernier (2004), the tears were aligned from the front using pressure to adjust the degree of the curve. They tacked the tears in place using a warm gelatine solution and wheat starch for strength. The aligned tears were mended on the verso using the Japanese tissues and wheat starch paste. The old-style alignment techniques did not work in aligning the sprung tears in this study, as stated by Bernier (2004). The tears were successfully aligned and mended using the new concave support procedure. After consolidating the prints with the gelatine solution, the tears were no longer noticeable and there were no local distortions as the tears were reunited.

Tear-mending recipes

The Northeast Document Conservation Centre (NEDCC) conservation leaflet (1999) also outlined some tear-mending procedures for books. According to this leaflet, tears in the leaves must first be carefully aligned and then repaired with the Japanese paper and a starch paste, the same as with normal paper-mending, as stated by different authors above. The holes and losses in books are filled with inlays of Japanese paper pulp. However, the NEDCC conservation leaflet (1999) proposed another option for filling holes in books, which is inlaying with a paper which is similar in weight, texture and colour to the book being treated. Choose two layers of Japanese tissue that are similar to the repaired page and cover up the hole— always remember to protect the text block with paper on both sides of the damaged page. Paste up the first piece of the Japanese tissue, ensure that it is well-positioned, and put the edges into place. Then, paste up the second piece and lay it in place, working the edges down. Cover the treated part with non-stick

material and dry it under a weight. Once it is dry, twist the paper around the hole to ensure that the edges are adhered. This procedure can be time-consuming, and it is only recommended for valuable books.

Mohie and Korany (2005) also did a study on the conservation of oil paintings, and they discussed a recipe for mending tears in oil paintings, stating that it is a process that requires accuracy and extensive knowledge of many sciences. An assessment of the preservation status should be conducted first, and the integrity of the materials should be analysed by examining and describing the changes in the physical and chemical properties.

In their study, they used two miniature paintings from the Museum of Helwan University, which are both supported on paperboard and both fixed to a thick secondary paper support. UV radiation was used to detect deterioration, tears and past restoration areas, while IR radiation was used to examine the artistic characteristics of the paintings. Mohie and Korany (2005: 111) stated that these paintings were exposed to harsh environments and had been neglected, which led to several deterioration phenomena such as tears, cracks, scratches, lacunas and dirty appearances. The treatment steps used in this study are as follows: they first had to separate the paintings from their frames, clean the dirt using ethyl alcohol, reinforce the paint layers and provide protection for the layer during the treatment process. A 5% and 10% solution of Beva 371 in white spirit and pieces of Japanese paper and gauze were applied.

The lacunas were restored by inserting pieces of special acid-free board in the lacunas and then fixed by what is known as the window method. The acid-free board used was of the same thickness as the paper board. The paperboard was then de-acidified by brushing it with 2.5% magnesium carbonate and distilled water. The tears in the board were mended by brushing them with 10% water solution of rabbit-skin glue, and the edges were repaired using a cauter. Then, they consolidated the board with a 5% solution of Plextol B500 (Mohie and Korany 2005: 112).

They also discussed the mounting process, whereby the first painting support was solidified by spreading a layer of Plextol B500 on the verso of the artwork, then Japanese paper of a similar board size was stuck on the rear of the composition board using 5% Plextol B500. Some Japanese paper strips were additionally stuck on the edges of the board; a corrosive-free board was then used to mount the first board using Plextol B500 (Mohie and Korany 2005: 111).

The paintings were then modified, re-varnished and encircled. And to protect

the paperboard from the high relative humidity, wacker BS 1001—a dissolvable-free silane/siloxane emulsion—was used (Mohie and Korany 2005: 112).

Conclusion

In summary, paper and books experience a wide range of damage, including broken joints, harmed sheets, split endpapers, and tears. Most of the time, it is possible to complete minor fixes or store deteriorated books in corrosive-free areas. However, mass tear-mending is advancing, and there are a few affordable methods these days. The examination and treatment of paper-mending is noteworthy, and new strategies have arisen. A lot has been written on paper conservation. In the relevant literature, many authors discussed mending techniques and procedures, definitions and principles. It is, however, surprising that not much has been documented on the impacts of improper structural mending or just lack of mending at all. Therefore, there is a need to cover some of the impacts of tear-mending blanks, and there is still a lack of information on several adhesives used in mending tears, which affects the process of decision-making.

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Marinda Van Der Nest: THC 803

Marinda Van Der Nest, a student who was part of the THC programme intake of 2021 and will have submitted her thesis in 2022, wrote the assignment below on analytical techniques for THC 803.

Introduction

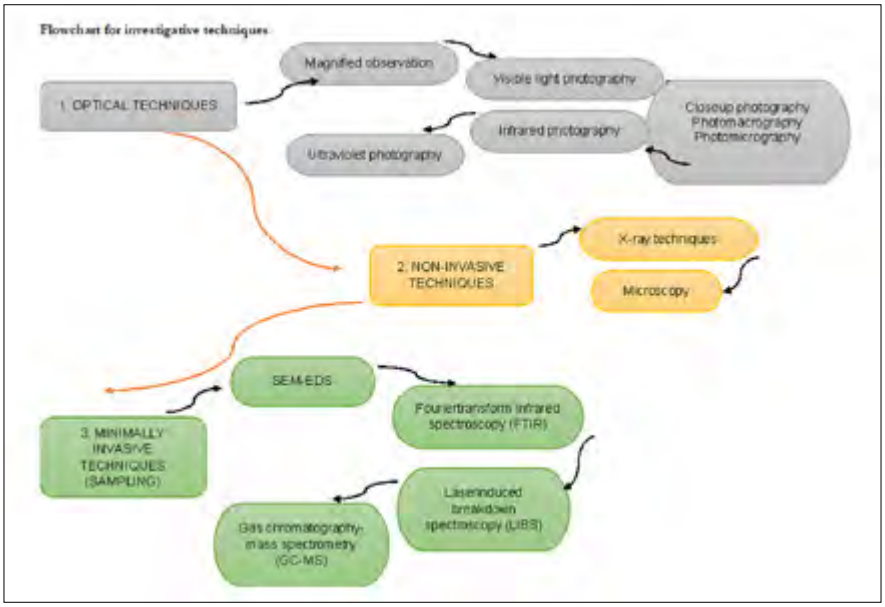
The conservator needs reliable and accurate methods to analyse objects to understand what materials are original, what deteriorated and what was altered or repaired and then determine what treatment to use (Bezur 2021: 5, Vallance 1997: 75). The conservator needs to do research by examining the object to answer questions and increase knowledge on the object for conservation. There should also be communication and teamwork between curators, restorers, art historians, conservation scientists and scientists from outside fields (Whitmore 2005: 2). This will provide the necessary information to design a conservation/restoration treatment plan. It will enable the conservator to understand what analytical methods and techniques to use to come to an educated and informed conclusion about the conservation/restoration treatment (Vallance 1997: 75).

With this assignment, all possible investigative imaging, as well as analytical techniques will be discussed. Information discussed will be whether the techniques are invasive or non-invasive, the basic information on the technique, the uses for conservators, the benefits and the limitations. A flowchart will suggest the procedure of investigation.

Visual examination is the first step of investigation. It is non-invasive, low-cost and examines the surface and underlying layers of an object. Direct observation can be used or magnified observation using a variety of illumination techniques. Visual examination detects the history of an object by examining its physical condition; it detects modifications and any conditions of components that may have an influence on the conservation and treatment of the object (Wasiutynski 2020: 1).

The next step in investigation is instrumental analysis. The conservator can operate most of the analytical equipment, but other instruments require conservation scientists to do analytical testing. The conservator, however, should understand the working of the instruments and what tests should be done, as well as how to evaluate the results (Rizzutto et al. 2015: 3, Wasiutynski 2020: 26).

The last step is sampling where the conservator should select a technique where the smallest of samples will give the maximum information needed (Vallance 1997: 80).



Different techniques
Optical techniques

TECHNIQUE	BASIC CONCEPT	USES FOR CONSERVATORS	ADVANTAGES	LIMITATIONS
Magnified observation Single-lens magnifiers	Hand-held magnifier	For initial examination of the surface of objects.	Inexpensive, compact, portable, simple to use, wide field of view.	Short depth of field, fixed magnification, no built-in light source.
Illuminated magnifiers	Hand-held flashlight magnifier	For initial examination of the surface of objects.	Inexpensive, easy to use, portable, compact, large view-field. Models with stands leave both hands free for work.	Resolving power is limited because of the small opening for magnification.

TECHNIQUE	BASIC CONCEPT	USES FOR CONSERVATORS	ADVANTAGES	LIMITATIONS
• Visible light photography. • Normal illumination	It is used to view the object under standard illumination conditions. The light beams are of equal intensity and distance at a 45° angle to the object to give an even illumination.	It will reveal the following of the object: design, the colouration of the medium used, the structure, any deformations, damages, stains or repairs.	The illumination is as even as possible to give a more satisfactory viewing as with normal daylight viewing.	Illumination can be harmful to works of art or photography (Wasiutynski 2020: 15).
• Raking illumination	The light source is projected across the surface of the object at a low angle, to the one side.	The light source coming from the top or one side will reveal the following: topography of the surface, watermarks, mould, print techniques, rubbing marks, flaking and repairs.	Detailed irregularities can be revealed.	Illumination can be harmful to works of art or photography (Wasiutynski 2020: 15).
• Specular illumination (two techniques)	Axial technique. The camera is positioned parallel to the object's surface, and the lamps are placed adjacent to the camera. Oblique technique. The viewer and the light source are placed on opposite sides of the object at the same angle as the camera.	Reveal surface topography, disparities in surface sheen, any coatings.	Can sometimes be more informative on surface irregularities than raking illumination.	Depth or height of surface irregularities will not be so specifically indicated as raking illumination. Incandescent light can be harmful to the object because of the heat (Warda 2017: 118).

TECHNIQUE	BASIC CONCEPT	USES FOR CONSERVATORS	ADVANTAGES	LIMITATIONS
• Transmitted illumination	The object is lit from the side, opposite the viewing position. Light that is able to penetrate the object is recorded, usually by using a fibre-optic light.	Reveal differences in density, thickness, gaps, separations, paper structure, watermarks, repairs, tears, scratches, cracks in canvas paintings. In objects, it can reveal separations, cracks or losses.	More detailed information can be revealed.	Watermarks or paper structure cannot be examined when overlying support is severely strained (Warda 2017: 121, Wasiutynski 2020: 16).
• Darkfield and edge illumination	It is mostly used to record cracks in glass and image transfer onto glass. The object is placed on a dark background and illuminated from one or both sides at a low angle.	Framed photographs, drawings, prints or paintings adhered to glass are illuminated to record points of attachment. It is also used to record the loosening of sealed paint in glass paintings or the loosening of photographs adhered to acrylic sheeting.	Impurities and deterioration can be revealed.	No natural light source is used, so colour or grayscale targets cannot be used (Warda 2017: 123).
• Reflectance transformation imaging (RTI)	Previously referred to as polynomial texture mapping (PTM), it consists of a dome with many light sources that is positioned at different angles. For each different illumination direction, images are recorded. The surface normal is then calculated based on the images (Bezur 2021: 10).	The technique creates texture maps of objects from multiple digital images with different illumination directions. This reveals the surface texture (Payne 2021: 18). JPEG files are created to be processed by the RTIBuilder software (Warda 2017: 126).	Complete surface information is gathered. Detailed images can be monitored. It can be easily repeated to compare sets of images effectively (Payne 2021: 21).	The images are virtual, and it is important that other inspection techniques are also used when unusual information is seen before conclusions are made (Warda 2017: 127).

TECHNIQUE	BASIC CONCEPT	USES FOR CONSERVATORS	ADVANTAGES	LIMITATIONS
Close-up photography, photomacrography, photomicrography	With this technique, small objects and detail of larger objects, like fibres or their microstructure, are captured. Photos are taken with a camera and/or a microscope. Close-up photography can take up to 1X magnification, photomacrography up to 50X and photomicrography up to 1500X.	It is practical to reference specific working setups. The proper terminology describing the specific technique is very important.	It is crucial to calculate exposed modifications in depth of field. Nearly all digital cameras can be mounted on a microscope. Diffuse illumination can be created by using a small circle of paper large enough for the focus area.	Close-up photography can often result in blurry images. Depth of field can be very limited and lens changes can result in loss of sharpness. Any movement of the microscope will result in blurry images (Warda 2017: 129).
Infrared photography Reflected infrared photography	Digital cameras are used where the infrared filter is removed to take near-infrared photos without the filter. Incandescent lamps should be used for the illumination as they emit enough infrared that the filters can absorb these longer wavelengths. The light should be uniform and glare-free. All of these techniques require photoshop software to finalise the images taken.	It is used to detect changes, examine underdrawings, faded inscriptions or any other obscured detail.	This technique is used to reveal images and texts that are not visible with the naked eye or general photography. Photographs are in grayscale and are in a mosaic form (lots of images).	The infrared flare can create a hot spot in the centre of the photograph.

TECHNIQUE	BASIC CONCEPT	USES FOR CONSERVATORS	ADVANTAGES	LIMITATIONS
Transmitted infrared photography	Digital cameras are used with infrared filters removed. The light source should emit infrared light, and the ambient illumination that will fall on the object should be minimised.	It reveals inscriptions, obscured designs (obscured by linings or mounts), watermarks or underdrawings, especially lead white.	It gives a deeper layer of visibility to works of art.	Accurate focus can sometimes be a problem (Warda 2017: 140).
False-colour infrared digital photography (FCIR)	An infrared and visible light image of the same area is taken, and because of both filtrations, a false-colour image is created.	It is used to differentiate and characterise materials to examine inks, dyes and pigments.	Colourants similar in appearance can be differentiated and characterised.	The camera should not be moved between taking images. Specific software should be used to develop the images (Warda 2017: 143).
Visible-induced infrared luminescence	Luminescent infrared wavelengths are produced by exciting material with a blue/green light. This is then recorded by a camera with an IR-pass filter.	It is used to examine documents to specify inks and pigments.	Greater intensity of images and larger subject matter can be examined.	Installing filters to eliminate all infrared output can be especially difficult (Warda 2017: 146).

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TECHNIQUE	BASIC CONCEPT	USES FOR CONSERVATORS	ADVANTAGES	LIMITATIONS
Ultraviolet photography Ultraviolet-induced visible fluorescence photography	Digital cameras may require no filtration for this imaging. The room should be very dark. Lamps should be positioned with edges parallel to the object so that their beams can fall as directly as possible on the object.	To document faded materials and repairs.	With digital cameras, you have greater control over colour accuracy.	Can be harmful to humans, but the necessary awareness should be adhered to (Warda 2017: 147).
Reflected ultraviolet photography	This technique records the reflection or transmission and the absorption of the ultraviolet radiation.	To examine surfaces and for the characterisation and differentiation of materials. Surface brush strokes, flaws, variations or scratches can be documented.	Enhances the visibility of gums, resins, varnishes, paint residues on paper, textiles, wood and other porous substrates. Residues on metal and stone are also visible. Pigments, textile fibres, dyes, iron, glass and glazes will be visible.	The radiation does not penetrate surfaces deeply, so no deeper visibility is available (Warda 2017: 160).
False-colour reflected ultraviolet (FCUV)	It is similar to false-colour infrared imaging where a non-visible radiation image is combined with two visible light sources.	It is an additional tool to characterise and differentiate materials.	Colourants similar in appearance can be differentiated and characterised.	Specific software like Adobe Photoshop must be used to develop the images (Warda 2017: 163).

Non-invasive techniques

TECHNIQUE	BASIC CONCEPT	USES FOR CONSERVATORS	ADVANTAGES	LIMITATIONS
Microscopy Stereo microscopy	It has low magnification and must typically be used with a light reflecting the surface of the object.	Study external features and objects that cannot be mounted flat. Study details of damage, former repairs, details of technique.	Two separate eyepieces. Mostly used for three-dimensional objects.	Low magnification range, between 10X and 40X (Wasiutynski 2020: 17).
X-ray techniques CT scanning	A rotating X-ray source and detector takes a series of virtual 2D cross-sections of the object. These images are combined to form a black and white 3D image.	It produces 3D images of the interior structure and surfaces of objects.	High-resolution images of very small objects can be taken.	Sometimes the 3D imaging data has a loss of surface detail (Payne 2021: 22).
X-ray fluorescence (XRF)	High-energy X-ray photons are emitted and strike the sample to knock electrons out of the innermost orbital. These atoms become unstable ions. An electron from an outer orbital will fill the vacant space in the inner orbital. These electrons have more energy that needs to be released as they drop. This energy is given off as a photon, which is then detected by the XRF (Loubser 2021: 16–19).	It detects the chemical elements in a sample as well as the concentration thereof.	It is very stable. Predictable and matrix effects can be corrected. It is used for solids, powders and liquids. It is precise and accurate. Elemental compositions from Mg to U can be determined. Concentrations as low as 5 PPM up to 100% can be identified. Up to 25 elements can be measured. It is portable.	The phase and oxidation state of the analyte cannot be detected. There is no differentiation between analytes with the same elemental composition. It cannot detect individual minerals in a sample. There is no low atomic number analysis and limited penetration depth in the sample (Loubser 2021: 7–13).

TECHNIQUE	BASIC CONCEPT	USES FOR CONSERVATORS	ADVANTAGES	LIMITATIONS
Raman spectroscopy	This technique identifies molecules of organic and inorganic compounds. The sample is irradiated with a focused laser beam. The difference in frequency of the scattered molecules is detected by the Raman and compared to a library of Raman spectra from known materials.	To identify crystalline materials (precious, semi-precious stones and minerals). Identify pigments, identify corrosion products on metals and alloys. Characterise mineral phases. Identify plastics.	Non-destructive and can be non-invasive. Analyse samples of powders, liquids and cross-sections. Can be used for chemical mapping. Relatively fast technique.	If laser power is too high, compounds can be destroyed. Dark materials like black pigments are difficult to analyse. Very small particles are difficult to analyse. Because of non-detection, it can give a false-negative result. It can be costly, and operation and interpretation of results can be difficult (Bezur and Sperber 2021: 3).
X-ray diffraction	The inter-planar spacings in the geometry of crystal are measured by X-ray diffraction. It is then compared to the database of collected powder patterns of almost all known organic and inorganic crystalline compounds.	It is used to examine and characterise pottery shards, metal corrosion, metal structures, pigments, cosmetics, ancient hair, salts and clays.	It is non-destructive and portable. The micro-structure of very old/corroded coins, pottery shards and rock art can be examined. Each crystalline phase has a unique powder diffraction pattern.	If the crystallites in a sample are very large, the distribution will not be smooth, and the measurement will not agree with the database. Interpretation of data requires experience (Loubser 2021: 67–78).

Minimally invasive techniques (sampling)

TECHNIQUE	BASIC CONCEPT	USES FOR CONSERVATORS	ADVANTAGES	LIMITATIONS
Scanning electron microscopy-energy dispersive X-ray spectroscopy analysis (SEM-EDS)	Samples are viewed at high magnifications (SEM) with the ability of mapping fixed elemental analysis (EDS). A focused electron beam is moved across the surface of a sample in a raster pattern. The backscattered electrons are captured and a grayscale image displays the intensity of the electrons. Sample atoms can also give off characteristic X-rays, similar to how XRF and EDS detectors show the elements present in the area.	It detects tool marks, hair/fur, alterations and deterioration of the surface area. It detects layer structures or exposed edges of metals, alloys, textile with metals, glass and glazed ceramics. It detects paint layers (in polished cross-section samples) as well as pigment elements.	High magnification helps to see features not visible with optical microscopy. Light elements and pigments can be more accurately identified than with XRF. Individual pigments and small particles can be identified more easily. It is more sensitive.	Mostly requires a sample. Inference from elemental data limits the identification of compounds. Operation and data interpretation requires extensive training. Maintenance is costly. It is not portable (Bezur and Sperber 2021: 4).

TECHNIQUE	BASIC CONCEPT	USES FOR CONSERVATORS	ADVANTAGES	LIMITATIONS
Fourier-transform infrared spectroscopy (FTIR)	Just as Raman spectroscopy, this technique also identifies molecules of organic and inorganic compounds. The sample is irradiated with an infrared beam. The molecules absorb the infrared wavelengths, and their vibrational motions are detected by the FTIR and compared to a library of FTIR spectra from known materials. This can be regarded as molecular fingerprints.	It categorises organic material (oils, resins, proteins, waxes) and identifies inorganic material (plastics, varnishes, acrylic paints). Fibres can be identified. Degradation products can be identified.	It can identify a wide range of organic and inorganic compounds. Samples are small and can be reused with other analytical techniques. It can be used in situ on relatively flat surfaces. It is widely available.	It requires sample removal. Operation and data interpretation requires experience and understanding of molecular structures. Custom spectral libraries must often be developed (Bezur and Sperber 2021: 5).
Laser-induced breakdown spectroscopy (LIBS)	This technique also identifies molecules. A short-pulse laser beam ablates (removes) a small volume of the sample. This interacts with a portion of the laser pulse to form a plasma that contains free electrons, excited atoms and ions. The plasma then cools, and during this process, the electrons fall down into natural ground states, causing the plasma to give off light with distinct spectral peaks, that is compared to a library of unique LIBS spectral peaks (Loubser 2021: 64).	It identifies chemical compositions.	Broad elemental coverage (H, Be, Li, C, N, O, Na, and Mg). Each element in the periodic table has a unique LIBS spectral peak. This identification enhances the determination of the chemical composition of samples.	It requires sample removal. Custom spectral peaks libraries must be developed (Loubser 2021: 61–64).

TECHNIQUE	BASIC CONCEPT	USES FOR CONSERVATORS	ADVANTAGES	LIMITATIONS
Gas chromatography-mass spectrometry (GC-MS)	It is used to detect and identify the molecular components of organic material (Bezur and Sperber 2021: 6) It uses a carrier gas, usually helium (mobile phase), to carry sample components through capillary columns containing the stationary phase. Low-molecular-weight compounds travel faster through the columns than high-molecular-weight compounds. When they exit, the molecules are ionised and fragmented and determined by the mass spectrometer using electrical or magnetic fields to determine ions based on their mass.	It identifies components of adhesives, coatings, plant resins, waxes, oils, synthetic organic pigments, some protein sources, plant gums and residues in vessels and containers like ointments, food or perfume.	It has a high level of specificity. It can deal with complex molecule mixtures. It is flexible and can use gasses, liquids and solids as samples.	Sampling is required, and the sample is then destroyed. It is highly sensitive, and contamination of samples can interfere with correct data interpretation. Interpretation of data is complex and needs trained and experienced analysers. Samples are prepared in a lab, and the analysing is also done in a lab (Bezur and Sperber 2021: 6).

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San-Mari van der Merwe: THC 803

San-Mari van der Merwe was a first-year master's student in 2021. For her analytical techniques' module assignment, she created a website that can be used when deciding on an appropriate technique for a conservator's research.

Behind all them unturned stones: A look at investigative techniques in heritage conservation

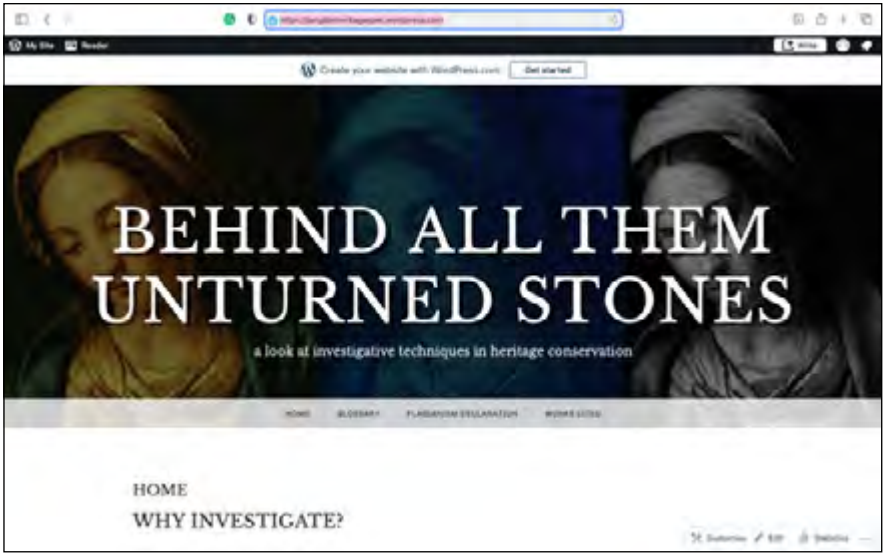
> *How are these imaging technologies currently employed for cultural heritage applications?*
> *What are the advantages, disadvantages and risks of these technologies?*
> *What are the implications of these technologies for preservation of accessibility to objects?*

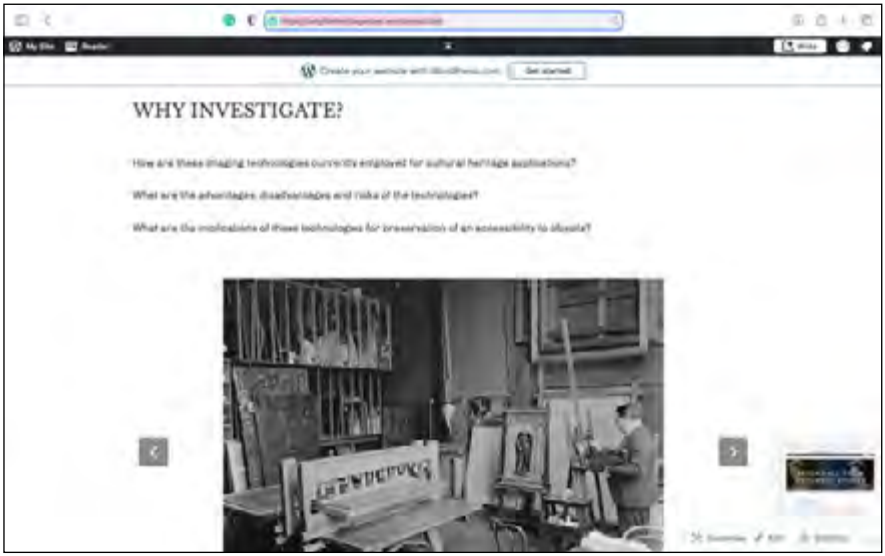
Analysis is needed to answer many questions we may feel the need to ask. It is there to determine the original materials of the object, as well as the characteristics and history of both the materials and the object. It is also there to determine the presence of components or conditions that may influence conservation treatment and to aid in the evaluation of ongoing treatment.

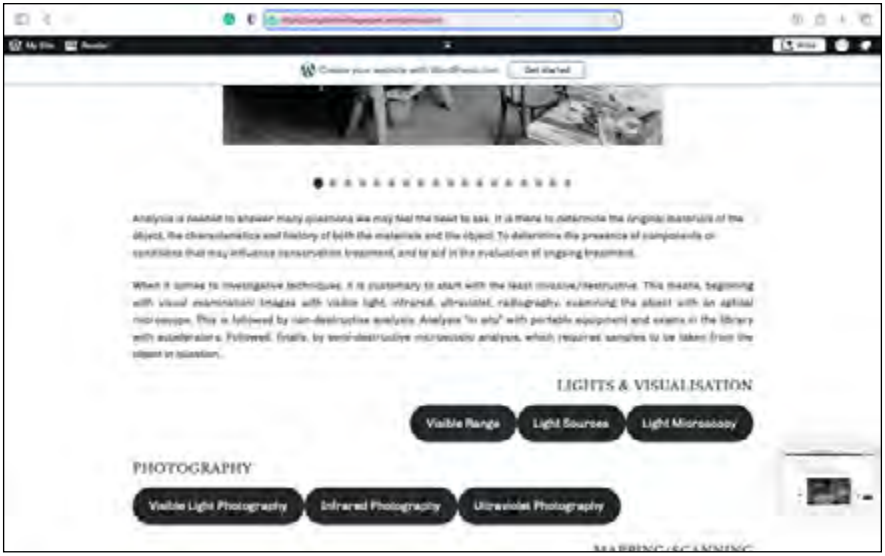
When it comes to investigative techniques, it is customary to start with the least invasive/destructive. This means beginning with visual examination: Images can be examined using visible light, infrared, ultraviolet, radiography or by examining the object with an optical microscope. This is followed by non-destructive analysis—analysis in situ with portable equipment and exams in the library with accelerators. Finally, semi-destructive microscopic analysis can be done, which requires samples to be taken from the object in question.

Please use the link to view the website: https://tangibleheritagespec.wordpress.com

Herewith are attached screenshots in case of technical difficulties:






LIGHTS & VISUALISATION
Visible Range
Light Sources
Light Microscopy
PHOTOGRAPHY
Visible Light Photography
Infrared Photography
Ultraviolet Photography


Visible Light Photography
Infrared Photography
Ultraviolet Photography
MAPPING/SCANNING
Maps and Scans
Handheld XRF
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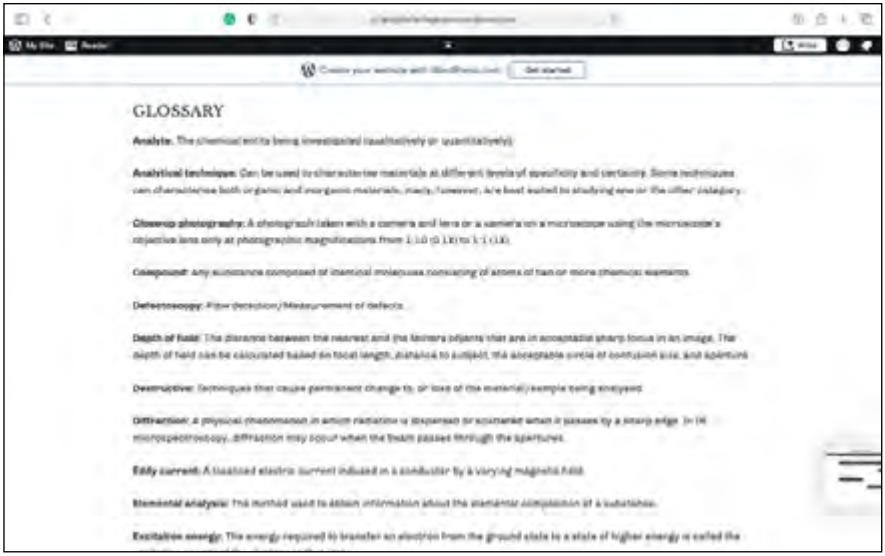


GLOSSARY

Analyte: The chemical entity being investigated (qualitatively or quantitatively).

Analytical technique: Can be used to characterise materials at different levels of specificity and certainty. Some techniques can characterise both organic and inorganic materials, many, however, are best suited to studying one or the other category.

Close-up photography: A photograph taken with a camera and lens or a camera on a microscope using the microscope's objective lens only at photographic magnifications from 1:1.0 (1.1X) to 1:1 (1X).

Compound: Any substance composed of identical molecules consisting of atoms of two or more chemical elements.

Deflectoscopy: Flaw detection/Measurement of defects.

Depth of field: The distance between the nearest and the farthest objects that are in acceptably sharp focus in an image. The depth of field can be calculated based on focal length, distance to subject, the acceptable circle of confusion size, and aperture.

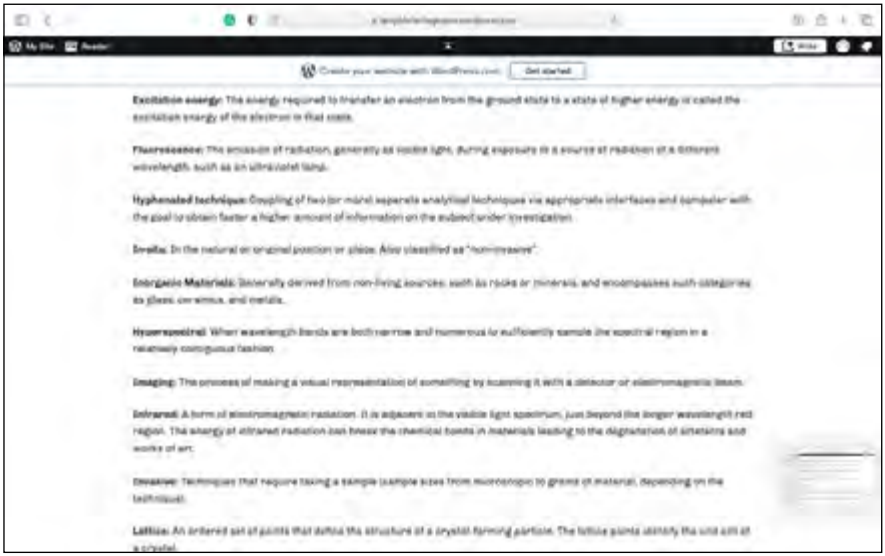
Destructive: Techniques that cause permanent change to, or loss of the material/sample being analysed.

Diffraction: A physical phenomenon in which radiation is dispersed or scattered when it passes by a sharp edge. In IR microspectroscopy, diffraction may occur when the beam passes through the apertures.

Eddy current: A localized electric current induced in a conductor by a varying magnetic field.

Elemental analysis: The method used to obtain information about the elemental composition of a substance.

Excitation energy: The energy required to transfer an electron from the ground state to a state of higher energy is called the



Excitation energy: The energy required to transfer an electron from the ground state to a state of higher energy is called the excitation energy of the electron in that state.

Fluorescence: The emission of radiation, generally as visible light, during exposure to a source of radiation of a different wavelength, such as an ultraviolet lamp.

Hyphenated technique: Coupling of two (or more) separate analytical techniques via appropriate interfaces and computer with the goal to obtain faster a higher amount of information on the subject under investigation.

In-situ: In the natural or original position or place. Also classified as "non-invasive".

Inorganic Materials: Generally derived from non-living sources, such as rocks or minerals, and encompasses such categories as glass, ceramics, and metals.

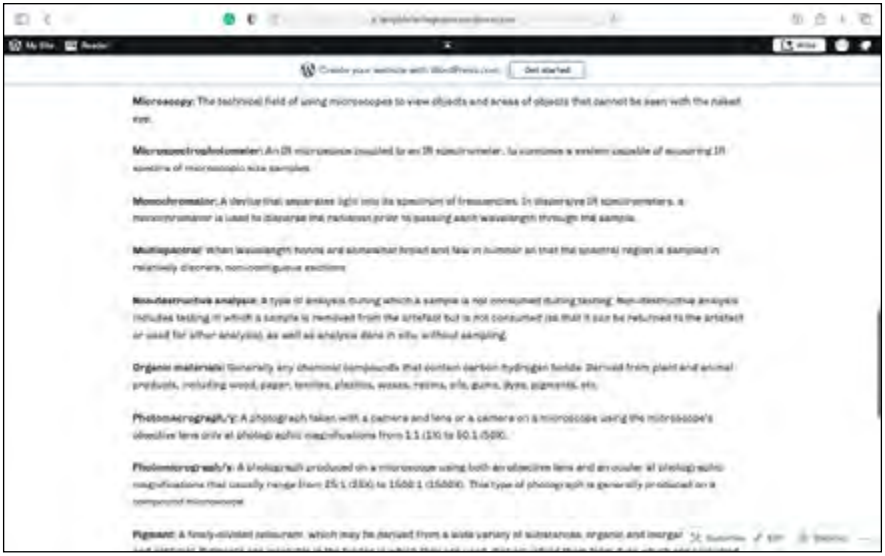
Hyperspectral: When wavelength bands are both narrow and numerous to sufficiently sample the spectral region in a relatively contiguous fashion.

Imaging: The process of making a visual representation of something by scanning it with a detector or electromagnetic beam.

Infrared: A form of electromagnetic radiation. It is adjacent to the visible light spectrum, just beyond the longer wavelength red region. The energy of infrared radiation can break the chemical bonds in materials leading to the degradation of artefacts and works of art.

Invasive: Techniques that require taking a sample (sample sizes from microscopic to grams of material, depending on the technique).

Lattice: An ordered set of points that define the structure of a crystal-forming particle. The lattice points identify the unit cell of a crystal.



Microscopy: The technical field of using microscopes to view objects and areas of objects that cannot be seen with the naked eye.

Microspectrophotometer: An IR microscope coupled to an IR spectrometer, to combine a system capable of acquiring IR spectra of microscopic size samples.

Monochromator: A device that separates light into its spectrum of frequencies. In dispersive IR spectrometers, a monochromator is used to disperse the radiation prior to passing each wavelength through the sample.

Multispectral: When wavelength bands are somewhat broad and few in number so that the spectral region is sampled in relatively discrete, noncontiguous sections.

Nondestructive analysis: A type of analysis during which a sample is not consumed during testing. Non-destructive analysis includes testing in which a sample is removed from the artefact but is not consumed (so that it can be returned to the artefact or used for other analysis), as well as analysis done in situ, without sampling.

Organic materials: Generally any chemical compounds that contain carbon-hydrogen bonds. Derived from plant and animal products, including wood, paper, textiles, plastics, waxes, resins, oils, gums, dyes, pigments, etc.

Photomicrograph/s: A photograph taken with a camera and lens or a camera on a microscope using the microscope's ocular lens only at photographic magnifications from 1:1 (1X) to 50:1 (50X).

Photomicrograph/s: A photograph produced on a microscope using both an objective lens and an ocular at photographic magnifications that usually range from 25:1 (25X) to 1500:1 (1500X). This type of photograph is generally produced on a compound microscope.

Pigment: A finely-divided colourant, which may be derived from a wide variety of substances, organic and inorganic, natural and artificial. Pigments are insoluble in the binder in which they are used, distinguishing them from dyes which are colouring matter that form solutions.

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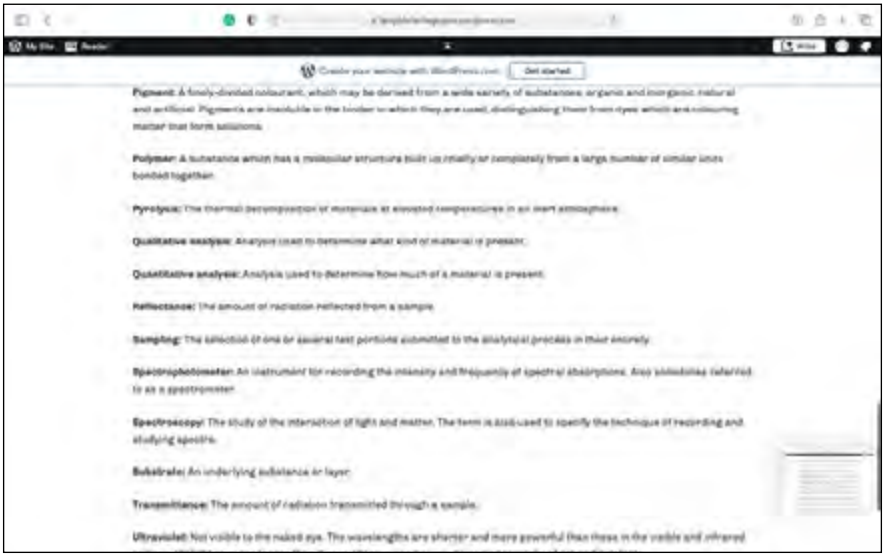

Pigment: A finely-divided colourant, which may be derived from a wide variety of substances, organic and inorganic, natural and artificial. Pigments are insoluble in the binder in which they are used, distinguishing them from dyes which are colouring matter that form solutions.

Polymer: A substance which has a molecular structure built up chiefly or completely from a large number of similar units bonded together.

Pyrolysis: The thermal decomposition of materials at elevated temperatures in an inert atmosphere.

Qualitative analysis: Analysis used to determine what kind of material is present.

Quantitative analysis: Analysis used to determine how much of a material is present.

Reflectance: The amount of radiation reflected from a sample.

Sampling: The selection of one or several test portions submitted to the analytical process in their entirety.

Spectrophotometer: An instrument for recording the intensity and frequency of spectral absorptions. Also sometimes referred to as a spectrometer.

Spectroscopy: The study of the interaction of light and matter. The term is also used to specify the technique of recording and studying spectra.

Substrate: An underlying substance or layer.

Transmittance: The amount of radiation transmitted through a sample.

Ultraviolet: Not visible to the naked eye. The wavelengths are shorter and more powerful than those in the visible and infrared

Reflectance: The amount of radiation reflected from a sample.

Sampling: The selection of one or several test portions submitted to the analytical process in their entirety.

Spectrophotometer: An instrument for recording the intensity and frequency of spectral absorptions. Also sometimes referred to as a spectrometer.

Spectroscopy: The study of the interaction of light and matter. The term is also used to specify the technique of recording and studying spectra.

Substrate: An underlying substance or layer.

Transmittance: The amount of radiation transmitted through a sample.

Ultraviolet: Not visible to the naked eye. The wavelengths are shorter and more powerful than those of the visible and infrared regions. UV light rays are longer than X rays. UV rays can be very damaging to works of art and artefacts.

Wavelength: The distance between two successive maxima or minima of a wave – i.e., the length of one wave.

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Full names of student: **Sam-Mari van der Merwe**

Full names of student: **San Mari van der Merwe**

Student number: **u16021123**

Topic of work: **THI0005 Module Assessment**

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1. I understand what plagiarism is and am aware of the University's policy in this regard.
2. I declare that this **assignment/website** (e.g. essay, report, project, assignment, dissertation, thesis, etc) is my own original work. Where other people's work has been used (either from a printed source, Internet or any other source), this has been properly acknowledged and referenced in accordance with departmental requirements.
3. I have not used work previously produced by another student or any other person to hand in as my own.
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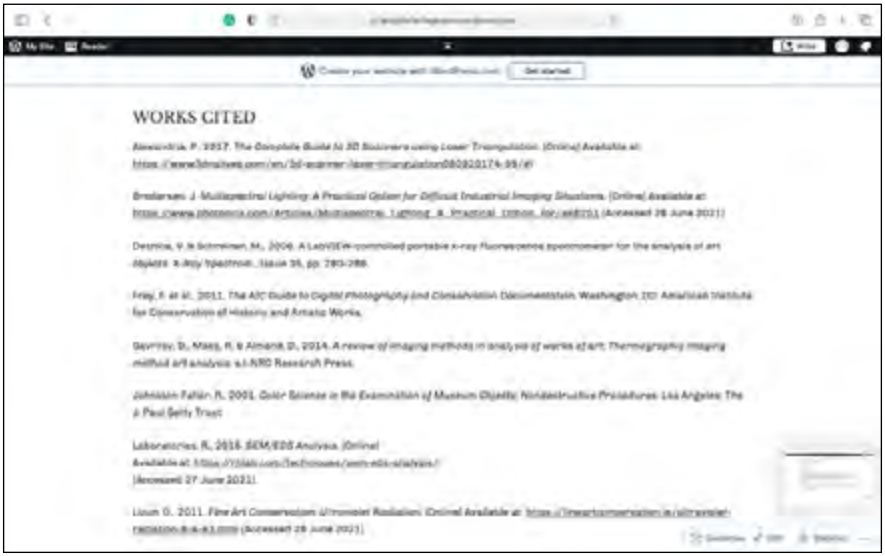

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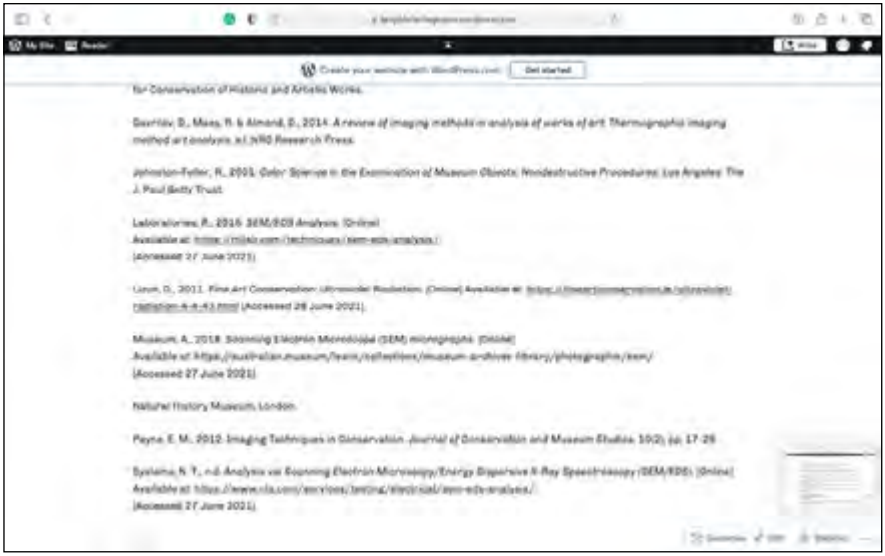

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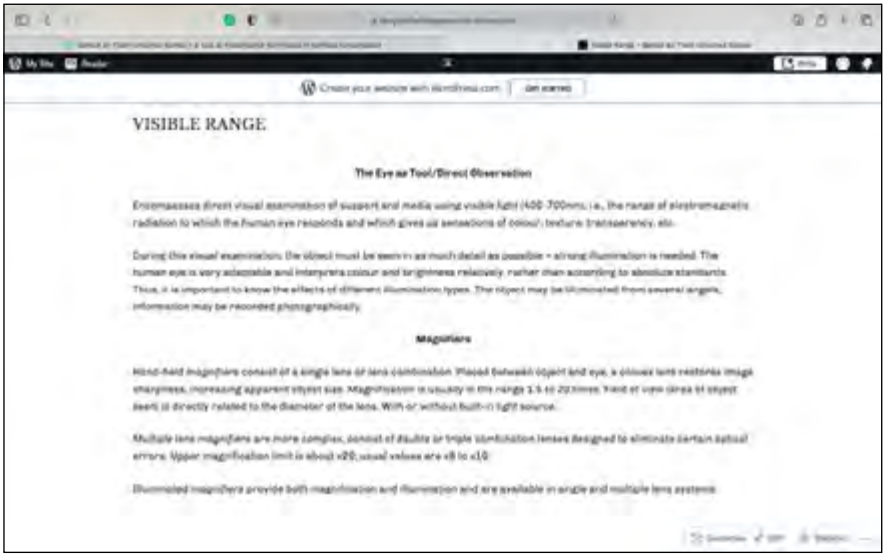

VISIBLE RANGE

The Eye as Tool/Direct Observation

Encompasses direct visual examination of support and media using visible light (400-700nm), i.e., the range of electromagnetic radiation to which the human eye responds and which gives us sensations of colour, texture, transparency, etc.

During this visual examination, the object must be seen in as much detail as possible - strong illumination is needed. The human eye is very adaptable and interprets colour and brightness relatively, rather than according to absolute standards. Thus, it is important to know the effects of different illumination types. The object may be illuminated from several angles, information may be recorded photographically.

Magnifiers

Hand-held magnifiers consist of a single lens or lens combination. Placed between object and eye, a convex lens restores image sharpness, increasing apparent object size. Magnification is usually in the range 1.5 to 20 times. Field of view (area of object seen) is directly related to the diameter of the lens. With or without built-in light source.

Multiple lens magnifiers are more complex, consist of double or triple combination lenses designed to eliminate certain optical errors. Upper magnification limit is about x20, usual values are x8 to x10.

Illuminated magnifiers provide both magnification and illumination and are available in single and multiple lens systems.

VISIBLE RANGE LIGHT SOURCES

Colour Temperature (C.T.)

The temperature (measured in degrees Kelvin) at which a heated black-body radiator would produce light giving a similar colour appearance and spectral distribution curve to that of the light source itself. The colour of an object appears different under warm (low C.T.) and cool (high C.T.) illuminance from different light sources.

Colour Rendering Index (C.R.I.)

A measure of the deviation of the spectral energy distribution of a light source from that of a heated black-body radiator. 100 indicates a perfect match. As the C.R.I. decreases in value, because of irregularities in the spectrum, deviation from the black-body standard increases. The colour of objects will differ under lights having the same C.T. but very different C.R.I.'s.

Natural Light/Daylight

Range of wavelengths from 300nm into the IR.

Direct Sunlight

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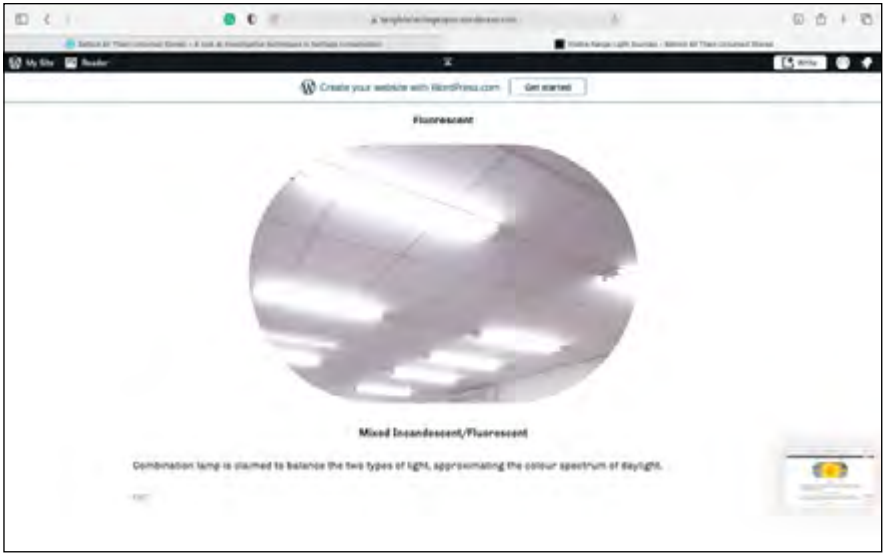
Incandescent Light

An incandescent light bulb, incandescent lamp or globe is an electric light with a wire filament that is heated until it glows. The filament is enclosed in a glass bulb with a vacuum or inert gas to protect the filament from oxidation. Current is supplied to the filament by terminals or wires embedded in the glass. Produces a warm, yellowish light and emits less than 5% watts of UV radiation, therefore UV filtering is unnecessary.

Tungsten Halogen/Quartz Halogen

The lamp is able to operate at higher temperatures because of the introduction of a small amount of halogen vapour that prevents loss of tungsten filament. A quartz envelope is needed because of the higher operating temperatures. Quartz allows transmission of UV, so UV filters are strongly advised.

Fluorescent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Fluorescent
Mixed Incandescent/Fluorescent
Combination lamp is claimed to balance the two types of light, approximating the colour spectrum of daylight.

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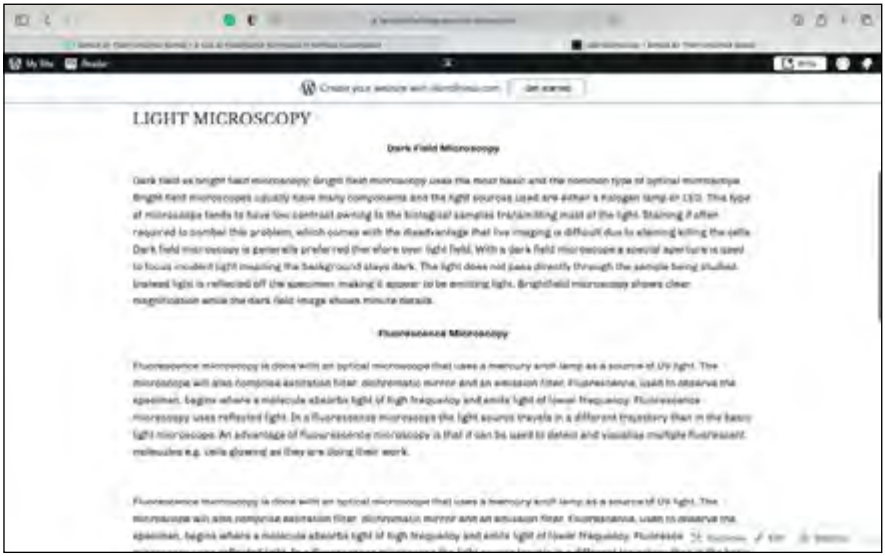
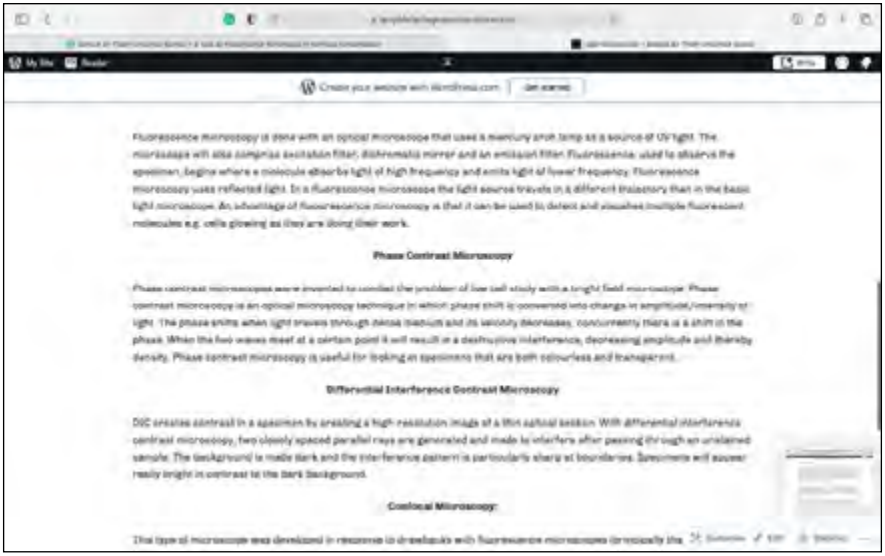

LIGHT MICROSCOPY
Dark Field Microscopy
Fluorescence Microscopy



Fluorescence microscopy is done with an optical microscope that uses a mercury arch lamp as a source of UV light. The microscope will also comprise excitation filter, dichromatic mirror and an emission filter. Fluorescence, used to observe the specimen, begins where a molecule absorbs light of high frequency and emits light of lower frequency. Fluorescence microscopy uses reflected light. In a fluorescence microscope the light source travels in a different trajectory than in the basic light microscope. An advantage of fluorescence microscopy is that it can be used to detect and visualise multiple fluorescent molecules e.g. cells glowing as they are doing their work.

Phase Contrast Microscopy

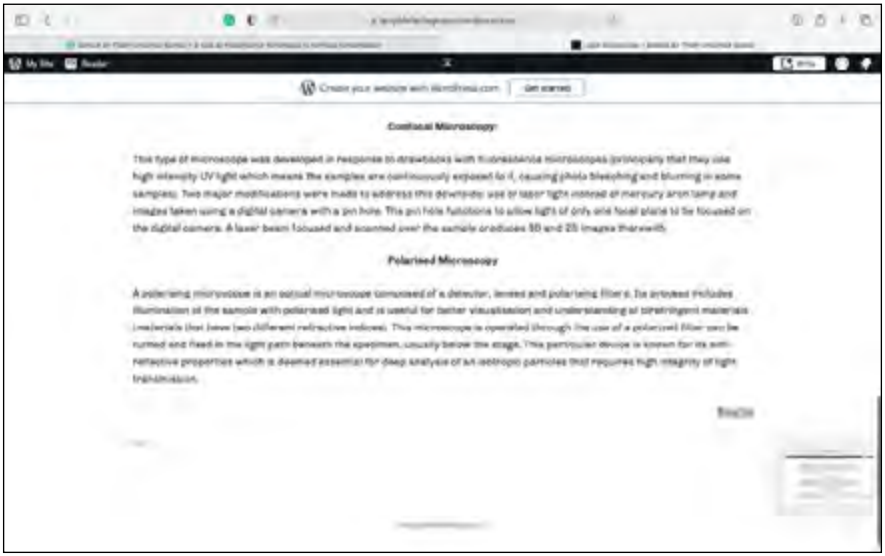
Phase contrast microscopes were invented to combat the problem of live cell study with a bright field microscope. Phase contrast microscopy is an optical microscopy technique in which phase shift is converted into change in amplitude/intensity of light. The phase shifts when light travels through dense medium and its velocity decreases, concurrently there is a shift in the phase. When the two waves meet at a certain point it will result in a destructive interference, decreasing amplitude and thereby density. Phase contrast microscopy is useful for looking at specimens that are both colourless and transparent.

Differential Interference Contrast Microscopy

DIC creates contrast in a specimen by creating a high-resolution image of a thin optical section. With differential interference contrast microscopy, two closely spaced parallel rays are generated and made to interfere after passing through an unstained sample. The background is made dark and the interference pattern is particularly sharp at boundaries. Specimens will appear really bright in contrast to the dark background.

Confocal Microscopy:

This type of microscope was developed in response to drawbacks with fluorescence microscopes (principally the

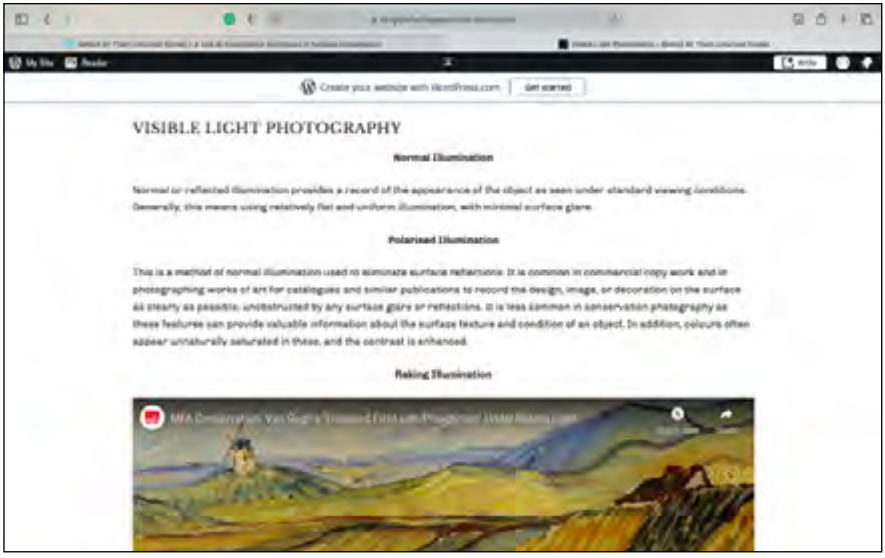


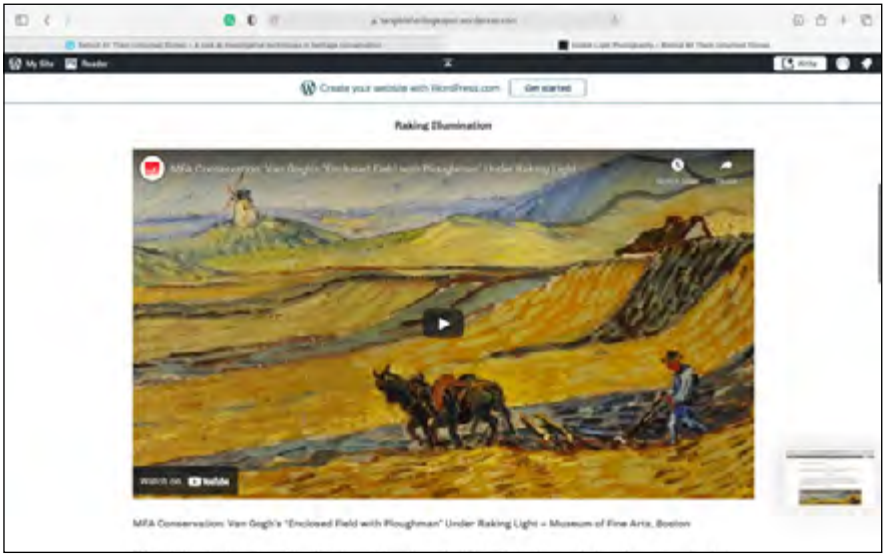
Confocal Microscopy:

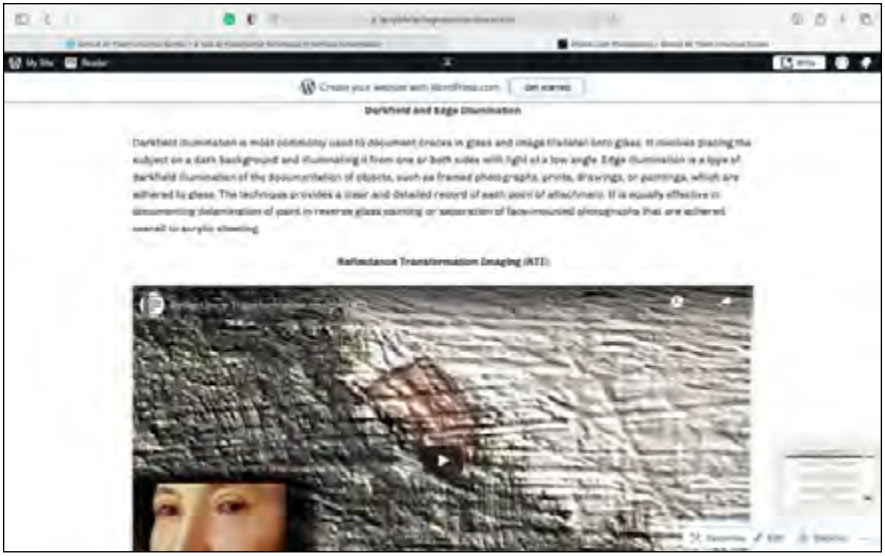
This type of microscope was developed in response to drawbacks with fluorescence microscopes (principally that they use high intensity UV light which means the samples are continuously exposed to it, causing photo bleaching and blurring in some samples). Two major modifications were made to address this downside: use of laser light instead of mercury arch lamp and images taken using a digital camera with a pin hole. The pin hole functions to allow light of only one focal plane to be focused on the digital camera. A laser beam focused and scanned over the sample produces 3D and 2D images therewith.

Polarised Microscopy

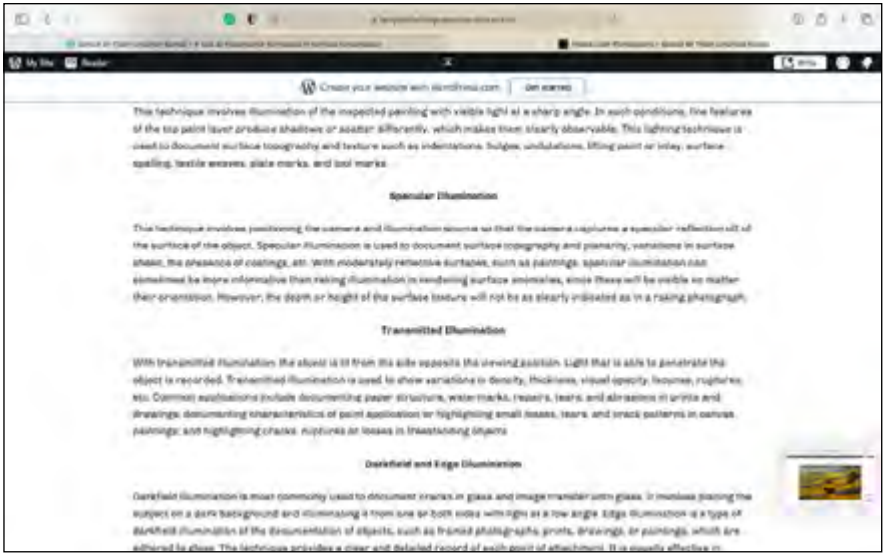
A polarising microscope is an optical microscope composed of a detector, lenses and polarising filters. Its principle includes illumination of the sample with polarised light and is useful for better visualisation and understanding of birefringent materials (materials that have two different refractive indices). This microscope is operated through the use of a polarised filter can be turned and fixed in the light path between the specimen, usually below the stage. This particular device is known for its anti-reflective properties which is deemed essential for deep analysis of an isotropic particles that requires high integrity of light transmission.


VISIBLE LIGHT PHOTOGRAPHY
Normal Illumination
Normal or reflected illumination provides a record of the appearance of the object as seen under standard viewing conditions. Generally, this means using relatively flat and uniform illumination, with minimal surface glare.
Polarised Illumination
This is a method of normal illumination used to eliminate surface reflections. It is common in commercial copy work and in photographing works of art for catalogues and similar publications to record the design, image, or decoration on the surface as clearly as possible, unobstructed by any surface glare or reflections. It is less common in conservation photography as these features can provide valuable information about the surface texture and condition of an object. In addition, colours often appear unnaturally saturated in these, and the contrast is enhanced.
Raking Illumination


Raking Illumination
MFA Conservation: Van Gogh's "Enclosed Field with Ploughman" Under Raking Light – Museum of Fine Arts, Boston


Darkfield and Edge Illumination
Reflectance Transformation Imaging (RTI):


Reflectance Transformation Imaging (RTI):
Reflectance Transformation Imaging RTI - Cultural Heritage Science Open Source, CHSOS



This technique involves illumination of the inspected painting with visible light at a sharp angle. In such conditions, fine features of the top paint layer produce shadows or scatter differently, which makes them clearly observable. This lighting technique is used to document surface topography and texture such as indentations, bulges, undulations, lifting paint or inlay, surface spalling, textile weaves, plate marks, and tool marks.

Specular Illumination

This technique involves positioning the camera and illumination source so that the camera captures a specular reflection off of the surface of the object. Specular illumination is used to document surface topography and planarity, variations in surface sheen, the presence of coatings, etc. With moderately reflective surfaces, such as paintings, specular illumination can sometimes be more informative than raking illumination in rendering surface anomalies, since these will be visible no matter their orientation. However, the depth or height of the surface texture will not be as clearly visualized as in a raking photograph.

Transmitted Illumination

With transmitted illumination the object is lit from the side opposite the viewing position. Light that is able to penetrate the object is recorded. Transmitted illumination is used to show variations in density, thickness, visual opacity, texture, roughness, etc. Common applications include documenting paper structure, watermarks, creases, tears, and abrasions in prints and drawings; documenting characteristics of paint application or highlighting small losses, tears, and cracks patterns in canvas paintings; and highlighting cracks, ruptures or losses in freestanding objects.

Darkfield and Edge Illumination

Darkfield illumination is most commonly used to document cracks in glass and image transfer onto glass. It involves placing the subject on a dark background and illuminating it from one or both sides with light at a low angle. Edge illumination is a type of darkfield illumination of the documentation of objects, such as framed photographs, prints, drawings, or paintings, which are adhered to glass. This technique provides a clear and detailed record of each point of attachment. It is equally effective in

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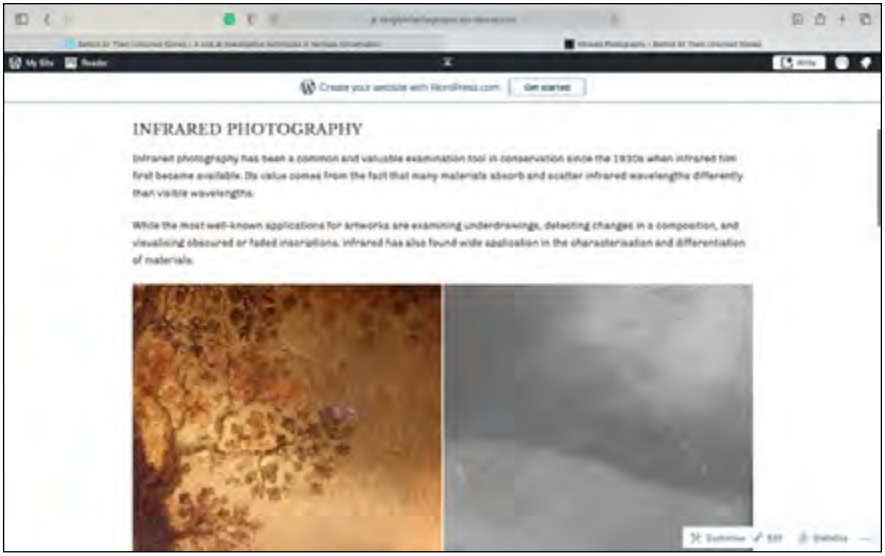
Reflectance Transformation Imaging (RTI) - Cultural Heritage Science Open Source, CHSOS

User-friendly and non-invasive for the examination and documentation of cultural heritage object surfaces. In this technique, a source image set is processed into an interactive file. It allows the viewer to examine the visual appearance of an object in various lighting conditions with a range of computational enhancements, highlighting and revealing characteristics of the imaged objects. RTI can be used for a variety of activities including documentation, condition monitoring, intervention, conservation treatment, interactive museum displays and research. RTI is a computational photography assisted technique which uses multi-lighting conditions to capture a set of images from a fixed camera position.

The distinctive feature of this method is the ability to virtually 'relight' the imaged surface from any angle in a viewer. A processed source image set is therefore often referred to as a relightable file or image. Key to this imaging method is the acquisition of the source image set, a series of images are captured with the object and camera static relative to each other, while knowing or recording the spatial location of the light sources.

If you want to see more of this, click here to view the Cooper Hewitt webpage where you are able to adjust the light source by moving your mouse over the images.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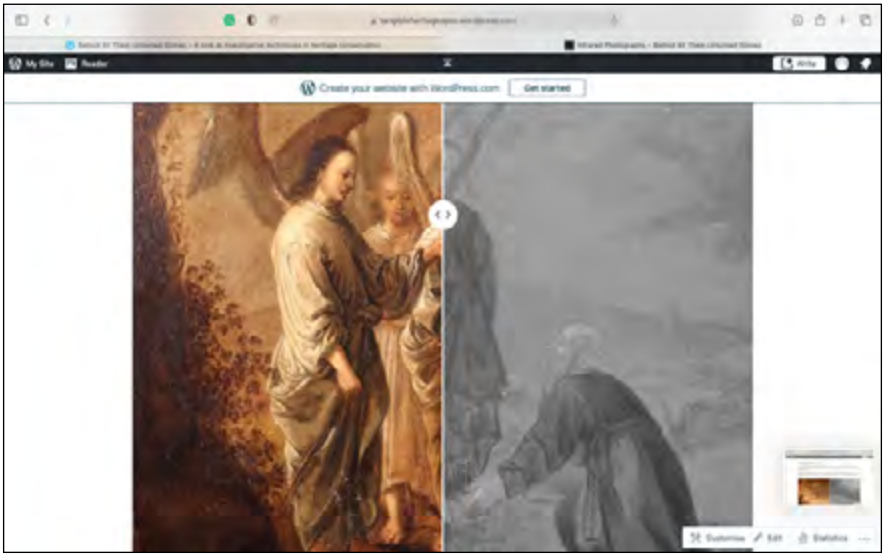
INFRARED PHOTOGRAPHY
Infrared photography has been a common and valuable examination tool in conservation since the 1930s when infrared film first became available. Its value comes from the fact that many materials absorb and scatter infrared wavelengths differently than visible wavelengths.
While the most well-known applications for artworks are examining underdrawings, detecting changes in a composition, and visualising obscured or faded inscriptions, infrared has also found wide application in the characterisation and differentiation of materials.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used in conjunction with blue-absorbing filtration, Kodak/Ilford Ltd has modified its film so that the upper blue-sensitive layer records only infrared reflectivity, while the red- and green-sensitive layers are still recorded in the visible spectrum. The combination of visible and infrared absorbency properties resulted in distinctive "false" colours that facilitated characterization of differentiation of materials. In conservation, for example, false-colour infrared using film cameras (and now digital cameras) has been successfully applied to the examination of inks, dyes, and pigments.

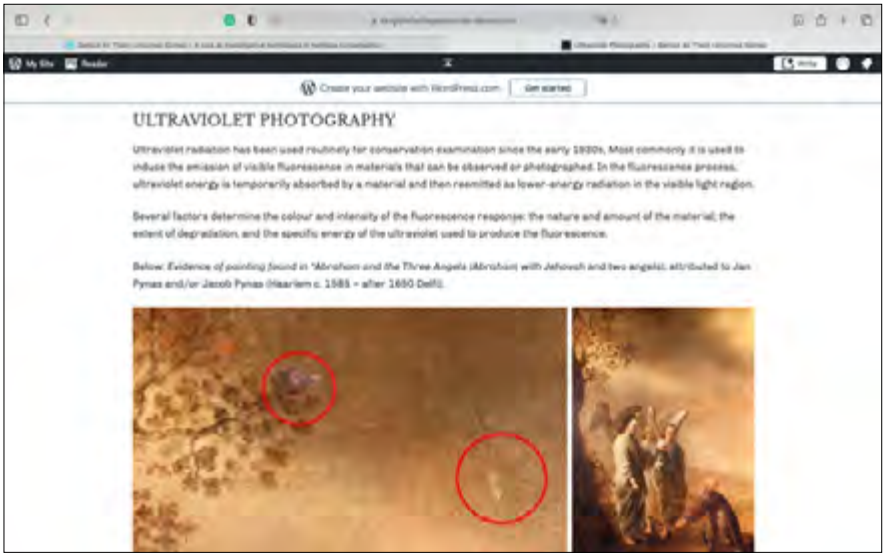
Infrared-Reflected False-Colour (IRRFC)

These images are produced by splitting the visible images into its red, green and blue (RGB) components and shifting the red and green components into the green and blue channels respectively. The IRR image is overlaid into the red channel. The reflective properties of the object in the IR range are described by red colour on the R channel. Note that Real Infrared False-Colour (IRRFC) images can also be produced by recording three infrared images in the ranges: IRR1 (700-800 nm) and IRR2 (900-1000 nm) and by placing those in the B, G and R channels of an RGB image, respectively.

Visible Induced Infrared Luminescence (VIL)

These images record the emission of radiation (luminescence) in the infrared region (700-1100 nm) from a subject which is illuminated with visible light. The image characterises the spatial distribution of pigments such as Egyptian blue, Han blue, Han purple, and cadmium-containing pigments. This technique is very sensitive and can reveal even single particles of such pigments. This technique involves excitation of materials with blue/green visible light in order to produce luminescence in infrared wavelengths, which is then recorded with an IR-pass filter.

Commonly used in forensic work, especially in the examination of documents, visible-induced infrared luminescence has seen only limited application in conservation work, primarily because of the difficulty of the procedure. Digital cameras can greatly simplify the process and as a result may lead to the development of more conservation-related applications.

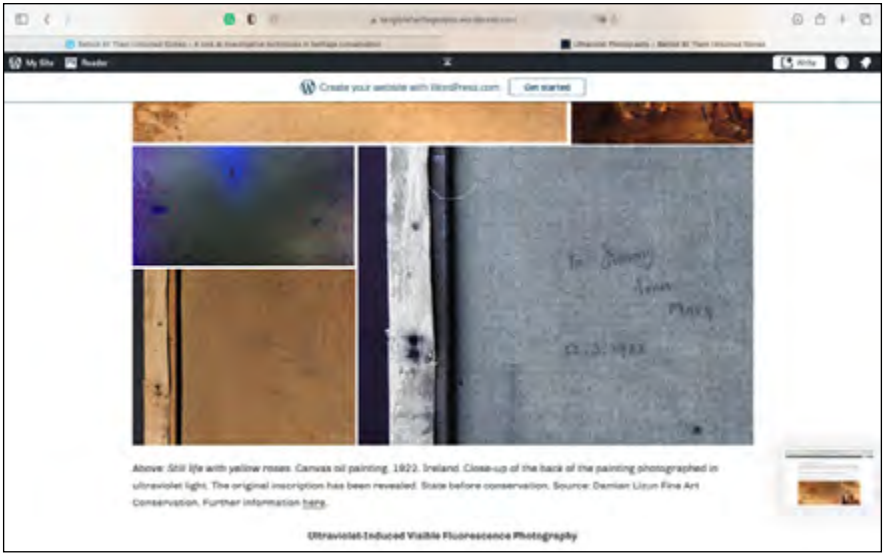


ULTRAVIOLET PHOTOGRAPHY

Ultraviolet radiation has been used routinely for conservation examination since the early 1930s. Most commonly it is used to induce the emission of visible fluorescence in materials that can be observed or photographed. In the fluorescence process, ultraviolet energy is temporarily absorbed by a material and then reemitted as lower-energy radiation in the visible light region.

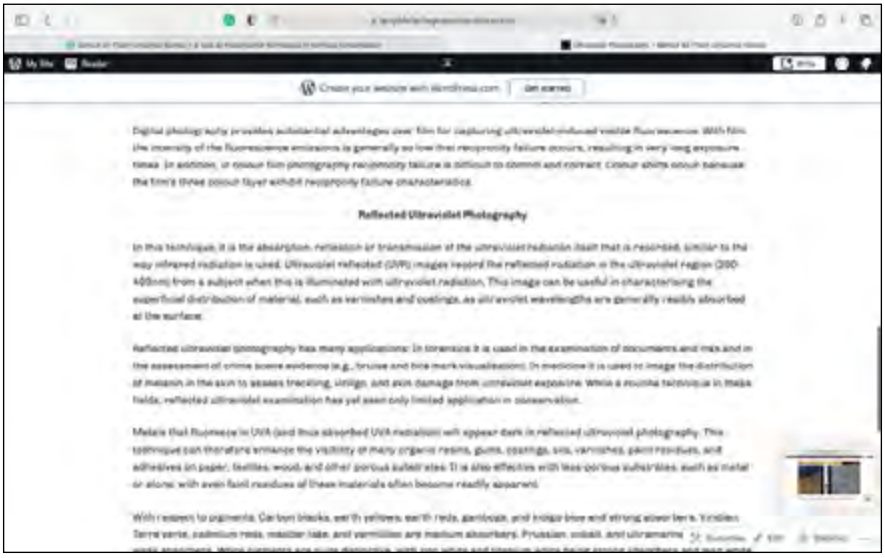
Several factors determine the colour and intensity of the fluorescence response: the nature and amount of the material; the extent of degradation; and the specific energy of the ultraviolet used to produce the fluorescence.

Below: *Evidence of painting found in "Abraham and the Three Angels (Abraham with Jehovah and two angels), attributed to Jan Pynas and/or Jacob Pynas (Haarlem c. 1583 – after 1650 Delft).*



Above: *Still life with yellow roses*. Canvas oil painting. 1922. Ireland. Close-up of the back of the painting photographed in ultraviolet light. The original inscription has been revealed. State before conservation. Source: Damian Lizon Fine Art Conservation. Further information here.

Ultraviolet-Induced Visible Fluorescence Photography



Digital photography provides substantial advantages over film for capturing ultraviolet-induced visible fluorescence. With film, the intensity of the fluorescence emissions is generally so low that reciprocity failure occurs, resulting in very long exposure times. In addition, in colour film photography reciprocity failure is difficult to control and correct. Colour shifts occur because the film's three colour layer exhibit reciprocity failure characteristics.

Reflected Ultraviolet Photography

In this technique, it is the absorption, reflection or transmission of the ultraviolet radiation itself that is recorded, similar to the way infrared radiation is used. Ultraviolet reflected (UVR) images record the reflected radiation in the ultraviolet region (200-400nm) from a subject when this is illuminated with ultraviolet radiation. This image can be useful in characterising the superficial distribution of material, such as varnishes and coatings, as ultraviolet wavelengths are generally readily absorbed at the surface.

Reflected ultraviolet photography has many applications: In forensics it is used in the examination of documents and inks and in the assessment of crime scene evidence (e.g., bruise and bite mark visualisation). In medicine it is used to image the distribution of melanin in the skin to assess freckling, vitiligo, and skin damage from ultraviolet exposure. While a routine technique in many fields, reflected ultraviolet examination has yet seen only limited application in conservation.

Metals that fluoresce in UVA (and thus absorbed UVA radiation) will appear dark in reflected ultraviolet photography. This technique can therefore enhance the visibility of many organic resins, glues, coatings, oils, varnishes, paint residues, and adhesives on paper, textiles, wood, and other porous substrates. It is also effective with less porous substrates, such as metal or stone, with even faint residues of these materials often become readily apparent.

With respect to pigments, Carbon blacks, earth yellows, earth reds, gamboge, and indigo blue and strong siccative lakes. Viridian, Terre verte, cadmium reds, madder lake, and vermilion are medium absorbers. Prussian, cobalt, and ultramarine

With colored to pigments: Carbon blacks, earth yellows, earth reds, gamboge and indigo blue are strong absorbers. Viridian, Terre verte, cadmium reds, madder lake, and vermilion are medium absorbers. Prussian, cobalt, and ultramarine blues are weak absorbers. White pigments are quite distinctive, with zinc white and titanium white being strong absorbers and lead white highly reflective. Lead white in a very yellowed oil medium would be somewhat less reflective. Textile fibres can show distinctive properties – for instance, bleached linen and raw cotton are non-absorbers, while raw linen is a strong absorber.

Ultraviolet radiation does not penetrate surfaces deeply. Therefore, it is an excellent means of imaging surface topography and very subtle variations in surface character, such as brush strokes, scratches or other flaws, variations or losses in coatings.

False-Colour Reflected Ultraviolet (FCUV)

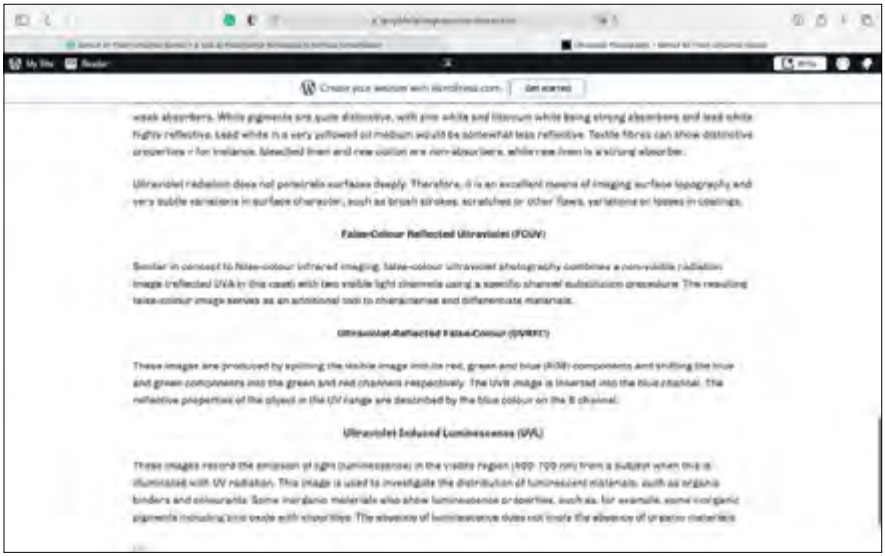
Similar in concept to false-colour infrared imaging, false-colour ultraviolet photography combines a non-visible radiation image (reflected UVA in this case) with two visible light channels using a specific channel substitution procedure. The resulting false-colour image serves as an additional tool to characterise and differentiate materials.

Ultraviolet-Reflected False-Colour (UVRFC)

These images are produced by splitting the visible image into its red, green and blue (RGB) components and shifting the blue and green components into the green and red channels respectively. The UVR image is inserted into the blue channel. The reflective properties of the object in the UV range are described by the blue colour on the B channel.

Ultraviolet-Induced Luminescence (UVL)

These images record the emission of light (luminescence) in the visible region (400-700 nm) from a subject when this is illuminated with UV radiation. This image is used to investigate the distribution of luminescent materials, such as organic binders and colourants. Some inorganic materials also show luminescence properties, such as, for example, some inorganic pigments including zinc oxide with silver/blue. The absence of luminescence does not imply the absence of organic materials



weak absorbers. White pigments are quite distinctive, with zinc white and titanium white being strong absorbers and lead white highly reflective. Lead white in a very yellowed oil medium would be somewhat less reflective. Textile fibres can show distinctive properties – for instance, bleached linen and raw cotton are non-absorbers, while raw linen is a strong absorber.

Ultraviolet radiation does not penetrate surfaces deeply. Therefore, it is an excellent means of imaging surface topography and very subtle variations in surface character, such as brush strokes, scratches or other flaws, variations or losses in coatings.

False-Colour Reflected Ultraviolet (FCUV)

Similar in concept to false-colour infrared imaging, false-colour ultraviolet photography combines a non-visible radiation image (reflected UVA in this case) with two visible light channels using a specific channel substitution procedure. The resulting false-colour image serves as an additional tool to characterise and differentiate materials.

Ultraviolet-Reflected False-Colour (UVRFC)

These images are produced by splitting the visible image into its red, green and blue (RGB) components and shifting the blue and green components into the green and red channels respectively. The UVR image is inserted into the blue channel. The reflective properties of the object in the UV range are described by the blue colour on the B channel.

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Used in conjunction with blue-absorbing filtration, Extachrome film was modified so that the upper blue-sensitive layer recorded only infrared reflectivity, while the red- and green-sensitive layers are still recorded in the visible spectrum. The combination of visible and infrared absorbency properties resulted in distinctive "false" colours that facilitated characterization of differentiation of materials. In conservation, for example, false-colour infrared using film cameras (and now digital cameras) has been successfully applied to the examination of inks, dyes, and pigments.

Infrared-Reflected False-Colour (IRRFC)

These images are produced by splitting the visible images into its red, green and blue (RGB) components and shifting the red and green components into the green and blue channels respectively. The IRR image is overlaid into the red observed. The reflective properties of the object in the IR range are described by red colour on the R channel. Some true (infrared False-Colour (IDRGC) images can also be produced by recording three infrared images in the ranges: (NIR) (700-870 nm) and (NIR) (900-1000 nm) and by placing those in the B, G and R channels of an RGB image, respectively.

Visible Induced Infrared Luminescence (VIL)

These images record the emission of radiation (luminescence) in the infrared region (700-1100 nm) from a subject which it is illuminated with visible light. The image shows/reveals the spatial distribution of pigments such as Egyptian blue, Han blue, Han purple, and cadmium-containing pigments. This technique is very sensitive and can reveal even single particles of such pigments. This technique involves excitation of materials with blue/green visible light in order to produce luminescence in infrared wavelengths, which is then recorded with an IR-pass filter.

Commonly used in forensic work, especially in the examination of documents, visible-induced infrared luminescence has seen only limited application in conservation work, primarily because of the difficulty of the procedure. Digital cameras can greatly simplify the process and as a result may lead to the development of more conservation-related applications.

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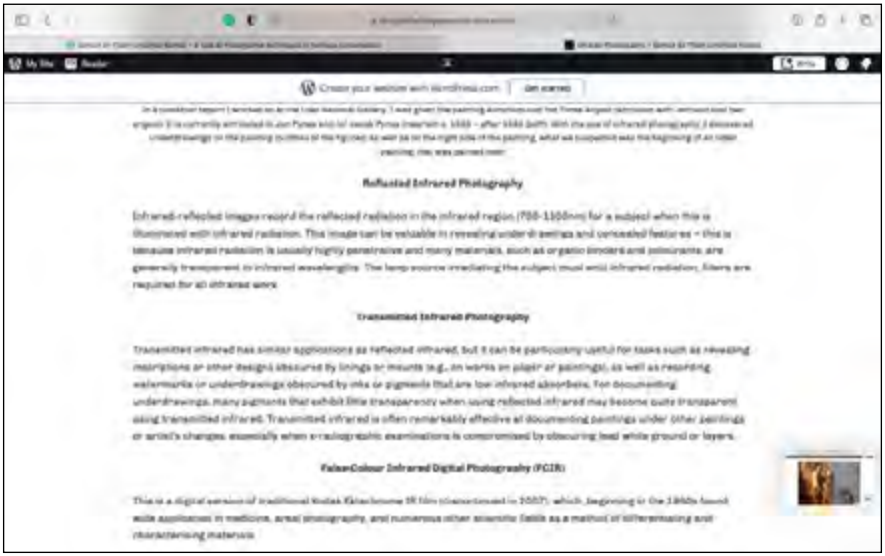


Reflected Infrared Photography

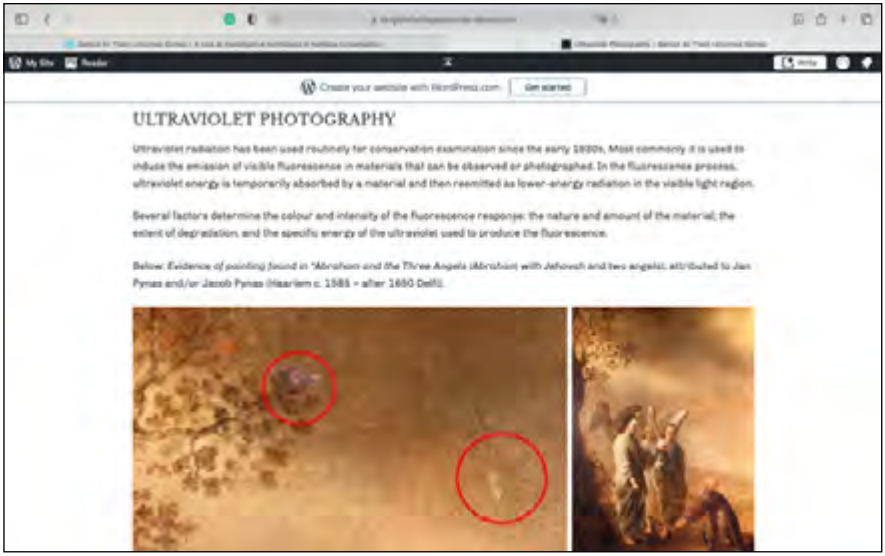
Infrared-reflected images record the reflected radiation in the infrared region (700-1100nm) for a subject when this is illuminated with infrared radiation. This image can be valuable in revealing underdrawings and concealed features – this is because infrared radiation is usually highly penetrative and many materials, such as organic binders and colourants, are generally transparent to infrared wavelengths. The lamp source irradiating the subject must emit infrared radiation, filters are required for all infrared work.

Transmitted Infrared Photography

Transmitted infrared has similar applications as reflected infrared, but it can be particularly useful for tasks such as revealing inscriptions or other designs obscured by linings or mounts (e.g., on works on paper or paintings), as well as recording watermarks or underdrawings obscured by inks or pigments that are low infrared absorbers. For documenting underdrawings, many pigments that exhibit little transparency when using reflected infrared may become quite transparent using transmitted infrared. Transmitted infrared is often remarkably effective at documenting paintings under other paintings or artist's changes, especially when x-radiographic examinations is compromised by obscuring lead white ground or layers.

False-Colour Infrared Digital Photography (FCIR)

This is a digital version of traditional Kodak Ektachrome IR film (discontinued in 2007), which, beginning in the 1940s found wide applications in medicine, aerial photography, and numerous other scientific fields as a method of differentiating and characterizing materials.


ULTRAVIOLET PHOTOGRAPHY
Ultraviolet radiation has been used routinely for conservation examination since the early 1930s. Most commonly it is used to induce the emission of visible fluorescence in materials that can be observed or photographed. In the fluorescence process, ultraviolet energy is temporarily absorbed by a material and then reemitted as lower-energy radiation in the visible light region.
Several factors determine the colour and intensity of the fluorescence response: the nature and amount of the material; the extent of degradation; and the specific energy of the ultraviolet used to produce the fluorescence.
Below: Evidence of painting found in "Abraham and the Three Angels (Abraham with Jehovah and two angels), attributed to Jan Pynas and/or Jacob Pynas (Haarlem c. 1581 – after 1650 Delft).

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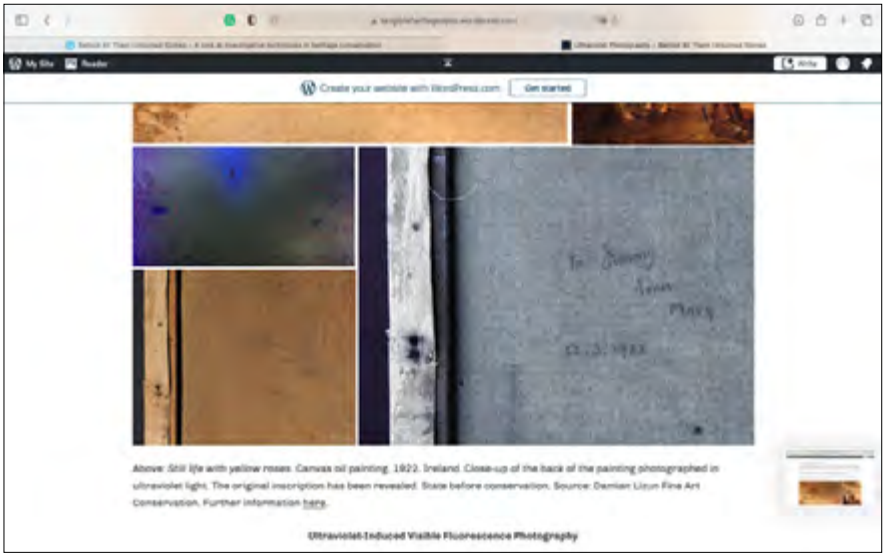
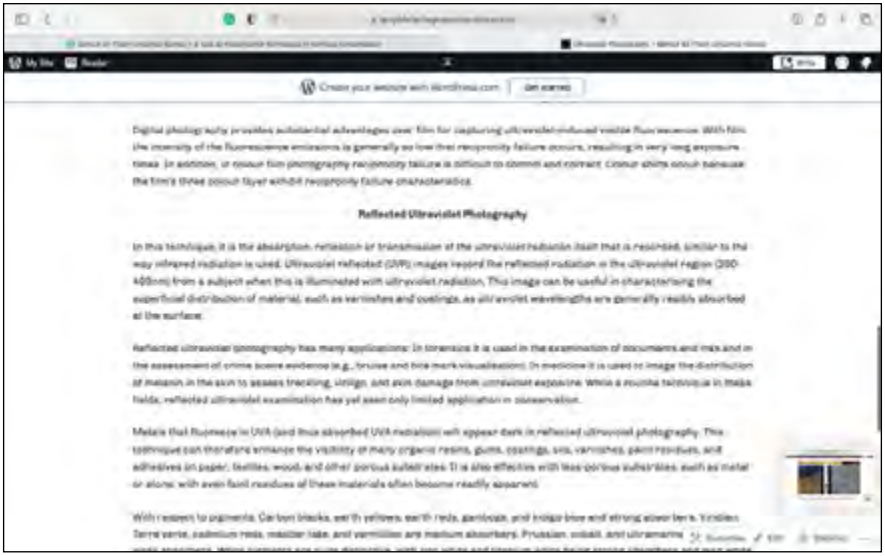

Above: Still life with yellow roses. Canvas oil painting. 1922. Ireland. Close-up of the back of the painting photographed in ultraviolet light. The original inscription has been revealed. State before conservation. Source: Damian Lizun Fine Art Conservation. Further information here.
Ultraviolet-Induced Visible Fluorescence Photography



Digital photography provides substantial advantages over film for capturing ultraviolet-induced visible fluorescence. With film the intensity of the fluorescence emissions is generally so low that reciprocity failure occurs, resulting in very long exposure times. In addition, in colour film photography reciprocity failure is difficult to control and correct. Colour shifts occur because the film's three colour layer exhibit reciprocity failure characteristics.

Reflected Ultraviolet Photography

In this technique, it is the absorption, reflection or transmission of the ultraviolet radiation itself that is recorded, similar to the way infrared radiation is used. Ultraviolet reflected (UVR) images record the reflected radiation in the ultraviolet region (300-400nm) from a subject when this is illuminated with ultraviolet radiation. This image can be useful in characterising the superficial distribution of material, such as varnishes and coatings, as ultraviolet wavelengths are generally readily absorbed at the surface.

Reflected ultraviolet photography has many applications: In forensics it is used in the examination of documents and inks and in the assessment of crime scene evidence (e.g., bruise and bite mark visualisation). In medicine it is used to image the distribution of melanin in the skin to assess freckling, vitiligo, and skin damage from ultraviolet exposure. While a routine technique in these fields, reflected ultraviolet examination has yet seen only limited application in conservation.

Media that fluoresce in UVA (and thus absorbed UVA radiation) will appear dark in reflected ultraviolet photography. This technique can therefore enhance the visibility of many organic resins, gums, coatings, oils, varnishes, paint residues, and adhesives on paper, textiles, wood, and other porous substrates. It is also effective with less porous substrates, such as metal or stone, with even faint residues of these materials often become readily apparent.

With respect to pigments, Carbon blacks, earth yellows, earth reds, glazings, and indigo blue and strong absorbers. Viridian, Terre verte, cadmium reds, madder lake, and vermillion are medium absorbers. Prussian, cobalt, and ultramarine blues are weak absorbers. White pigments are quite distinctive, with zinc white and titanium white being strong absorbers and lead white highly reflective. Lead white in a very yellowed oil medium would be somewhat less reflective. Textile library can show distinctive properties – for instance, bleached linen and raw cotton are non-absorbers, while raw linen is a strong absorber.

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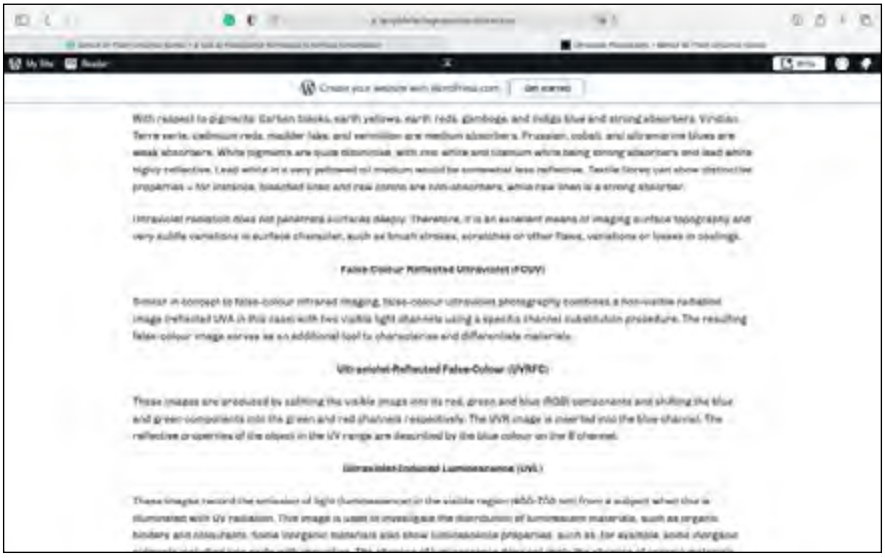
Ultraviolet-Induced Luminescence (UVL)

These images record the emission of light (luminescence) in the visible region (400-750 nm) from a subject when that is illuminated with UV radiation. The image is used to investigate the distribution of luminescent materials, such as organic binders and consolidants. Some inorganic materials also show luminescence properties, such as, for example, some manganese



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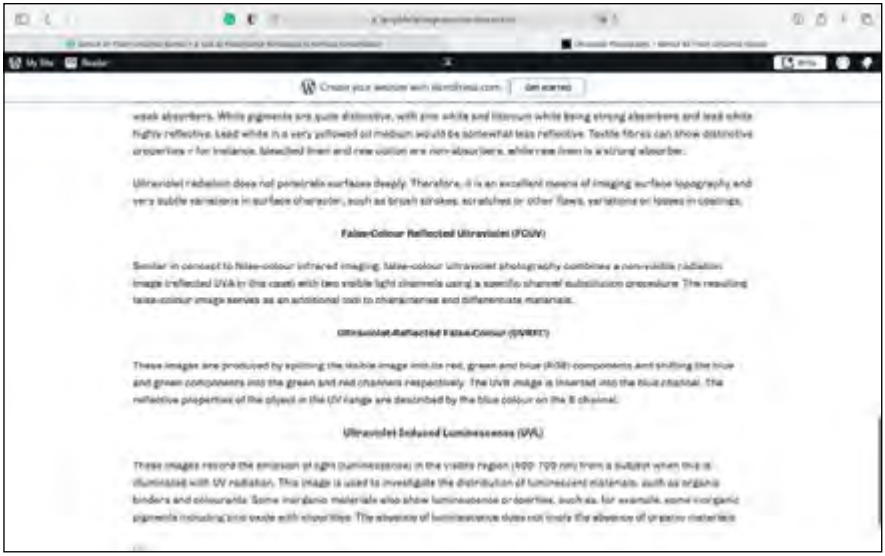

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SCANNING & MAPPING

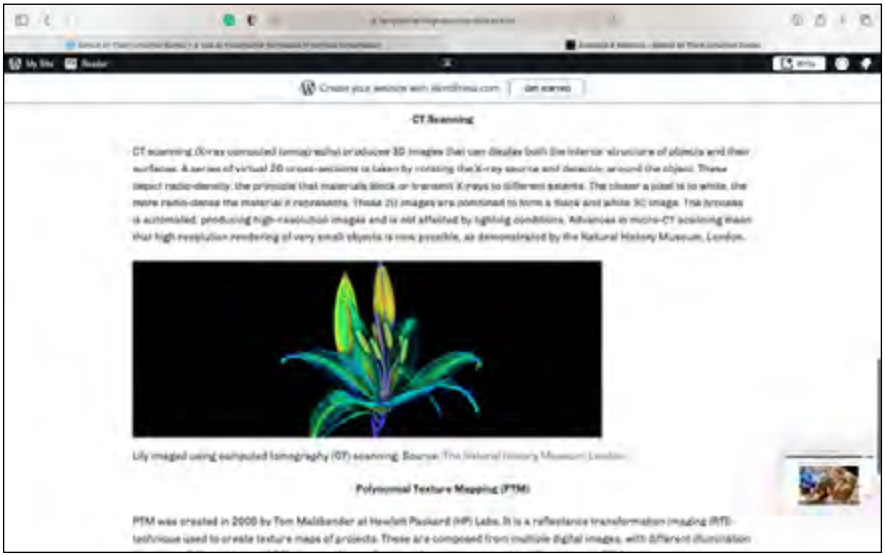
3D Laser Scanning

By definition, a 3D scanner is used to obtain a 'digital image' of a physical object. To acquire this digital replica, there are different methods to record the object, which is then analysed and reprocessed on a computer in order to determine its general shape. The laser beam is reflected by the object and recorded by a sensor producing data points that construct an object map. In colour laser scanning the red(R), green(G), and blue(B) wavelengths as measured to give an RBB value as well as an XYZ coordinate. There are two main types of laser scanning: time-of-flight and triangulation.

Triangulation is used for smaller objects. It can be used to calculate XYZ coordinates for the point cloud because there is a fixed, known distance between the laser source and sensor. Triangulation has good accuracy but relatively restricted operating range (< 0.1m–1m). The operating range can be extended to approximately 10m using a mirror or prism-based system to scan the other object rather than an arm-mounted scanner or rotation stage. However, deterioration of accuracy is generated at this higher range. The fixed distance required between laser source and sensor also restricts the size of objects that can be scanned.

Time-of-flight scanning, also known as LiDAR (Light Direction and Ranging), sends a laser pulse towards the object and generates the point cloud by calculating the length of time the laser takes to be reflected back to the scanner. This is not restricted by the need for a fixed distance between laser source and sensor. The allows time-of-flight scanners are more portable and capable of greater object-to-sensor range enabling imaging of larger objects and sites. Time-of-flight scanning can also be performed day or night, whereas triangulation can be distributed by bright sunlight. However, time-of-flight scanning is less accurate (±3–6mm) than triangulation. Therefore, for most museum objects triangulation-based scanning is more appropriate.

Additionally, 3D printing can be used to create replicas of missing pieces of an artefact. While clearly not authentic, aids in allowing patrons to envisage the wholeness of the object they are observing. Source



CT Scanning

CT scanning (X-ray computed tomography) produces 3D images that can display both the interior structure of objects and their surfaces. A series of virtual 2D cross-sections is taken by rotating the X-ray source and detector around the object. These depict radio-density, the principle that materials block or transmit X-rays to different extents. The closer a pixel is to white, the more radio-dense the material it represents. These 2D images are combined to form a black and white 3D image. The process is automated, producing high-resolution images and is not affected by lighting conditions. Advances in micro-CT scanning mean that high-resolution rendering of very small objects is now possible, as demonstrated by the Natural History Museum, London.

Lily imaged using computed tomography (CT) scanning. Source: The Natural History Museum London

Polynomial Texture Mapping (PTM)

PTM was created in 2000 by Tom Malzbender at Hewlett Packard (HP) Labs. It is a reflectance transformation imaging (RTI) technique used to create texture maps of projects. These are composed from multiple digital images, with different illumination

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PTM was created in 2000 by Tom Malzbender at Hewlett Packard (HP) Labs. It is a reflectance transformation imaging (RTI) technique used to create texture mapped objects. These are composed from multiple digital images, with different illumination directions. Different types of RTI store surface reflection information per pixel in different ways. PTM is the most common type of RTI used within cultural heritage. Each pixel in the PTM stores both colour information and 'normal' values. Normals are vectors perpendicular to the object surface. They represent surface shape and enable calculation of light reflection, allowing the object image to be artificially relit from different directions to reveal surface texture. Therefore, PTMs are interactive 3D images that appear 3D.

To create a PTM, illumination direction must be either known in the source images or determinable from them.The analytical capabilities of these technologies combined with their non-contact nature mean that they are potentially very useful for investigating objects. The detailed images produced can be beneficial from a functional conservation perspective to monitor and record condition can be used within exhibitions and online to enhance object exploration and reach a broader audience. This suggests that wider introduction of the techniques would be beneficial for conservation and display.

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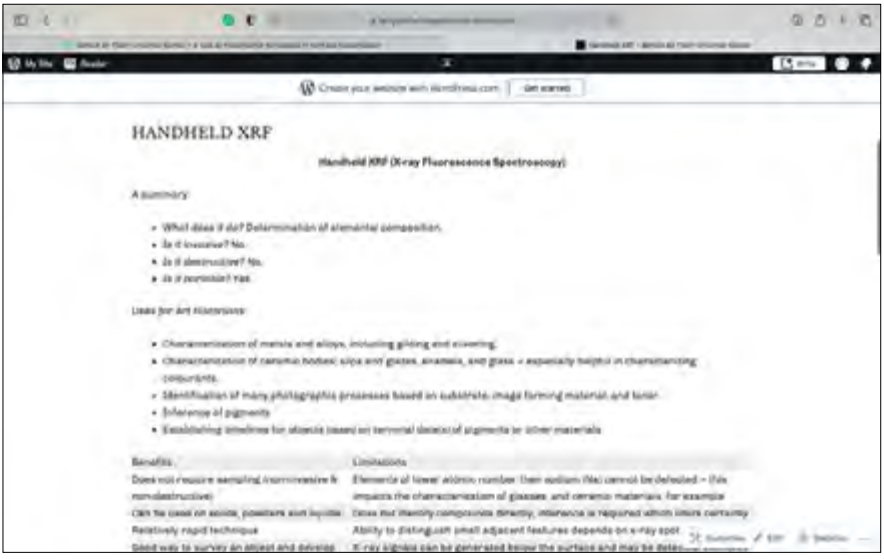


HANDHELD XRF

Handheld XRF (X-ray Fluorescence Spectroscopy)

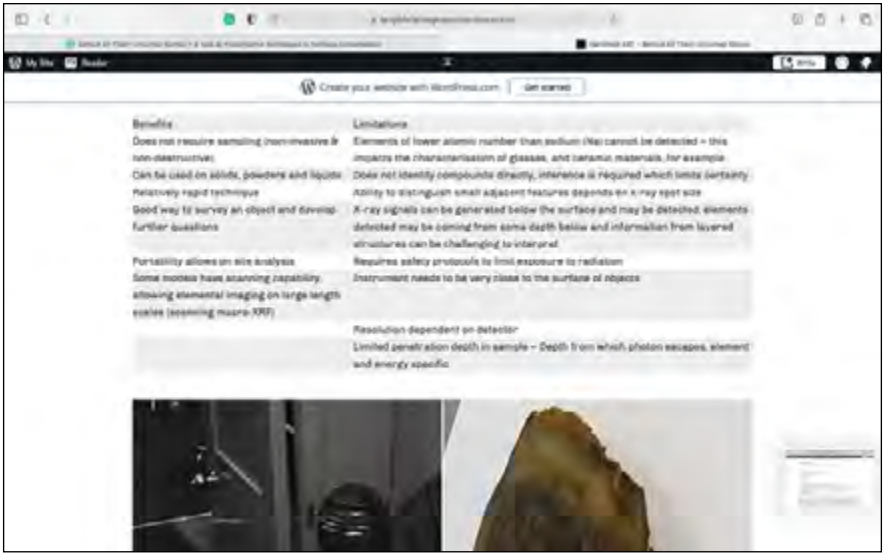
A summary

- What does it do? Determination of elemental composition.
- Is it invasive? No.
- Is it destructive? No.
- Is it portable? Yes.

Uses for art historians

- Characterization of metals and alloys, including gilding and silvering.
- Characterization of ceramic bodies, slips and glazes, enamels, and glass – especially helpful in characterizing colourants.
- Identification of many photographic processes based on substrate, image forming material and toner.
- Inference of pigments.
- Establishing timelines for objects based on terminal dates of pigments or other materials.

Benefits	Limitations
Does not require sampling (non-invasive & non-destructive)	Elements of lower atomic number than sodium (Na) cannot be detected – this impacts the characterization of glasses and ceramic materials, for example
Can be used on solids, powders and liquids	Does not identify compounds directly; reference is required which limits certainty
Relatively rapid technique	Ability to distinguish small adjacent features depends on x-ray spot
Good way to survey an object and develop	X-ray signals can be generated below the surface and may be detec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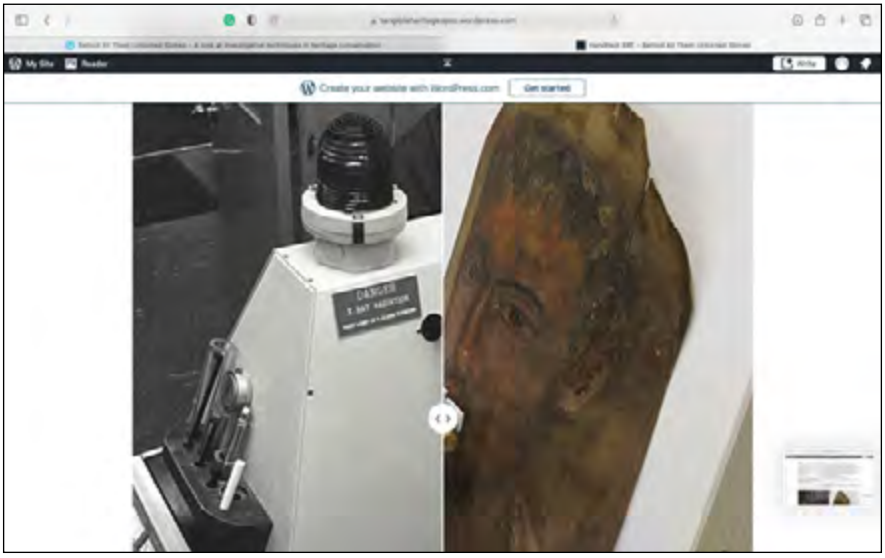
Benefits
Does not require sampling (non-invasive & non-destructive).
Can be used on solids, powders and liquids.
Relatively rapid technique.
Good way to survey an object and develop further questions.
Portability allows on site analysis.
Some models have scanning capability, allowing elemental imaging on large length scales (scanning macro-XRF).
Limitations
Elements of lower atomic number than sodium (Na) cannot be detected – this impacts the characterisation of glasses, and ceramic materials, for example.
Does not identify compounds directly, inference is required which limits certainty.
Ability to distinguish small adjacent features depends on x-ray spot size.
X-ray signals can be generated below the surface and may be detected, elements detected may be coming from some depth below and information from layered structures can be challenging to interpret.
Requires safety protocols to limit exposure to radiation.
Instrument needs to be very close to the surface of objects.
Resolution dependent on detector.
Limited penetration depth in sample – Depth from which photon escapes, element and energy specific.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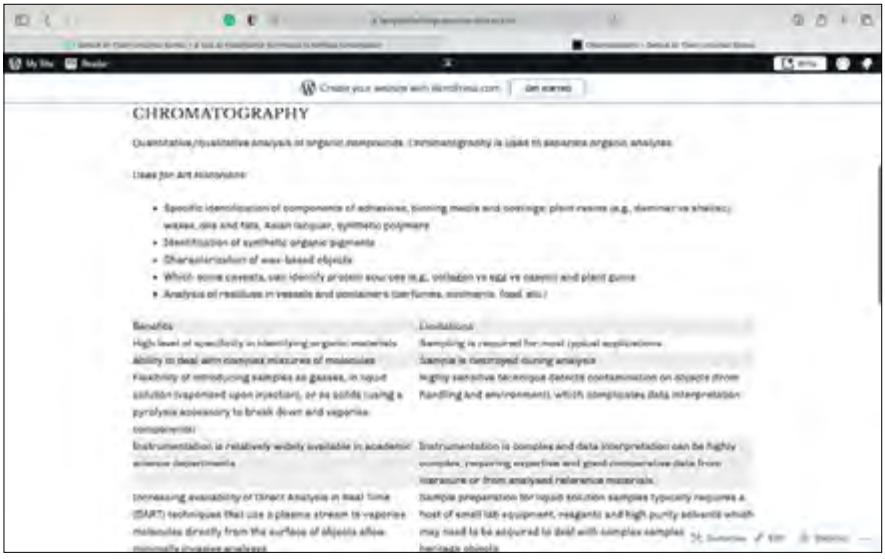
CHROMATOGRAPHY
Quantitative/qualitative analysis of organic compounds. Chromatography is used to separate organic analytes.
Uses for art conservation:
• Identification of components of adhesives, binding media and coatings: plant resins (e.g. dammar vs shellac), waxes, oils and fats, Asian lacquer, synthetic polymers
• Identification of synthetic organic pigments
• Characterisation of wax-based objects
• Which work variants can identify protein sources (e.g. collagen vs egg vs casein) and plant gums
• Analysis of residues in vessels and containers (perfumes, cosmetics, food, etc.)
Benefits
High level of specificity in identifying organic materials
Ability to deal with complex mixtures of molecules
Flexibility of introducing samples as gasses, in liquid solution (vaporised upon injection), or as solids (using a pyrolysis accessory to break down and vaporise components)
Instrumentation is relatively widely available in academic science departments
Increasing availability of Direct Analysis in Real Time (DART) techniques that use a plasma stream to vaporise molecules directly from the surface of objects allow minimally invasive analyses
Limitations
Sampling is required for most typical applications
Sample is destroyed during analysis
Highly sensitive technique detects contamination on objects (from handling and environment), which complicates data interpretation
Instrumentation is complex and data interpretation can be highly complex, requiring expertise and good comparative data from literature or from analysed reference materials.
Sample preparation for liquid solution samples typically requires a host of small lab equipment, reagents and high purity solvents which may need to be acquired to deal with complex samples from heritage objects

The separation of a mixture by passing it in solution or suspension or as a vapour. The sample is dissolved in the mobile phase: gas and liquid. Types of mobile & stationary phases:

Gas Chromatography (GC):

Instrumentation:

- Inert gaseous mobile phase
- It does not interact the analyte molecules
- Its only function is to transport the analyte through the column
- We use an immobilized liquid stationary phase.
- Partitioning of analyte between phases occurs

The gaseous mobile phase is also referred to as the carrier gas. It must be chemically inert; thus, helium or hydrogen are usually employed. Gas flow rates are controlled with pressure regulators, gauges and flow meters. High purity gases are needed (99.99% purity or better) & molecular sieve cartridges are employed to remove any traces of impurities of water. Water is very bad for GC column stationary phases.

Pyrolysis-gas chromatography

- For non-volatile materials.
- Identification of major materials in art works (aged linseed oil, dammar (varnish) of mastic (varnish or sealant) from different sources).
- Study of materials (linseed oil, artifact, glues, natural products).
- Study of specific problems (renaissance bronze paints, printing inks, antique furniture coatings, the medium of a painting on a 1900-year-old sarcophagus).

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GC-MS, PY-GC-MS (Gas chromatography – mass spectrometry, Pyrolysis GC-MS):

Invasive technique, sample needed – but offers high level of specificity and handles mixtures well. Compositional analysis of organic molecules.

Do FTIR first, then GC-MS. FTIR helps inform GC-MS sample preparation and introduction approach, more specific than FTIR.

Sample preparation can be complex and lengthy, data interpretation requires experience. Sample must be thermally stable & volatile, must not contain inorganic pigments that can damage the GC column. Characterization of proteins, lipids, and polysaccharides in artworks. Used to characterise most materials including insoluble and complex materials at trace levels often without any sample pre-treatment e.g., polymers, plastics, rubber, paints, dyes, resins, coatings, cellulose, wood, textiles, inks, etc.

Due to the direct sample introduction and the chromatographic separation, it is possible not only to analyse very small amounts, but also to obtain detailed, unique information.

THERMOGRAPHY

Thermal methods of non-destructive evaluation (NDE) are aimed at the analysis of the properties, structure and conditions of materials and samples by analysing their temperature and temperature dynamics.

Nowadays most thermal NDEs are remote and are based on detection of infrared radiation coming from the object of interest. All objects with nonzero temperature emit radiation with a wavelength determined by the temperature of the emitting object. The radiation coming off the studied object is collected by a sensor, analysed by the electronics and presented to the observer in terms of temperature readings. Modern technologies allow for the construction of image-detection devices with a wide range of parameters and for various applications. The noncontact nature of such devices makes them very attractive for the purpose of non-destructive studies.

Choosing the best method for analysis of works of art is a non-trivial problem. A method becomes most successful when an assumption on the sample geometry and properties is made a priori, an appropriate mathematical model of the sample is utilized, and the form of the stimulation signal is correctly used in calculations.

The factors governing the choice of a thermal detector include the thickness of the artwork to be analysed, the depth, character, and size of artifacts to be found, and the thermal properties of the material. In cases when the analyst deals with a plaster or a mosaic, the temperature distribution on the surface of the sample does not change rapidly, while for relatively thin paintings temperatures do change rapidly. For this reason one may choose a less expensive microbolometer imager (30–60 frames per second) for plaster or mosaic while for canvas paintings a photonic detector (e.g., InSb or MCT) is preferable (up to several hundred frames per second).

There are two factors that determine the choice of the heating source for the purpose of analysis of art: first, the paint layers are not electrically conductive (inductive heating would not work); and second, the analysis should be contactless. Because of these reasons the heating source for analysis of artworks is usually either a heating fan or a flash lamp. A flash is

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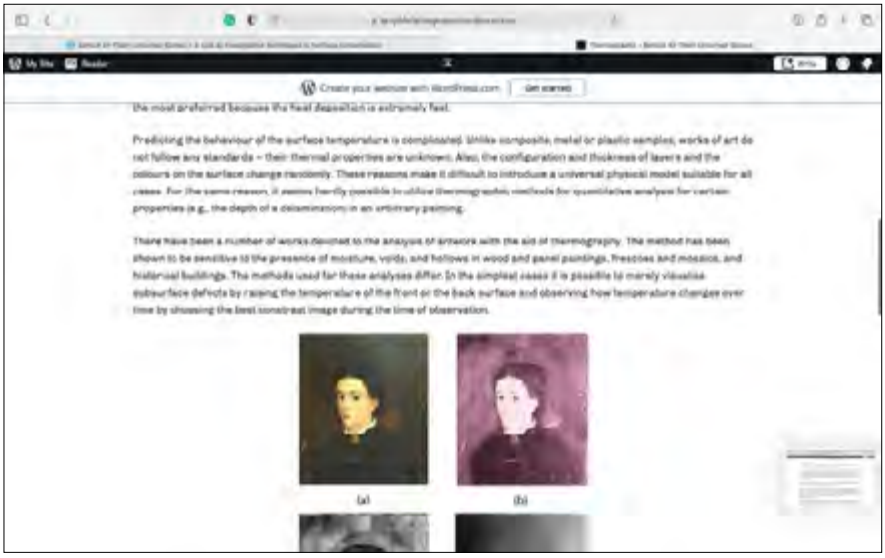
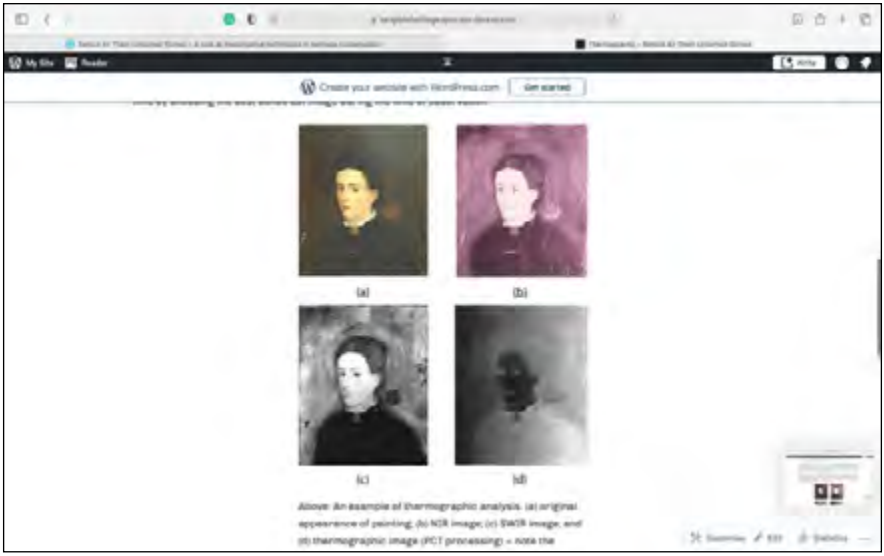


the most preferred because the heat deposition is extremely fast.

Predicting the behaviour of the surface temperature is complicated. Unlike composite, metal or plastic samples, works of art do not follow any standards – their thermal properties are unknown. Also, the configuration and thickness of layers and the colours on the surface change randomly. These reasons make it difficult to introduce a universal physical model suitable for all cases. For the same reasons, it seems hardly possible to utilize thermographic methods for quantitative analysis for certain properties (e.g., the depth of a delamination) in an arbitrary painting.

There have been a number of works devoted to the analysis of artwork with the aid of thermography. The method has been shown to be sensitive to the presence of moisture, voids, and hollows in wood and panel paintings, frescoes and mosaics, and historical buildings. The methods used for these analyses differ. In the simplest cases it is possible to merely visualise subsurface defects by raising the temperature of the front or the back surface and observing how temperature changes over time by choosing the best contrast image during the time of observation.

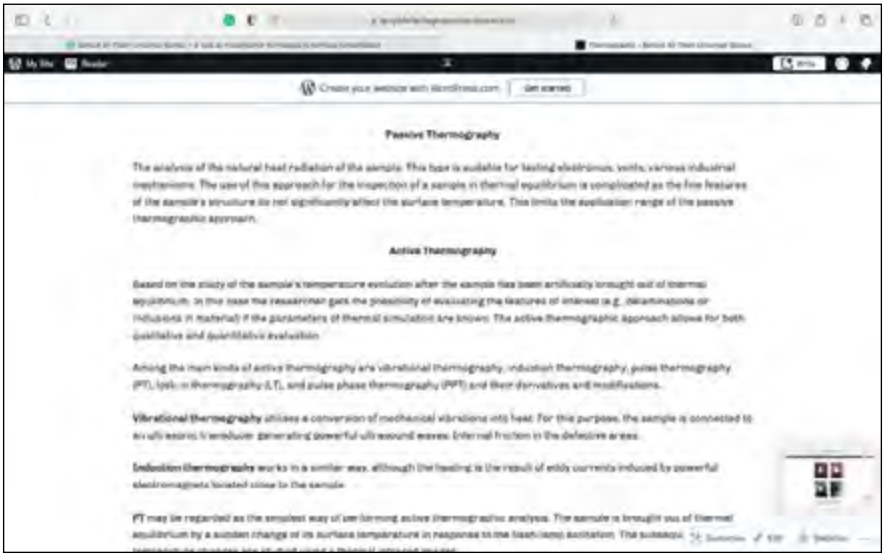
(a) (b)



(a) (b)

(c) (d)

Above: An example of thermographic analysis. (a) original appearance of painting, (b) NDR image, (c) SWIR image, and (d) thermographic image (PCT processing) – note the



Passive Thermography

The analysis of the natural heat radiation of the sample. This type is suitable for testing electronics, joints, various industrial mechanisms. The use of this approach for the inspection of a sample in thermal equilibrium is complicated as the fine features of the sample's structure do not significantly affect the surface temperature. This limits the application range of the passive thermographic approach.

Active Thermography

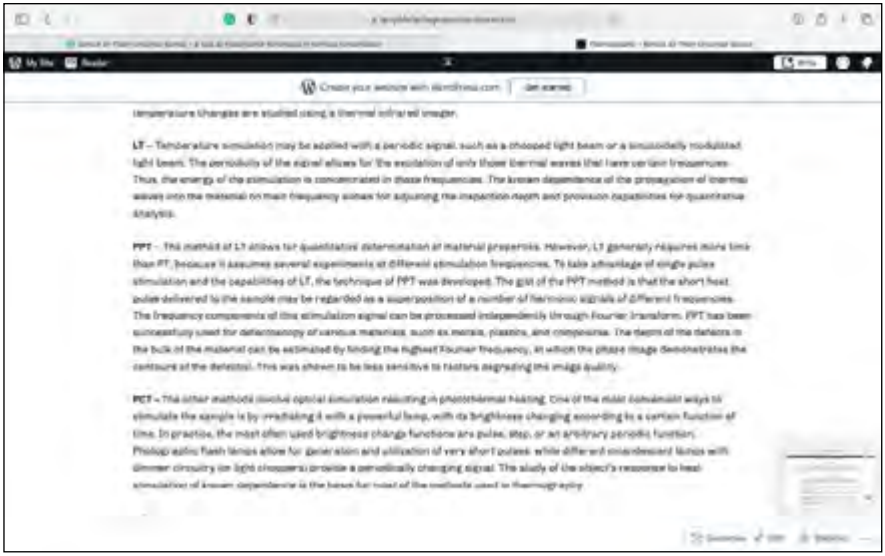
Based on the study of the sample's temperature evolution after the sample has been artificially brought out of thermal equilibrium. In this case the researcher gets the possibility of assessing the features of interest (e.g., delaminations or inclusions in material) if the parameters of thermal simulation are known. The active thermographic approach allows for both qualitative and quantitative evaluation.

Among the main kinds of active thermography are vibrational thermography, induction thermography, pulse thermography (PT), lock-in thermography (LT), and pulse phase thermography (PPT) and their derivatives and modifications.

Vibrational thermography utilizes a conversion of mechanical vibrations into heat. For this purpose, the sample is connected to an ultrasonic transducer generating powerful ultrasound waves. Internal friction in the defective areas

Induction thermography works in a similar way, although the heating is the result of eddy currents induced by powerful electromagnets located close to the sample.

PT may be regarded as the simplest way of performing active thermographic analysis. The sample is brought out of thermal equilibrium by a sudden change of its surface temperature in response to the flash lamp excitation. The subsequ



temperature changes are studied using a thermal infrared imager.

LT – Temperature simulation may be applied with a periodic signal, such as a chopped light beam or a sinusoidally modulated light beam. The periodicity of the signal allows for the excitation of only those thermal waves that have certain frequencies. Thus, the energy of the stimulation is concentrated in those frequencies. The known dependence of the propagation of thermal waves into the material on their frequency allows for adjusting the inspection depth and provides capabilities for quantitative analysis.

PPT – This method of LT allows for quantitative determination of material properties. However, LT generally requires more time than PT, because it assumes several experiments at different stimulation frequencies. To take advantage of single pulse stimulation and the capabilities of LT, the technique of PPT was developed. The gist of the PPT method is that the short heat pulse delivered to the sample may be regarded as a superposition of a number of harmonic signals of different frequencies. The frequency components of this stimulation signal can be processed independently through Fourier transform. PPT has been successfully used for defectoscopy of various materials, such as metals, plastics, and composites. The depth of the defects in the bulk of the material can be estimated by finding the highest Fourier frequency, at which the phase image demonstrates the contours of the defects. This was shown to be less sensitive to factors degrading the image quality.

PCT – The other methods involve optical stimulation resulting in photothermal heating. One of the most convenient ways to stimulate the sample is by irradiating it with a powerful lamp, with its brightness changing according to a certain function of time. In practice, the most often used brightness change functions are pulse, step, or an arbitrary periodic function. Photographic flash lamps allow for generation and utilization of very short pulses, while different oscilloscope lamps with dimmer circuitry or light choppers provide a periodically changing signal. The study of the object's response to heat stimulation of known dependence is the basis for most of the methods used in thermography

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SEM-EDS

Scanning Electron Microscopy – Energy Dispersive X-ray Spectroscopy (SEM-EDS)

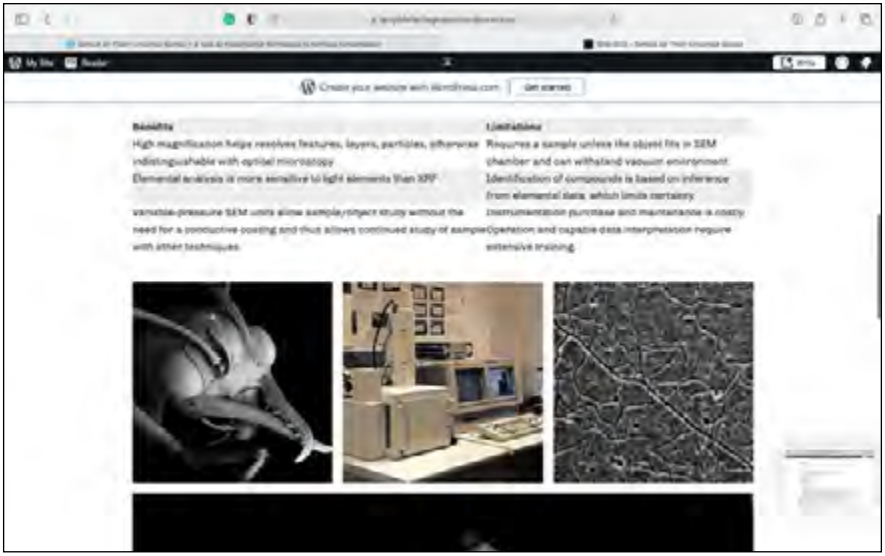
A summary:

- *What does it do?* Imaging & elemental analysis. Both qualitative and quantitative analysis
- *Is it invasive?* Yes. But non-invasive for small objects.
- *Is it destructive?* No.
- *Is it portable?* No.
- *Resolution?* High
- *Depth of field?* Great

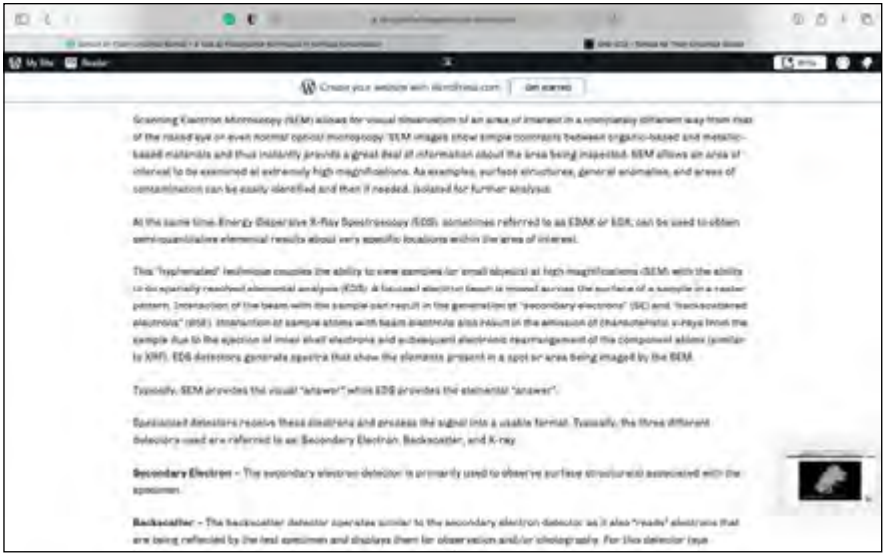
Uses for Art Historians:

- Visualisation of surface topography using secondary electron (SE) imaging (tool marks, hair/fur surface, alteration due to aging/deterioration)
- Visualisation of layer structures based on polished cross sections or exposed edges (gilded or corroded metals/alloys, metal-wrapped textile yarns, glazed ceramics, glass) using backscattered electrons (BSE)
- Visualisation of layer stratigraphy of painted surfaces (using samples prepared as polished cross sections) along with detailed elemental analysis of pigment components (aiding based on dates of pigments)
- Visualisation and elemental analysis of phases in alloys to help infer processing/fabrication steps

Benefits	**Limitations**
High magnification helps resolves features, layers, particles, otherwise	Requires a sample unless the object fits


Benefits
High magnification helps resolves features, layers, particles, otherwise indistinguishable with optical microscopy
Elemental analysis is more sensitive to light elements than XRF
variable-pressure SEM units allow sample/object study without the need for a conductive coating and thus allows continued study of sample with other techniques.
Limitations
Requires a sample unless the object fits in SEM chamber and can withstand vacuum environment
Identification of compounds is based on inference from elemental data, which limits certainty
Operation and cognitive data interpretation require extensive training


Acc.V Spot Magn Det WD 500 µm
15.0 kV 6.0 100x BSE 13.5



Scanning Electron Microscopy (SEM) allows for visual observation of an area of interest in a completely different way than that of the naked eye or even normal optical microscopy. SEM images show simple contrasts between organic-based and metallic-based materials and thus instantly provide a great deal of information about the area being inspected. SEM allows an area of interest to be examined at extremely high magnifications. As examples, surface structures, general anomalies, and areas of contamination can be easily identified and then if needed, isolated for further analysis.

At the same time, Energy Dispersive X-Ray Spectroscopy (EDS), sometimes referred to as EDAX or EDX, can be used to obtain semi-quantitative elemental results about very specific locations within the area of interest.

This "hyphenated" technique couples the ability to view samples (or small objects) at high magnifications (SEM) with the ability to do spatially resolved elemental analysis (EDS). A focused electron beam is moved across the surface of a sample in a raster pattern. Interaction of the beam with the sample can result in the generation of "secondary electrons" (SE) and "backscattered electrons" (BSE). Interaction of sample atoms with beam electrons also result in the emission of characteristic x-rays from the sample due to the ejection of inner shell electrons and subsequent electronic rearrangement of the component atoms (similar to XRF). EDS detectors generate spectra that show the elements present in a spot or area being imaged by the SEM.

Typically, SEM provides the visual "answer" while EDS provides the elemental "answer".

Specialized detectors receive these electrons and process the signal into a usable format. Typically, the three different detectors used are referred to as: Secondary Electron, Backscatter, and X-ray.

Secondary Electron – The secondary electron detector is primarily used to observe surface structure(s) associated with the specimen.

Backscatter – The backscatter detector operates similar to the secondary electron detector as it also "reads" electrons that are being reflected by the test specimen and displays them for observation and/or photography. For this detector type

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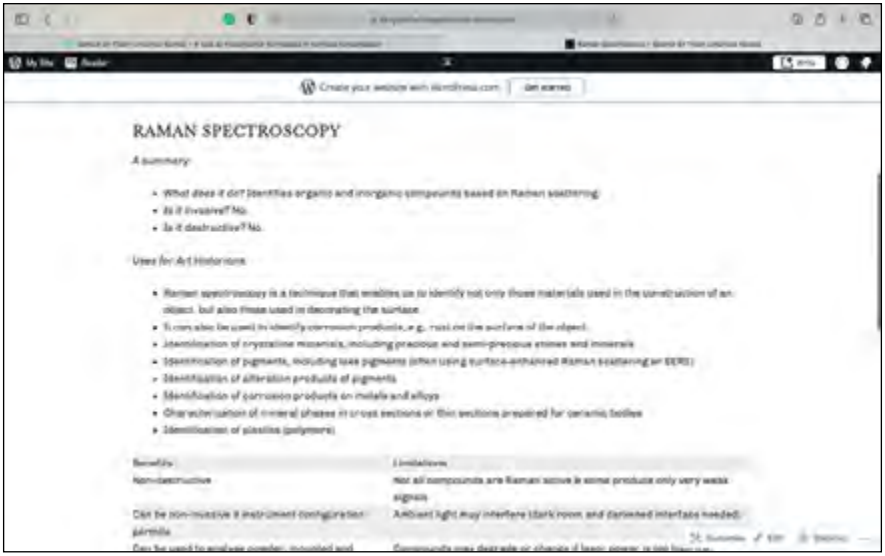
Secondary Electron – The secondary electron detector is primarily used to observe surface structure(s) associated with the specimen.

Backscatter – The backscatter detector operates similar to the secondary electron detector as it also "reads" electrons that are being reflected by the test specimen and displays them for observation and/or photography. For this detector type however, the grayscale observed in the images is a direct result of the element(s) present in the area being observed.

X-Ray – The term X-ray detector is a general term for the type of detector used to perform Energy Dispersive X-Ray Spectroscopy (EDS). The X-ray detector, or more specifically, the EDS technique is used to qualitatively and most of the time "semi-quantitatively" determine the elemental composition on an area of interest which was visually identified and observed using the secondary electron and backscatter detectors mentioned above.



RAMAN SPECTROSCOPY

A summary

- *What does it do?* Identifies organic and inorganic compounds based on Raman scattering
- *Is it invasive?* No.
- *Is it destructive?* No.

Uses for Art Historians

- Raman spectroscopy is a technique that enables us to identify not only those materials used in the construction of an object, but also those used in decorating the surface.
- It can also be used to identify corrosion products, e.g., rust on the surface of the object.
- Identification of crystalline minerals, including precious and semi-precious stones and minerals
- Identification of pigments, including lake pigments (often using surface-enhanced Raman scattering or SERS)
- Identification of alteration products of pigments
- Identification of corrosion products on metals and alloys
- Characterization of mineral phases in cross sections or thin sections prepared for ceramic bodies
- Identification of plastics (polymers)

Benefits	Limitations
Non-destructive	Not all compounds are Raman active & some produce only very weak signals
Can be non-invasive if instrument configuration permits	Ambient light may interfere (dark room and darkened interface needed)
Can be used to analyse powder, mounted and	Compounds may degrade or change if laser

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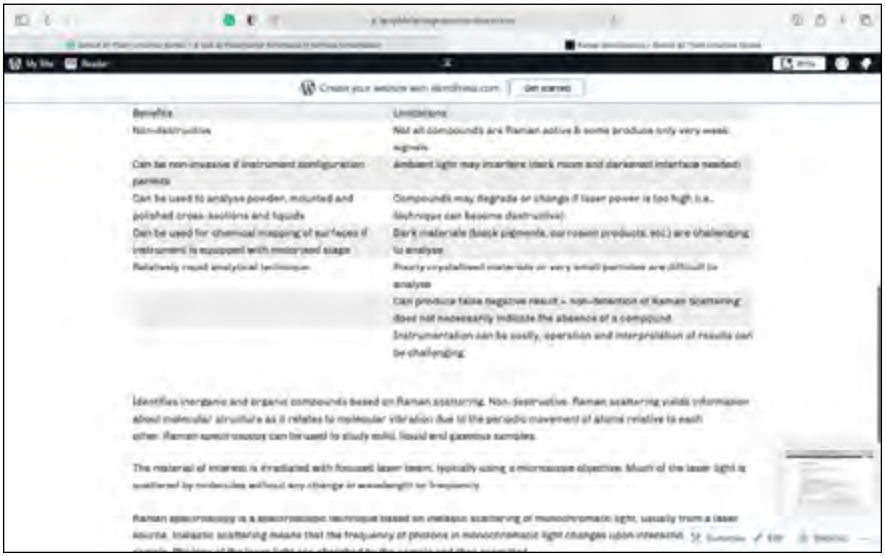

Benefits	Limitations
Non-destructive	Not all compounds are Raman active & some produce only very weak signals
Can be non-invasive if instrument configuration permits	Ambient light may interfere (dark room and darkened interface needed)
Can be used to analyse powder, mounted and polished cross-sections and liquids	Compounds may degrade or change if laser power is too high (i.e., technique can become destructive)
Can be used for chemical mapping of surfaces if instrument is equipped with motorized stage	Dark materials (black pigments, our rosemi products, etc.) are challenging to analyse
Relatively rapid analytical technique	Poorly crystallised materials or very small particles are difficult to analyse
	Can produce false negative result – non-detection of Raman scattering does not necessarily indicate the absence of a compound
	Instrumentation can be costly, operation and interpretation of results can be challenging

Identifies inorganic and organic compounds based on Raman scattering. Non-destructive. Raman scattering yields information about molecular structure as it relates to molecular vibration due to the periodic movement of atoms relative to each other. Raman spectroscopy can be used to study solid, liquid and gaseous samples.

The material of interest is irradiated with focused laser beam, typically using a microscope objective. Most of the laser light is scattered by molecules without any change in wavelength or frequency.

Raman spectroscopy is a spectroscopic technique based on inelastic scattering of monochromatic light, usually from a laser source. Inelastic scattering means that the frequency of photons in monochromatic light changes upon interaction.

The material of interest is irradiated with focused laser beam, typically using a microscope objective. Most of the laser light is scattered by molecules without any change in wavelength or frequency.

Raman spectroscopy is a spectroscopic technique based on inelastic scattering of monochromatic light, usually from a laser source. Inelastic scattering means that the frequency of photons in monochromatic light changes upon interaction with a sample. Photons of the laser light are absorbed by the sample and then reemitted.

Frequency of the reemitted photons is shifted up or down in comparison with original monochromatic frequency, which is called the Raman effect. This shift provides information about vibrational, rotational and other low frequency transitions in molecules.

A Raman system typically consists of four major components:

1. Excitation source (laser)
2. Sample illumination system and light collection optics
3. Wavelength selector (filter or spectrophotometer)
4. Detector (Photodiode array, CCD or PMT).

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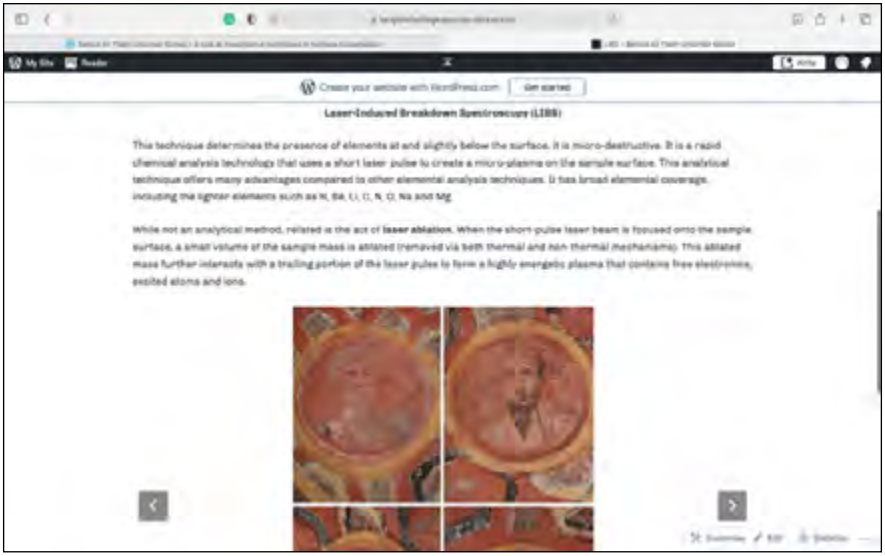
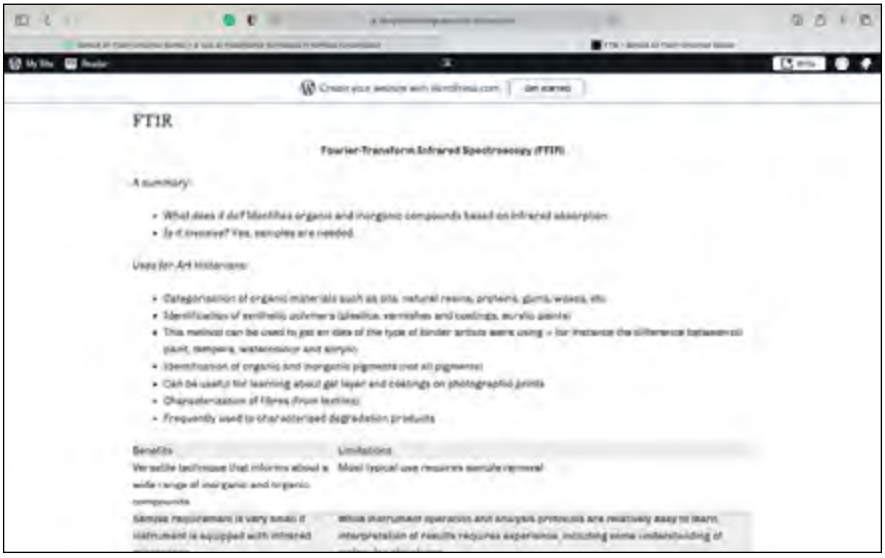
Pictured above is the laser ablation that was used in the St Thecla catacomb in Rome. Originally, traditional conservation methods with regards to frescoes were considered unsatisfactory, as conservators were often unable to accurately clean the entire surface layer. When laser ablation is used, the surface will be cleaned, but the original colours of the paintings will once again become visible. Lasers can be calibrated to remove only specific colours, in the case of the St Thecla catacombs, the white of the calcium, which fell away.



Laser-Induced Breakdown Spectroscopy (LIBS)

This technique determines the presence of elements at and slightly below the surface. It is micro-destructive. It is a rapid chemical analysis technology that uses a short laser pulse to create a micro-plasma on the sample surface. This analytical technique offers many advantages compared to other elemental analysis techniques. It has broad elemental coverage, including the lighter elements such as H, Be, Li, C, N, O, Na and Mg.

While not an analytical method, related is the act of **laser ablation**. When the short pulse laser beam is focused onto the sample surface, a small volume of the sample mass is ablated (removed via both thermal and non-thermal mechanisms). This ablated mass further interacts with a trailing portion of the laser pulse to form a highly energetic plasma that contains free electrons, excited atoms and ions.



FT1R

Fourier-Transform Infrared Spectroscopy (FTIR)

A summary:

- What does it do? Identifies organic and inorganic compounds based on infrared absorption
- Is it invasive? Yes, samples are needed.

Uses for Art Historians:

- Categorization of organic materials such as oils, natural resins, proteins, gums, waxes, etc.
- Identification of synthetic polymers (alkyds, varnishes and coatings, acrylic paints)
- This method can be used to get an idea of the type of binder artists were using – for instance the difference between oil paint, tempera, watercolour and acrylic
- Identification of organic and inorganic pigments (not all pigments)
- Can be useful for learning about gel layer and coatings on photographic prints
- Characterization of fibres (from textiles)
- Frequently used to characterized degradation products

Benefits	Limitations
Versatile technique that informs about a wide range of inorganic and organic compounds	Most typical use requires sample removal
Simple requirement is very small if instrument is equipped with infrared	While instrument operation and analysis protocols are relatively easy to learn, interpretation of results requires experience, including some understanding of

compounds

Sample requirement is very small if instrument is equipped with infrared microscope	While instrument operation and analysis protocols are relatively easy to learn, interpretation of results requires experience, involving some understanding of molecular structures
Samples can frequently be reused and analysed with another analytical technique	If a mixture of compound is present, spectra contains peaks relating to the components, thus complicating interpretation of data
Analysis can be conducted in-situ on relatively flat surfaces	While collection of spectra in reflectance mode can be done non-invasively, interpretation of results often requires development of custom spectral libraries
Portable instruments may allow non-invasive, in-situ analysis with some limitations	
Widely available	

Basic Concept

This is a molecular spectroscopy technique capable of characterising and identifying inorganic and organic compounds. It is complimentary to Raman spectroscopy. The material/sample of interest is irradiated with an infrared (IR) beam containing 2500-25000 nm wavelength range. Molecules absorb IR wavelengths with frequencies corresponding to certain vibrational motions within the molecule (such as stretching of specific bonds). Infrared spectrometers detect with specific frequencies are absorbed and to what degree and display spectra that can be regarded as molecular fingerprints for compounds. Compounds are typically identified by comparing results to libraries of infrared spectra from known compounds/materials.

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Mampopi Namane: THC 804

Mampopi Namane, from the Lesotho State Library, submitted this THC 804 assignment for the section on ceramics, in which she proposes a treatment for a Ruan Hoffmann plate. She graduated in April 2022.

Introduction

Ceramics are materials that have been altered by heat at different temperatures (Logan and Grant 2018). They are often thought of as inert; however, the stability of their fabric is affected by use, environmental conditions and manufacturing defects (Canadian Conservation Institute n.d Logan and Grant 2018). The more a ceramic is fired at a high temperature, the more water-resistant it becomes, but it is still brittle (Logan and Grant 2018). Their manufacturing defects, like poorly formulated body and inappropriate firing, make them more prone to agents of deterioration (Logan and Grant 2018). Before cleaning an object, it is always important to identify the type of ceramic composition and the nature of the dirt (Abd-Allah, al-Muheisen and al-Howadi 2010: 106). Not all ceramics are glazed (Logan and Grant 2018), but this paper focuses on a ceramic with a fragile gilt and lustre surfaces. When cleaning an object, not only is the effectiveness of cleaning considered but also the potential damage as a result of cleaning (Abd-Allah, al-Muheisen and al-Howadi 2010: 97) Cleaning is the removal of dirt from an object to a desired state without disrupting the original material or archaeological features (Abd-Allah, al-Muheisen and al-Howadi 2010: 106).

Removing dust

Dust is made up of loose foreign material that attaches itself to the surface of an object (Conservation Unit Museums & Galleries Commission 1992: 14). It is often made of textile fibres, human skin and soot, among other things (Conservation Unit Museums & Galleries Commission 1992: 14). Within this, there are micro-organisms that feed on organic material such as human skin and will secrete waste after feeding (Conservation Unit Museums & Galleries Commission 1992: 14). If left untreated, this further soils the surface until a hard grit is formed, which is hard to remove (Conservation Unit Museums & Galleries Commission 1992: 14). Dust is easier to remove because it does not chemically bond with the object

(Conservation Unit Museums & Galleries Commission 1992: 28).

Why brushes?

Brushes are best used when there is dust/loose dirt and where the surface of an object has either crevices or undercuts because they get in between the cracks (Lavelle and Miller 2017: 7). Brushes ensure that there is little to no fiction while in use (Lavelle and Miller 2017: 7). They also allow for flexibility and gentleness of hand during cleaning (Lavelle and Miller 2017: 7). However, brushes must be matched to the surface to be worked—for example, avoid using hard-bristled brushes on gilded surfaces; this is damaging (Lavelle and Miller 2017: 7).

Dusters

- Use a lint-free duster (microfibre cloth) so no fibres attach to the surface of the object during cleaning.
- Avoid damaged or fragile (gilded) surfaces of the object while dusting.
- While cleaning, always fold the duster towards the clean area.
- Wash dusters after object treatment in mild, non-ionic detergent and rinse well (Canadian Conservation Institute n.d., Lavelle ad Miller 2017: 8).

Why dusters?

Dusters make it easy to remove dust from smooth surfaces (Lavelle and Miller 2017: 8). There is no solvent added, so hygroscopic objects will be safe (Conservation Unit Museums & Galleries Commission 1992: 27). There is also no interaction of toxic chemicals with objects (Conservation Unit Museums & Galleries Commission 1992: 28).

Vacuum cleaner

- Turn the vacuum cleaner to a low-suction setting.
- With a brush, sweep dust towards the mouth of the vacuum while also minding the grain, if any.
- Ensure that the vacuum is a few centimetres away from the surface of the object as you sweep and suction, as ceramics are prone to damage from

knocks and other physical forces (Conservation Unit Museums & Galleries Commission 1992: 28).

Why vacuum?

Dust is not chemically bonded with an object; rather, it is adhered to the surface of an object by electrostatic attraction (Conservation Unit Museums & Galleries Commission 1992: 16 & 28). Therefore, only dusting or using brushes may not be enough; because as dust is swept away, there is further charging of particles and surface (Conservation Unit Museums & Galleries Commission 1992: 28). Dust removed with brushes and dusters floats in the atmosphere then attaches to the newly charged surface, but with vacuum-cleaning, everything is removed (Conservation Unit Museums & Galleries Commission 1992: 28, Lavelle and Miller 2017: 7). Due to the attached Perspex stand and the folds in the ceramic body, there are recesses that make access and removal of dust by brushing inaccessible and complicated. No chemicals are used.

Removing the perspex stand

Because of the thickness of the silicone, it was feasible to attempt to cut through it to liberate the Perspex stand.

Sharp object/scalpel

- With a scalpel, pick and cut the silicone between the stand and the ceramic carefully, especially where it is in contact with the guiding.
- Movements must be cautious while cutting to avoid scraping part of the object.
- On the caulk below the date, carefully cut but not all the way through, then use solvents to soften.
- The caulk may also be cut completely to separate the stand and the object (Buys and Oakley 1993: 78).

Why scalpel?

Because of its location, thickness and size, the caulk will be easily removed when

cut and scraped thinly before chemical cleaning (Buys and Oakley 1993: 78). Silicone softens, and chemical cleaning introduces the risk that the surface of the object will be damaged, depending on its porosity (Buys and Oakley 1993: 78).

Removing the stand chemically

Seeing as the caulk just below the date is as the base, in contact with the gilding, and given the fact that the stand is a bit raised, there may be a need for both mechanical and chemical cleaning.

- Cut or poke the silicone just enough for the chemicals to be introduced.
- Roll cotton onto the swab stick and moisten in the solution.
- Roll the swab stick in between the holes made in the silicone, leaving the cotton sandwiched in the caulk.
- After some time, attend to the object and carefully cut the now-softened caulk (Buys and Oakley 1993: 77 & 78).

Why chemically?

Since the silicone caulk is just under the date on the object, it is a bit hard to reach. Introducing a certain amount of solution will help soften it (Buys and Oakley 1993: 77). This will make it easier to remove because the long chains of silicone caulk will be broken (Deziel 2019).

Removing silicone

Silicone consists of polymers made of siloxane (chain of alternating silicon atoms and oxygen atoms) (Deziel 2019, Jenkins n.d.). Silicon, used to make Silicone, is an element found abundantly in sand (silicon), and it is mixed with hydrogen and carbon (Deziel 2019, Jenkins n.d.). It is elastic, non-reactive and resistant to extreme environmental conditions. For this reason, it does not dissolve when solvents are introduced; rather, it softens (Deziel 2019, Jenkins n.d.).

Removing silicone with a scalpel

- Scrape the silicone that has been softened by chemicals further with a

sharp blade/scalpel.
- Smooth the remaining residue with a scalpel.

Why with a scalpel?

Cutting through the silicone makes work faster because there are no preliminary tests needed to evaluate damage that may occur (Buys and Oakley 1993: 78). Using a scalpel also ensures that an object will be spared some of the chemical cleaning it might have to undergo (Buys and Oakley 1993: 78). If an object was porous, it would not have had contact with liquids, which could potentially cause staining, drive dirt below the surface or leave potentially damaging residues in the substrate (Buys and Oakley 1993: 78).

Removing silicone with chemicals

Solvent must always be appropriate for the intended adhesive while also gentle on the substrate (Buys and Oakley 1993: 78). If unsure of the properties of the solvent, take a sample for testing.

Dodecylbenzenesulfonic acid, dichloromethane toluene and xylene solution

- Prepare a solution of dodecylbenzenesulfonic acid, dichloromethane toluene and xylene and moisten cotton wool, then apply to the affected area (poultice).
- Softening may be done in vapour form by placing an object and solution together in an airtight container or a few fume cupboards.
- Rinse with carbon-based solvents to avoid ionisation of acid content left during cleaning (Buys & Oakley 1993:79 & 80).

Why acidic solutions?

Silicone is acidic; therefore, using acidic solvents will shorten the long bonds of silicone making it softer to work on (Deziel 2019). Other chemicals may be used, like dodecylbenzenesulfonic acid, dichloromethane toluene and xylene solution, following the same procedure:

- White spirit/white vinegar
- Isopropyl alcohol
- Denatured alcohol

Conclusion

Museum objects do not necessarily have to be perfectly clean—rather, clean enough that there is no material falling if one touches an object. Methods of cleaning and the level of cleaning must be considered thoughtfully because some interventions are damaging to objects. In this particular case, silicone could have ingressed into the porous ceramic causing some measure of staining, which could be irreversible as the required solvents may not be able to draw out the silicone and may in fact damage the ceramic body. However, as the silicone is on the reverse of the object, chemical cleaning was not necessary, and the potential damage is too high a risk for very little benefit as a thin residual layer of silicon is neither damaging nor visually distracting. Conservation always balances the needs of the object and those of the custodian and aims for a mutually beneficial compromise. Cleaning is one of those routine treatments that needs to be carefully considered because it is irreversible.

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Jabu Ntuli: THC 804

Jabulile Ntuli is a dedicated and successful student from the 2021 intake. She was also part of the Holocaust Centre digitisation and Jagger Reading Room fire at the UCT Library salvage projects. She will complete her degree at the end of 2022.

Introduction

Ultraviolet (UV) light is a form of electromagnetic radiation invisible to the naked eye. However, certain materials absorb this light and reflect it back as longer-wavelength radiation, which is then visible to the naked eye as UV-induced visible fluorescence (Measday et al. 2017).

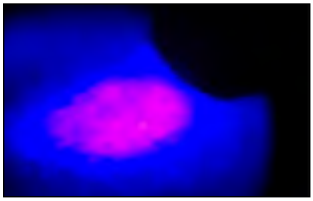
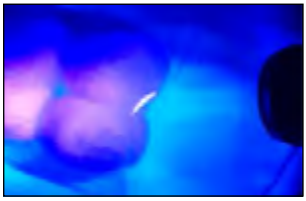
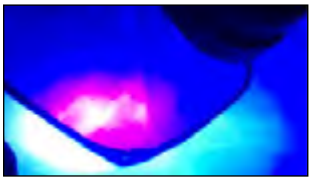
As this fluorescence is particular to certain materials, it can be used by conservators as a non-destructive analytical technique in the examination of cultural materials to aid in the identification of previous restorations to help identify what an object is made of. The colours of the fluorescence depend on the wavelength used and the type of material examined. For example, many adhesives used in repairs fluoresce under long-wave UV but not under short-wave.

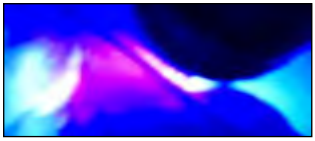
Long-wave UV, also referred to as UV-A, is between 320 and 400 nm; UV-B, also known as medium-wave UV, is between 280 and 320 nm; and short-wave UV, or UV-C, is between 180 and 280 nm (Simpson-Grant 2000a: 1).

Although UV examination can assist in identifying some materials, it is not always conclusive. Colour evaluation can easily be misinterpreted, and results can also sometimes be misleading due to changes occurring as the materials age or with the presence of obscuring surface dirt.

The objective of this assignment is to place the various organic materials in the discovery kit under the UV light provided (long-wave) and note observations in a table.

Results

Material	UV colour	Protein type in material
Wool sample swatch	Spritz purple 	Keratin
Cotton sample swatch	Light spritz purple 	No protein, cotton is cellulose-based
Silk sample swatch	Light spritz purple 	Fibrion
Ivory sample item	Whitish blue 	Collagen

Shell/horn sample item	Dark Purple 	Keratin
Bone sample item	Dark purple 	Collagen
Feather sample	Spritz purple 	Keratin

Conclusion

I felt that the test was inconclusive as it was difficult to see any of the colours reported in Measday's article and even harder to photograph the differences. The only difference was the intensity of the fluorescence, for example, the bone and ivory, which are similar materials and noted in Simpson-Grant (2000b:2) as both fluorescing with a bright whitish colour when new, appeared dark purple and whitish-blue in my test. In fact, most of the colours observed tended to be blue or purple. Perhaps there was a problem with the way the samples were illuminated.

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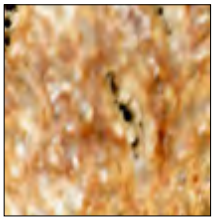
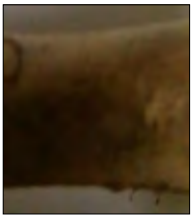
Mabokang Mokotjo: THC 804

Mabokang Mokotjo is from Lesotho where she works for the Department of Culture. She completed her degree with a distinction. In this assignment, she discussed the degradation of buried bones as part of THC 804.

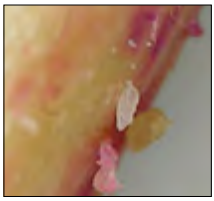
Bone inspection

PLACE TO EXAMINE	NORMAL PICTURE	PICTURE NORMAL + MICROSCOPE	DESCRIPTION
END OF THE BONE			The end of the bone (epiphysis) under the microscope shows different tissues ranging from brown to light brown and white, and the gaps or breakages are also visible on the black spots. In the normal photo, tissues are not clear and the breakages on the epiphysis are not visible. The epiphysis consists of a cancellous bone protected by a thin layer of compact bone (Editors of the Encyclopaedia Britannica 2018).
MID PART OF THE BONE			The mid part of the chicken leg bone (diaphysis) looks cream-white to light brown and smooth to the naked eye. Under the microscope, the bone appears to have ridges of what looks like a boiling paste forming thick little bubbles. Diaphysis is composed of compact bone surrounding the medullary cavity (Brick 2018: 1).

CROSS-SECTION OF THE BONE			The cross-section of the chicken leg bone has two parts visible under the microscope, the hard outer layer and the inner spongy part. According to Rice University (2020: 4), the outer layer is called compact bone and contains four important cells, namely osteoblasts, osteocytes, osteogenic cells, and osteoclasts. It is also the denser, stronger of the two types of bone tissue (Rice University 2020: 4). The inner spongy tissue of the bone is called cancellous, and it contains osteocytes and red marrow protected by the trabeculae (Rice University 2020: 4).

226 It is obvious that normal photos cannot provide enough information about objects. Photos taken with a microscope are detailed and consist of all information that is needed about the object. This observation brings me to the conclusion that for museum documentation, normal photography is not enough and can also be deceptive when it comes to the object condition assessment. It needs to be coupled with microscope photos for adequate documentation.

PERIOD	PHOTO OF BONE MARKED WITH FELT-TIP PEN	DESCRIPTION OF THE BONE MARKED WITH A FELT-TIP PEN	REMOVE PEN MARK	DESCRIPTION OF THE BONE AFTER RE-MOVING THE PEN MARK
DAY ONE		A greyish-brown, 35 mm-thick and 67 mm-long chicken thigh bone with little rem-nants of meat marked with pink felt-tip pen. A week old.		I used erasers and sponges but they could not remove the pe mark. I used a wool swab dipped in distilled warm water and rubbed it against the bone surface. A lot of the ink was removed but the bone had absorbed some of it so I waited for 15 minutes for the bone to dry off. While I was rubbing it with the cotton swabs, some dry remnants of meat came off the bone.

ONE MONTH		A 16 mm-long grey and brown bone with tiny, shiny remnants of dried meat and a broken epiphysis on the other side. The epiphysis has become light brown to lighter grey and shiny. On the other side of the bone, a purple ink mark is applied. The bone is harder than before. When applying ink on the bone, it seemed to be absorbed quickly. The applied ink dried and was absorbed by the bone.	 Cleaned bone under magnification.  The purple ink is visible under magnification.	To clean the ink, I started with all the dry methods in my kit, Staedtler eraser, crepe eraser, wishabs, vulcanised rubber sponge and polyurethane sponges. Only the Staedtler eraser removed some green colour of the ink, although it did not come off. I then used acetone, rubbing it on the ink mark with the cotton swabs, which removed a bit of ink—a green colour. So I made a poultice of rubbing alcohol and acetone, which did not remove the ink altogether.

THREE MONTHS		A dried grey bone 18 mm long and 13 mm wide with dry, brown meat remnants. On one side of the epiphysis, across the body of the bone, a pink ink mark is applied.	 The cleaned bone under magnification. 	An 18 mm-long, 13 mm-wide bone with visible wet remnants of meat due to warm wash. Across the middle of the bone, towards the epiphysis, there is slight evidence of the orange ink mark applied three months prior to removal. All dry methods I used failed to remove the ink. I also used acetone and rubbing alcohol, then an alcohol poultice, but neither removed the ink completely. Although the cotton swabs removed some ink, there was a lot of ink left on the bone. Then, I used saliva, then warm water with soap with a brush, and a lot of ink came off, but I could not remove it all.

Through this exercise, I realised that bones are absorbent, and if ink is applied to them, it is difficult to remove because it is absorbed.

Buried bones before burial

BONES BEFORE BURIAL	PHOTO	DESCRIPTION
A BONE COVERED WITH A CLOTH		A 60 mm-long, brown and grey chicken thigh bone with 51 mm-thick, chipped epiphysis and 40 mm un-chipped epiphysis and a small amount of meat remnants.
UNCOVERED BONE		A 70 mm-long, 34 mm-thick chicken thigh bone with 51 mm and 58 mm epiphyses and a few meat remnants.

Buried bones after a few months

BONES BEFORE BURIAL	PHOTO	DESCRIPTION
A BONE BURIED COVERED	 Bone after cleaning	A 60 mm-long, 51 mm-thick bone with 40 mm epiphyses, slightly greenish, rustic, wet with a toxic muddy smell. It has a very fragile and flaking epiphysis, which is easily dented and flaked by a short thumbnail. The bone also has tiny worms. It is also mouldy, and its exterior particles are flaking onto the cloth, changing its colour to those of the bone. There is a white, powdery substance on the bigger epiphysis. Dark spots are also evident. The covered bone after cleaning After cleaning, the bone looks dark grey and dark brown with large and small black patches all over the surface. It is fragile; the epiphysis comes off in a form of powder when rubbed off or against the finger.

BURIED BONES	PHOTO	DESCRIPTION
UNCOVERED BONE	 Bone under magnification  Above is the bone buried covered with cloth under magnification. Dark patches, visible to the naked eye, look green under the microscope. The green patch seems to be embedded in the bone like it has always been part of it. I suspect the black patches and spots are due to mould.  The epiphysis of the bone is buried, covered with a cloth, showing a long string within the epiphysis.	

BURIED BONES	PHOTO	DESCRIPTION
A BONE BURIED UNCOVERED	 Uncovered bone after cleaning  The bone under magnification  The epiphysis of the bone buried uncovered under magnification  The bone buried uncovered does not show large black patches like the bone buried covered with a cloth.	A 70 mm-long, 34 mm-thick rustic bone with 58mm epiphyses, embedded with soil and with a muddy smell. The bone has slightly greenish dots due to mould, and its body is fragile to the extent that it is dented with a short thumbnail. Its epiphyses are more fragile; they are flaked when rubbed with fingertips. Uncovered bone after cleaning: The bone looks dark brown with small black patches scattered along the bone. The epiphysis comes off in a powder form when rubbed against any hard surface.

Challenges

Two weeks after I had buried the bones, I went to check on them but I found them exposed. Fortunately, I had buried them under a garden chair so they were not exposed to the sun. I had to change the cloth and extend the time before digging them up by a week.

Conclusion

Buried bone degradation is determined by many factors, and it does not follow simple, predictable pathways (Nicholson 1996: 529). These factors include the history of the bone before burial, the soil pH, microorganisms, and the overall environment (Karr and Outram 2015: 207). Nord, Kars, Ullen, Tronner and Kars (2005: 78) argue that bones buried in soil with a high organic content deteriorate slowly while those buried in soil with acidifying pollutants deteriorate faster. Buried bones lose their strength and rigidity due to acidic conditions (Tiley-Sian and Antonites 2015: 07). Also, bacteria and fungi cause degradation of bone material (Nord et al. 2005: 77). Bones that were previously frozen have been proven to deteriorate slowly (Karr and Outram 2015: 207). It is obvious that if these bones were to remain buried for a longer time they would have deteriorated more. Therefore, bone objects need extra care—especially archaeological bone objects as they have been under different environmental conditions that render them extremely fragile.

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Mariet Conradie: THC 804

This assignment was written by Mariet Conradie, an education officer from the Ditsong Museums of South Africa: Kruger Museum in Pretoria. She is a museum professional with more than 20 years' experience in the sector. She will submit her thesis in 2023.

Introduction: Silver (Ag) silver bowl

Silver tarnishes on exposure to pollutants, particularly sulphur in the environment, and this dark layer can obscure details on the surface of artefacts (Selwyn 2004). As such, cleaning historic silver to remove the tarnish is a common practice in period house museums. This can be carried out by the use of polishes, polishing cloths, chemical dips or electrochemical reduction, and the method chosen depends on the object (Selwyn 2007). The objective of this assignment was to observe what happens when cleaning a silver (Ag) object. Please see photos taken with an iPhone on pages 5, 6 and 7. I first have to document 'before' and 'after' overall images and then show the different sides with scale.

Next, I have to document 'before' and 'after' at 100x and 10x magnification with your USB microscope. The USB microscope is set at 1600x. That is the setting that I can use, I cannot change this setting—it is what it is. (I have since discovered how to scale an object photo taken with a USB microscope. Please see p. 8.)

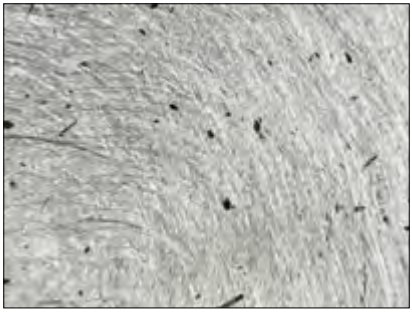
I will now, as instructed, mix 50% H2O (water) + 25% CaCO3 (chalk) + 25% C2H6O (ethyl alcohol) and apply this paste to the bottom of the silver object to see what the outcome is. I will turn the object upside-down and apply the paste right at the bottom.

	
This is a photo, taken with my iPhone, from one of the long sides. (So here are two recto sides.)	This is a photo, taken with my iPhone, from the other, shorter side of the same silver object. (So here are two recto sides)

	
This is a photo, taken with my iPhone. With this asymmetrical object, you cannot say which side is recto and which is verso.	This is a photo, taken with my iPhone. With this asymmetrical object, you cannot say which side is recto and which is verso

	
This is the inside of the silver bowl, taken with my iPhone.	This is the bottom of the silver bowl, taken with my iPhone.

	
The silver bowl, lying on its side, taken with my iPhone	The pattern of the silver dish, taken with the USB microscope at 1600x magnification

	
Photos taken with the USB microscope before applying paste 1 that I made to the bottom of the silver object	Photos taken with the USB microscope after applying paste 1 that I made to the bottom of the silver object

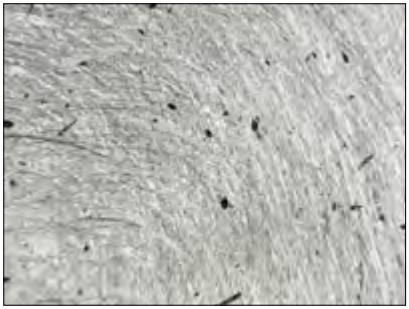
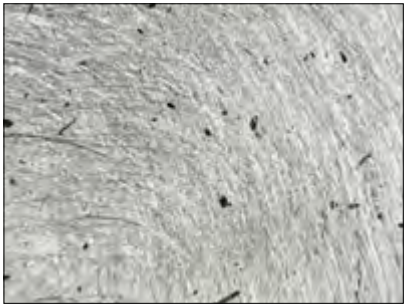
Paste 1:

When making the first paste that we were instructed to make, mixing 50% H_2O (water) + 25% $CaCO_3$ (chalk) + 25% C_2H_6O (ethyl alcohol), I observed, as shown in the pictures above, that the consistency of the paste remained more constant. There was less evaporation taking place, compared to the second paste. Thus, the abrasive properties of the paste remained more constant over a short period of time, which made the paste dry and more abrasive, and when I applied it to the bottom of the bowl, it was so abrasive that it immediately caused the instant damage as described below in the conclusion.

Paste 2:

The second paste that I made consisted of 50% $CaCO_3$ (chalk) and 50% C_2H_6O (ethyl alcohol) only. In the above paste, the $CaCO_3$ (chalk) + C_2H_6O (ethyl alcohol) evaporated very quickly, and then the chalk became dry very quickly. Please see the conclusion.

I have discovered how to enlarge a USB microscope photo to 10x, as well as to 100x.

	
Before applying the second paste to the right side (underneath) of the silver bowl, enlarging USB microscope photo 10x	Before applying the second paste to the right side (underneath) of the silver bowl, enlarging USB microscope photo 100x
	
After applying the first paste to the right side (underneath) of the silver bowl, enlarging USB microscope photo 10x	After applying the first paste to the right side (underneath) of the silver bowl, enlarging USB microscope photo 100x

Conclusion

On page 7, the pictures on the versa side show the object before I applied the first paste, and the pictures on the recto side show so much damage to the silver object that I will immediately stop applying this paste to this object.

This paste, which I made by mixing 50% H_2O (water) + 25% $CaCO_3$ (chalk) + 25% C_2H_6O (ethyl alcohol) until the chalk was ground into a paste that could mix with the water and alcohol, rubbed away the thin layer of plating. This will now expose the object to corrosion. This object is an 1840 electroplated silver

dish, and the bronze alloy underneath the layer of plating, which I have now removed, is showing in the pictures on the right side (you see a yellowish metal).

The abrasive nature of the chalk, albeit used in a very fine powder form, has also scratched the surface of the object; it can be clearly seen on the USB microscope photo on the side of pages 7 and 8, where it is enlarged 10x and 100x. So, while the chalk paste was effective at removing the tarnish from the surface of the historic silver object, the polishing action required is in itself causing damage. As Selwyn notes, 'The resulting finish, or scratch pattern, is often influenced more by the polisher than by the polish. The polisher must take care to minimise damage from abrasive polishing.' This suggests that, perhaps, routine polishing of the silverware in period house museums should be minimised in order to extend the life of the objects.

Secondly, mixing the solution oneself allows for complete control over both the abrasive particles (the chalk) and how fast the paste dries, which in turn minimises the potential for metal oxidation, thereby minimising damage and deterioration from the materials themselves. In contrast, the recipe and ingredients of commercial polishes and chemicals are not controlled, can change without warning, can contain harmful chemicals and are generally more abrasive (Selwyn 1991).

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Laura Esser: THC 804

Laura Esser, one of the five students from the 2020 intake, wrote the assignment titled: Adhesives and their solvents in ceramic objects.

Introduction

Conservators deal with a variety of art and museum objects made of different kinds of material. Generally, these materials can be grouped into inorganics and organics. Inorganic material is made out of plants and minerals, while organic objects are made of plants and animal parts or extracts. This essay focuses on inorganic materials. Inorganic materials include stone, metals, ceramics and glass (Wilks 1992a: 16). Since covering adhesives and adhesive solvents for all of these materials goes beyond the scope of this paper, the focus is on ceramics. Ceramics form an important part of museum collections because they have been used for storage, transport and cooking and have served as pieces of art since prehistoric times. There is a variety of different ceramics available, but this is not the focus of this essay (Met Museum 2020).

This essay focuses on the adhesives that have been used for ceramics over time. In particular, the composition, properties and ageing of each adhesive are discussed. Then, solvents which have been used for the particular adhesive are explained, with a particular focus on the Teas solubility chart. At first, a few historic adhesives are discussed, but special attention is given to shellac, which is still found as an adhesive in many museum collections. The next adhesive is cellulose nitrate, which was commonly found in the nineteenth and early twentieth century in museums (Neiro 2003: 237). Lastly, acrylic adhesives are discussed, with special attention given to Paraloid B-72. To get a better picture of the usage and ageing of these adhesives, different case studies are consulted and their findings compared.

Solvents and solubility

A solvent dissolves a solute in a solution. Solutions are usually homogenous mixtures of more than one substance. Usually, solutes are solids, but they can also be gaseous or liquids. Conservation practice mostly deals with solid solutes (Helmenstine 2019, Brown, LeMay, Busten, Murphy and Woodward 2019a).

Solubility describes the maximum amount of a solute that can possibly be dissolved in a given amount of solvent, at a constant temperature and pressure. In conservation, however, solvents are mostly used to soften adhesives on objects; they are not present in excess in solutions, as may be the case in a chemistry laboratory (Conservation Science Tutorials n.d.) To know which solvents dissolve which solute, it is important to know about the intermolecular interactions in the substrates, in particular focusing on London dispersion forces, dipole-dipole interactions and hydrogen bonding (Brown, LeMay, Busten, Murphy and Woodward 2019b). As a general rule, 'like dissolves like', meaning that substrates whose molecules are similar in structure and therefore exhibit similar intermolecular forces tend to be soluble in each other (Vitz, Moore, Shorb, Prat-Resina, Wendorff and Hahn 2019a). According to Stravroudis and Blank (1989: 1f.), the 'likeness' of substrates can also be compared with their polarity.[1] Substances with similar polarities are usually miscible. However, in some cases, a non-polar solvent will mix with a polar solvent if one of them is present in excess (Conservation Science Tutorials n.d.). Most organic materials appear to be polar, such as proteins and minerals, animal and plant derivatives, as well as waxes (intermediate polarity). Another important factor when considering solubility is the cohesive energy density, which is the attractive force that holds molecules of a solute to a liquid, the solvent. In order to dissolve a solute in a solvent, their cohesive energy density must be relatively equal. If the solute's molecules prefer to stick to each other instead of the solvent, a solution does not form (Stravroudis and Blank 1989: 4).

There are many ways to measure and categorise the solubility of adhesives and adhesive solvents, such as Hansen's solubility parameter and the Teas solubility chart diagram. The Teas diagram was inspired by Hansen's solubility parameter but incorporated its three dimensions into a two-dimensional triangle. It represents the effects of London dispersion forces (f_d), dipole forces, also called polar attractions (f_p), and hydrogen bonding forces (f_h) combined, each on one side of the triangle. The sum of these forces always adds up to the value of 100. For most solvents used in conservation, the fractional solubility parameters have already been published. They were determined by trial-and-error experiments

1 Polarity describes the electrical charges in an atom. When atoms do not have the same charge bond, a partial charge is created, which signifies that a polar bond has been formed (Editors of Encyclopaedia Britannica 2019).

and therefore are not possible to measure by oneself. Solvents that are located in roughly the same area on the triangle can form solutions (Stravroudis and Blank 1989: 5, Conservation Science Tutorials n.d.). Even though this chart has been used extensively over the years by conservators, some, including Stravroudis and Blank (1989: 5), criticise its accuracy. They argue that Teas himself admitted that the diagram does not work for a number of solvents, especially the aromatic and aliphatic hydrocarbons, because some relations between solvents are lost due to their triangular shape.

Ceramics and their composition

There are four types of ceramic objects: earthenware (which is low-fired pottery), stoneware (which is high-fired pottery), soft-paste 'imitation' porcelain, and hard-paste 'true' porcelain (Icon 2006: 2). The bodies of ceramic objects are made from clay minerals and filling materials, also called temper, which prevents the body from shrinking when fired, as well as impurities. Ceramic objects also often have a glazed surface, which makes the object waterproof, but also serves for decoration purposes. The glaze is made of glass, which contains silica and fluxes, such as sodium, potassium, calcium and lead, as well as colourants. When ceramics are fired at high temperatures, the glaze is usually hard and glassy. If a ceramic is fired at low temperatures, the glaze can become brittle and flaky. Low or unevenly fired ceramics tend to be porous and more prone to breakage and flaking (Newton and Logan 2007).

Adhesives

Historic adhesives

Ceramics have been repaired since ancient times, but adhesives and solvents have changed over time. To discuss each adhesive would be outside the scope of this essay; therefore, a short historic summary of adhesives made from animal glue and plants is given. Then, more recent adhesives are discussed. Several case

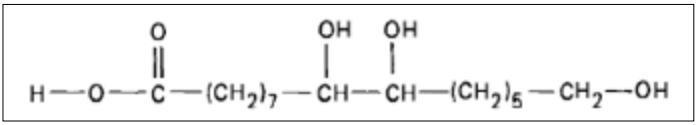

Figure 1: Chemical structure of shellac (Horie 1987:149)

studies are consulted to indicate what museums use for their own collections.

In a study about adhesives used on ceramic, glass and stone done at the Arizona State Museum (ASM) collections in the United States of America, it was found that pine resins and creosote lac resins were among the oldest adhesives found in their collection. Pine resins were used as adhesives, as well as to waterproof objects. This resin continues to be used by some Native American potters. Creosote Lac is produced by the insect *Tachardiella larreae* on the leaves of the creosote bush. It is a relatively strong adhesive used by Native Americans in the southwestern USA. The earliest example of an object with this adhesive in the ASM collection was from around 1440 until 1460. Creosote lac also continues to be used by Native American potters today (White and Odegaard 2008: 180f.).

Hide or animal glues were commonly used in conservation laboratories before the introduction of cellulose nitrate around 1915. Unfortunately, the study at the Arizona State Museum showed that 5% of objects repaired with animal glues have failed, and another 19% are labelled as unstable (White and Odegaard 2008: 180f.). A study done at the Greek Ceramics collection of the National Museum of Antiquities in Leiden, Netherlands, states that animal glues were relatively easy to remove from ceramics. The objects were submersed in de-ionised water to soften the animal glue. Then, using cotton swabs with acetone or industrial methylated spirit, the glue swelled enough that it could be removed mechanically using a scalpel or soft brushes (Dooijes 2007: 106).

Since the early twentieth century, cellulose nitrate became widely used in conservation, which also shows in the ASM collection, because it is the adhesive that was most commonly found in repaired objects. However, the study found that the adhesive does not age well; it becomes brittle and its strength decreases with age. Fifteen percent of repairs done with cellulose nitrate had failed, while four percent were considered to be unstable. Cellulose nitrate is discussed below.

Another historic adhesive is shellac. Shellac is made from the secretions of the lac beetle, which is native to southwest Asia. It was introduced to Europe as early as the 1300s. This secretion is washed and purified and becomes a resin when dissolved in ethyl alcohol (Bjorneberg 2019). However, shellac does not age well. It becomes brittle and discoloured. This can leave stains on the ceramic object. The shellac is also likely to seep into the body of the ceramic. Any solvent could cause the resin to soak even deeper into the material (Dooijes 2007: 108). Removing this resin can be difficult because of its complicated chemical

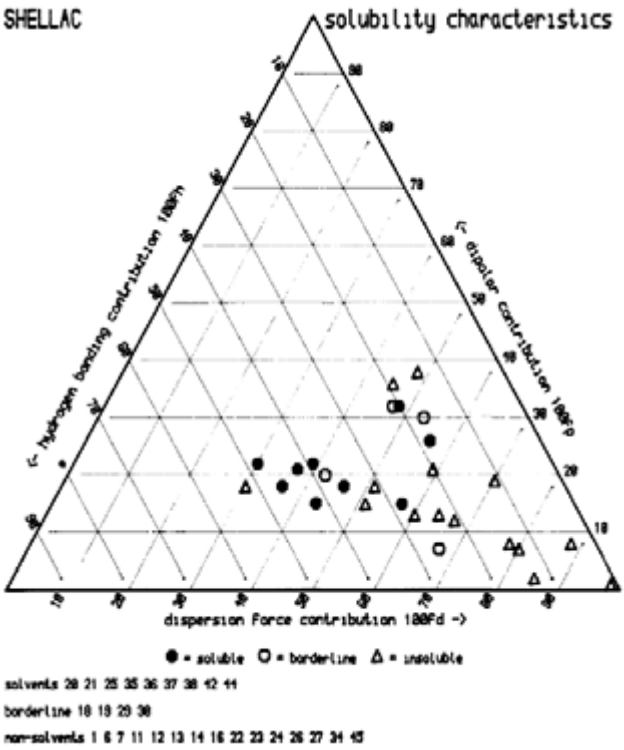

Figure 1: Chemical structure of shellac (Horie 1987:149)

structure. Since the resin comes from a beetle, the chemical structure can change depending on the environmental conditions the insect was exposed to. One of its major elements is aleuritic acid,[2] which esterifies into a polyester (see figure 1, Horie 1987: 149) According to a study done in 2017 (Tamburini, Dyer and Bonaduce 2017: 1), shellac consists predominantly of soft and hard resin, with the soft resin taking up 30% and the hard resin taking up 70%. These fractions can further be divided into mixtures of mono- and polyesters of hydroxy aliphatic acids, sesquiterpenoid acids and lactic acids. These mixtures are complex.

When ageing, the shellac undergoes crosslinking,[3] intermolecular

2 9, 10, 16-trihydroxyhexacanoic acid

3 Cross-linking occurs when covalent bonds form that hold polymer chains together. The result is a three-dimensional, random network of polymer chains. Cross-linking makes a substance more rigid and harder (Vitz et al. 2019b).

esterification, as well as the formation of unsaturated compounds, which makes it more difficult to identify in FTIR or fluorescence spectroscopies. While this study does not mention any solvents for shellac, it refers to another study done on the molecular changes during biopolymer ageing, which had shellac as a case study. They used methanol as a solvent for their shellac samples (Coelho, Nanabala, Menager, Commereuc and Verney 2012: 937). When Koob (1979: 134) discussed the removal of aged shellac in 1979, he considered the pyridine (C_5H_5N), a solvent with slight to moderate chemical toxicity, as most appropriate for the removal of shellac from ceramics. However, Koob states that 2-methoxy ethanol and a 50:50 mixture of ethyl alcohol and acetone are also effective. The latter two solvents only swell the resin enough so that it can be brushed or scraped away mechanically. The Victoria and Albert Museum suggested in 1971 that shellac should be removed with a 50:50 mixture of ammonia and industrial methylated spirits or Nitromors, which is a paint stripper containing predominantly methylene chloride (Larney 1971: 70). This shows how the approach to dissolving adhesives has changed over time.

According to the Teas solubility chart, shellac is soluble in methyl Cellosolve (2-methoxyethanol), butyl Cellosolve (2-butoxyethanol), isopropyl acetate, methanol, ethanol, isopropyl alcohol (propan-2-ol), butanol, n-methyl-2-pyrrolidone and pyridine (Horie 1987: 190). Koob (1979: 134) also used pyridine, which matches Horie's findings.

Cellulose nitrate

An adhesive that is still found in abundance in many museum collections is cellulose nitrate. In the Arizona State Museum, cellulose nitrate is the most widely used adhesive material in repaired ceramic vessels. It is a derivative of cellulose and made by adding nitric acid (HNO_3) to cellulose ($(C_6H_{10}O_5)$

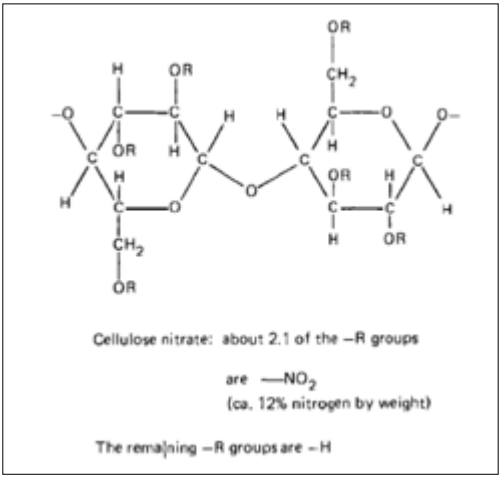

Figure 3: Chemical structure of cellulose nitrate (Horie 1987:131)

$_n$) (Encyclopedia.com n.d., National Centre for Biotechnology Information n.d.). At first, cellulose nitrate was a popular adhesive among conservators and is still being used today, not only for ceramics but also for iron and glass. Cellulose nitrate was considered useful because the solvents rapidly evaporated, leaving a strong, dry film of adhesive. However, it is extremely unstable (Horie 1987: 132). The lifetime of cellulose nitrate as an adhesive is only estimated to be around 100 years, after which degradation has made the product completely unstable (Ziegler, Kuhn-Wawrzinek, Eska and Eggert 2014: 1). Horie (1987: 133) also mentions that, as early as the 1920s, conservators expressed concerns about cellulose nitrate's stability as an adhesive, as well as its effects on objects. The study done at the Arizona State Museum noted that cellulose nitrate becomes problematic with age because it becomes increasingly brittle. About 15% of all ceramics repaired with cellulose nitrate failed and another 4% were considered unstable (White and Odegaard 2008: 180).

There are a number of different cellulose nitrate adhesives available on the market. The most popular ones are Archäocoll 2000, Frigilene, HMG and Mecosan L-TR (Ziegler et al. 2014: 2).

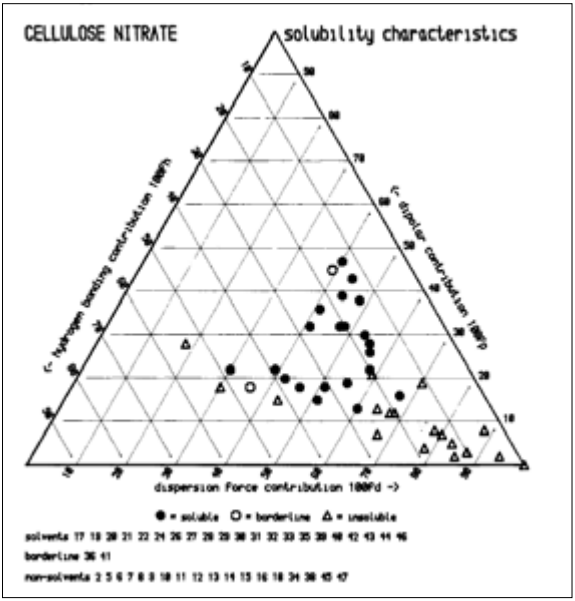

Figure 4: Teas chart for cellulose nitrate (Horie 1987:214)

Archäocoll 2000 was developed in Germany in 1997 as an adhesive for archaeological ceramics. It contains no plasticiser[4] and is therefore relatively rigid and brittle. Its glass transition temperature (T_g)[5] is between 80 and

4 Plasticisers are often added to adhesives to increase their flexibility and workability. They lower the adhesive's glass transition temperature (see below) and elastic modulus (Chemceed 2017).

5 The glass transition temperature (Tg) is the temperature at which the thermal energy of a material/chemical is smaller than the forces that hold the molecules in the chemical together. At that temperature, the substrate moves from a hard, glassy consistency to a soft consistency. Below its Tg, an amorphous (not exhibiting crystalline structure) polymer is (Vincotte et al. 2019: 2).

90°C. Archäocoll can be didsolved in a mix of ethylacetate (35–40%), acetone (35–40%) and *i*-propanol (10–25%). Unfortunately, Archäocoll degrades faster than plasticised cellulose nitrate adhesives. Frigilene is a cellulose nitrate lacquer. It contains alkyd resin and phthalates (possibly dibutyl phthalate) as plasticisers. It is not often used in conservation. Frigilene best dissolves in a mix of butyl acetate (30–60%), xylene (30–60%) and butanol (10–30%). HMG is a cellulose nitrate adhesive that contains 2.5–10% di-iso-nonyl phthalate as a plasticiser. Its solvent is acetone, or a mixture of 50–100% acetone, 10–25% butyl acetate, 2.5–10% *i*-propanol, 2.5–10% *i*-butanol, as well as 2.5–10% 2-methoxy-1-methylethyl acetate. Mecosan L-TR is plasticised with camphor and small amounts of diphenylkresyl-phosphate. This adhesive can be dissolved in 100% methyl acetate or a mixture of 50–100% methyl acetate, 10–12.5% ethanol, 5–10% naphtha, 5–10% *i*-propanol and less than 1.5% hexane (Ziegler et al. 2014: 2). The adhesives that have additional plasticisers have a T_g around 70°C. Most studies, however, state that cellulose nitrate is readily soluble in acetone (Neiro 2003: 238, Larney 1971: 70). Whether or not these adhesives are soluble in acetone or a mixture alcohol and ether also depend on the amount of nitrogen that is
250 contained in the cellulose nitrate. Manufacturers may have different formulas (Encyclopedia.com n.d.).

The study also conducted tests for each of the above-listed cellulose nitrate adhesives to show how they age. The results showed that the plasticisers had a negative impact on the adhesives' degradation process. For example, Mecosan L-TR showed yellowing and shrinkage when heat-aged (Ziegler et al. 2014: 6f.). Cellulose nitrate also shows discolouration and becomes brittle. Light and heat can accelerate its deterioration severely (Neiro 2003: 238). The study proposed polyvinyl butyral 30 (PVB 30), and Paraloid B-72 as alternatives to cellulose nitrate adhesives (Ziegler et al. 2014: 3). Another disadvantage of cellulose nitrate is that its degradation is autocatalytic; the chemicals created during initial

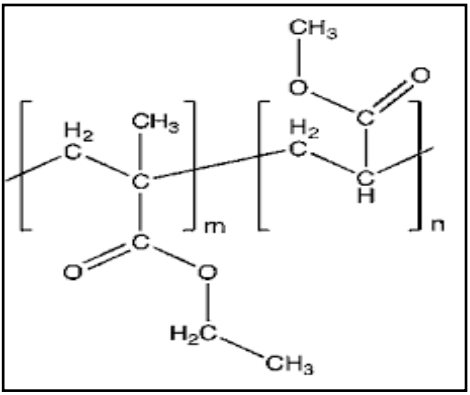

Figure 5: Chemical structure of Paraloid B-72 (Baglioni 2014)

degradation increase the speed of cellulose nitrate breakdown. Furthermore, one of the chemicals created during the degradation process is nitrous oxide (NO_2), an oxidising agent which is highly toxic (Shashoua, Bradley and Daniels 1992: 114).

There only appears to be a Teas solubility chart for pure cellulose nitrate. It is soluble in tetrahydrofuran, Cellosolve (2-ethoxyethanol), methyl Cellosolve (2-methoxyethanol), butyl Cellosolve (2-butoxyethanol), Cellosolve acetate (2-ethoxyethyl acetate), ethyl acetate, *n*-butyl acetate, propylene carbonate (propane-1,2-diol carbonate), 4-butanolide (butyrolactone), acetone, ethyl methyl ketone (MEK or butan-2-one), cyclohexanone, isobutyl methyl ketone (4-methyl pentan-2-one), di-isobutyl ketone (2,6-dimethylheptan-4-one), methanol, *n*-butyl alcohol (butanol), nitroethane, n-methyl-2-pyrrolidone, dimethyl methanamide (*N*, *N-dimethylformamide*), pyridine and dimethyl sulphoxide (Horie 1987: 188–190). None of these solvents appears in the above-mentioned studies.

Acrylic adhesives

Acrylic polymers as adhesives began to appear on the market in the 1950s (Samson Kamnik, 2013). They were developed by the company Rohm and Haas and were originally used as surface coating (Cameo, 2019). They are now the most widely used in conservation laboratories. The most frequently used acrylic adhesive is Paraloid B-72, which is a copolymer of 70% ethyl methacrylate (EMA) and 30% methyl acrylate (MA, see figure 5). Butyl methacrylate (BMA) may make up 2% of Paraloid B-72. This adhesive is often preferred over cellulose nitrate because of its relative stability, its transparency and mechanical resistance, but most importantly, its reversibility (Vincotte, Beauvolt, Boyard and Guilminot 2019: 1).

There are many different acrylic adhesives on the market, including Paraloid B-44, B-66, B-72 and B-82. However, not all chemical compositions of these resins are as clearly specified as that of Paraloid B-72. Paraloid B-44, for example, has a higher T_g than Paraloid B-72—above 60°C (Vincotte et al. 2019: 1f). Since Paraloid B-72 is the most widely used in conservation, it is what this essay focuses on.

Paraloid B-72 is relatively resistant to oxidation, light and hydrolysis.[6] Its moderate hardness is beneficial since adhesives that are too hard are prone to cracking at the joins because they are less flexible (Koob 1986: 7f.). Paraloid B-72 can be used for many materials, including metals, stone, wood, glass and ceramics.

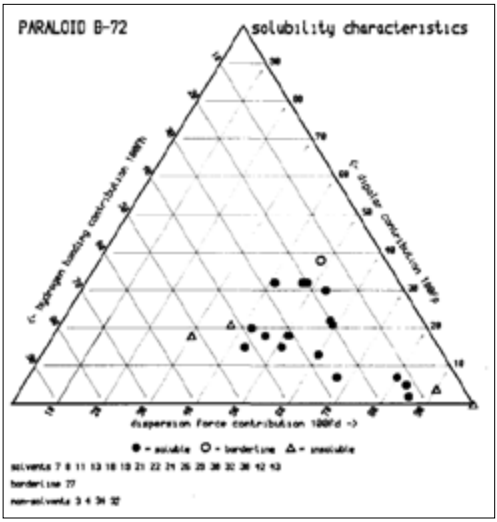

Figure 5: Chemical structure of Paraloid B-72 (Baglioni 2014)

In the Arizona State Museum's collection, acrylic polymers, especially Paraloid B-72 and B67, began to appear around 1984. These adhesives largely replaced cellulose nitrate adhesives. As of 2008, there was a failure rate of below 1% for objects treated with Paraloid (White and Odegaard 2008: 180). However, other studies claim that Paraloid B-72 proved to be unstable in large ceramic objects, which is attributed to its glass transition temperature of only 40°C (Shashoua et al. 1992: 113).

The Kaman-Kalehözük Museum in Kaman, Turkey, for example, found Paraloid B-72 to collapse in ceramic vessels repaired with the resin. Since Turkey has extremely hot summers but also cold winters, this study questioned the effectiveness of Paraloid B-72 in extreme climates. Therefore, the study suggests conservators in warmer climates use Paraloid B-48N, which has a T_g of 50°C (Pohoriljakova and Moy 2013: 83). However, the study also showed that Paraloid B-48N lost its flexibility and became brittle after three years and lost its solubility over the years as well. Paraloid B-72, however, retained the best solubility when compared to Paraloid B-48N. None of the Paraloid adhesives showed any yellowing or discolouration as they aged (Pohoriljakova and Moy 2013: 89, 92).

As an adhesive for ceramics, Paraloid B-72 is often dissolved in a 70:30 ratio of acetone and Paraloid B-72. Other solvents include ethanol, toluene, xylene

6 Hydrolysis is a chemical reaction in which a water molecule is added to a substance. This often breaks down the substance (The Editors of Encyclopaedia Britannica 2016).

and ethyl acetate (Vincotte et al. 2019: 1). Acetone is the most commonly used solvent for Paraloid B-72 because it is the least toxic. However, it evaporates relatively quickly. Therefore, ethanol is used in combination with acetone to create a slower setting time. In hotter climates, solvent mixtures containing up to 40% ethanol are often used to dissolve Paraloid B-72, which prevents the acetone from dissolving too quickly (Koob 1986: 9, Neiro 2003: 239f.).

Vincotte et al. (2019: 2, 7) divide the solvents of Paraloid B-72 into two groups. The first group consists of more volatile solvents, including ethanol, acetone and ethyl acetate. The second group contains heavier solvents—toluene, butyl acetate and ethyl lactate. Increasing the quantity of solvent with a set amount of Paraloid B-72 will decrease its T_g. Acetone, for example, can decrease the T_g of Paraloid B-72 by several degrees Celsius, and toluene can lead to as much as a 15°C reduction. This can be problematic since Paraloid B-72 only has a T_g of 40°C but often softens at 30 to 35°C.

According to the Teas solubility chart, Paraloid B-72 is soluble in toluene, xylene, methylene chloride (dichloromethane), carbon tetrachloride (tetrachloromethane), dioxane (1,4-dioxacyclohexane), Cellosolve (2-ethoxyethanol), butyl Cellosolve (2-butoxyethanol), Cellosolve acetate (2-ethoxyethyl acetate), ethyl acetate, *n*-butyl acetate, acetone, ethyl methyl ketone (MEK, butan-2-one), isobutyl methyl ketone (4-methyl pentan-2-one), *n*-butyl alcohol (butanol), *n-methyl-2-pyrrolidone*, dimethyl methanamide (*n*, *n-dimethylformamide*) (Horie 1987: 186–190). Some of these adhesive solvents correlate with previously discussed literature, but most of the solvents found on the Teas solubility chart for Paraloid B-72 are not mentioned in literature.

Conclusion

This essay only covered a small section of the adhesives and their solvents used in the conservation of ceramic objects. Among the adhesives not discussed are polystyrene (PS) and polyvinyl acetate (PVAC) (Nel, Noake, Jones-Amin and McKenna 2024: 1, 4, White and Odegaard 2008: 180), as well as epoxy adhesives such as Araldite and adhesives designed to make archaeological excavations easier, such as Aquazol (Ortlik, Bussienne and Maynes 2011, Muros 2012). While these adhesives play an important role in conservation and are still used, the most relevant adhesive used in the twentieth century, according to literature coverage, seemed to be cellulose nitrate, while Paraloid B-72 was most commonly found in

literature for the twenty-first century.

Finding solvents for adhesives has been a practice ever since the invention of adhesives, which was long before academics gained the chemical knowledge about molecular structures and chemical reactions in adhesives that we have today. Therefore, many of the solvents used are a result of trial-and-error experiments (Stravroudis and Blank 1989: 5). What also has to be taken into consideration is that different manufacturers may have differing recipes for their adhesives, which may also have changed over the years, as was the case with the amount of nitrogen in cellulose nitrate (Encyclopedia.com n.d.). This might explain why there are so many solvents on the Teas solubility chart for the respective adhesives discussed that are not mentioned in literature at all. While the Teas solubility chart is a scientific measurement to identify possible adhesive solvents according to their properties (London dispersion forces, attraction forces and hydrogen bonds), these may not always be the most useful solvents in practice because of differing recipes for adhesives.

This highlights the importance of staying updated with current literature on adhesives and their solvents and learning from other conservators who work with similar objects. When doing so, the difference in location has to be taken into consideration. Seeing as adhesives have varying glass transition temperatures, conservators working in hotter climates, such as those in the Kaman-Kalehözük Museum in Kaman, Turkey, may have different experiences than the Arizona State Museum in the United States of America (Pohoriljakova and Moy 2013: 83).

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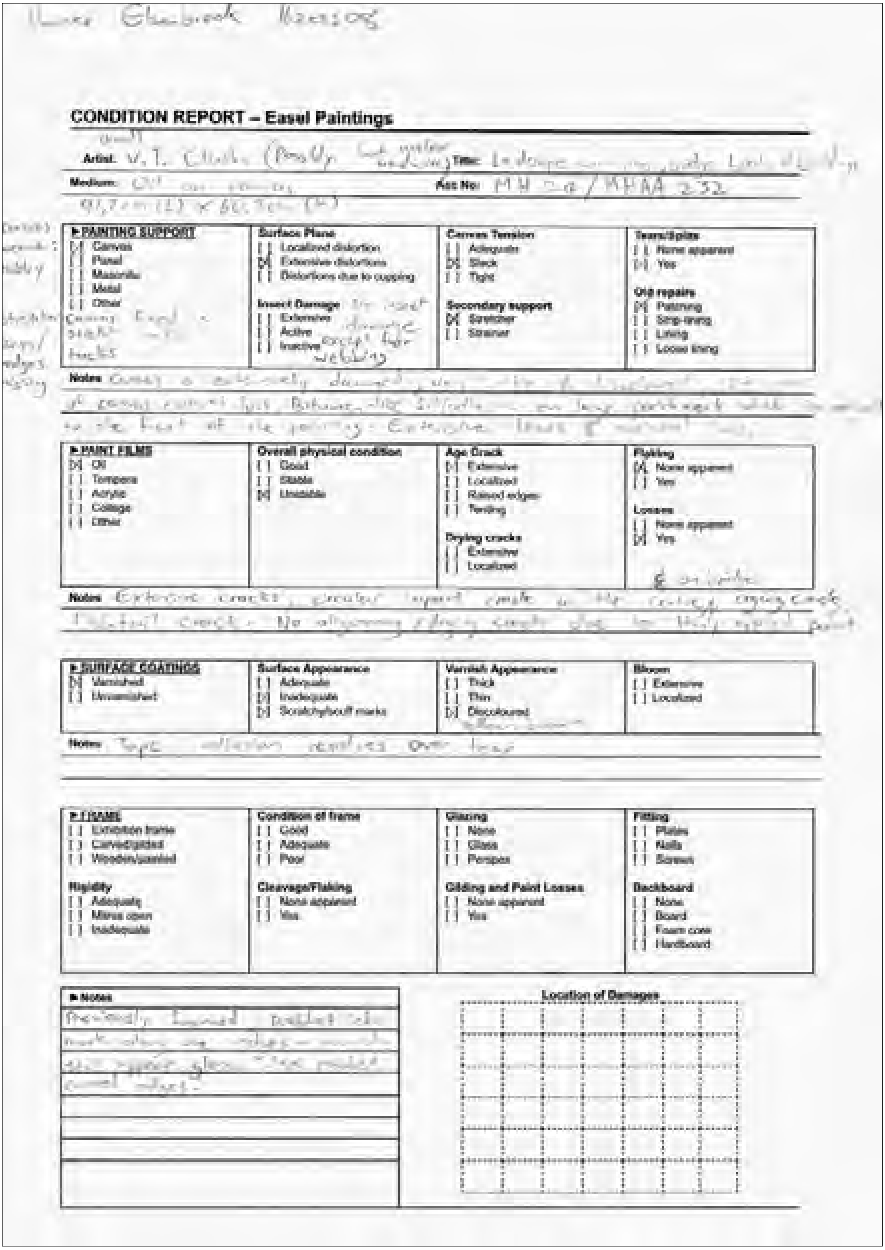
Hannes Elsenbroek: THC 807

Hannes Elsenbroek, an artist and student from the 2021 intake, aims to become a paintings conservator. He submitted this condition report and documentation of an easel painting during the THC 807 speciality module.

Introduction

This condition report formed part of the core grading components of the elective module THC 807: Conservation: Polychrome Surfaces. While serving as an exercise for identifying and documenting the damage and deterioration processes inherent in easel paintings, this project further provided an opportunity to apply newly learnt concepts, such as the anatomy of easel paintings, as well as several methods of observational analysis such as microscopy, normal and raking-light photography, and ultraviolet and infrared imaging. This exercise also enabled an opportunity to undertake and experience a project at a professional level since the client is Melrose House Museum Collection. This condition report marks the beginning of the conservation treatment of an undated O.T. Clark painting titled River Scene as requested by the client. This painting is in poor overall condition, displaying multiple areas of material loss, extensive tears, planar distortion, cracks, varnish discolouration, as well as previous areas of repair that have become undesirable. Paintings in such an unstable condition are generally at risk of being deaccessioned if not restored, and so the objective is to use this artwork as a teaching tool in live demonstrations or practical sessions and ultimately restore the painting.



CONDITION REPORT – Easel Paintings

Artist: V. T. Clarke (Possibly ...) Title: Landscape ...

Medium: Oil on canvas Acc No: MH 20 / MHAA 232

91.7 cm (L) x 60.5 cm (H)

▸PAINTING SUPPORT	Surface Plane	Canvas Tension	Tears/Splits
[x] Canvas [ ] Panel [ ] Masonite [ ] Metal [ ] Other	[ ] Localized distortion [x] Extensive distortions [ ] Distortions due to cupping Insect Damage [ ] Extensive [ ] Active [ ] Inactive	[ ] Adequate [x] Slack [ ] Tight Secondary support [x] Stretcher [ ] Strainer	[ ] None apparent [x] Yes Old repairs [x] Patching [ ] Strip-lining [ ] Lining [ ] Loose lining

Notes:

▸PAINT FILMS	Overall physical condition	Age Crack	Flaking
[x] Oil [ ] Tempera [ ] Acrylic [ ] Collage [ ] Other	[ ] Good [ ] Stable [x] Unstable	[x] Extensive [ ] Localized [ ] Raised edges [ ] Tenting Drying cracks [ ] Extensive [ ] Localized	[x] None apparent [ ] Yes Losses [ ] None apparent [x] Yes

Notes: Extensive cracks, ...

▸SURFACE COATINGS	Surface Appearance	Varnish Appearance	Bloom
[x] Varnished [ ] Unvarnished	[ ] Adequate [x] Inadequate [x] Scratchy/scuff marks	[ ] Thick [ ] Thin [x] Discoloured	[ ] Extensive [ ] Localized

Notes:

▸FRAME	Condition of frame	Glazing	Fitting
[ ] Exhibition frame [ ] Carved/gilded [ ] Wooden/painted Rigidity [ ] Adequate [ ] Mitres open [ ] Inadequate	[ ] Good [ ] Adequate [ ] Poor Cleavage/Flaking [ ] None apparent [ ] Yes	[ ] None [ ] Glass [ ] Perspex Gilding and Paint Losses [ ] None apparent [ ] Yes	[ ] Plates [ ] Nails [ ] Screws Backboard [ ] None [ ] Board [ ] Foam core [ ] Hardboard

▸Notes

Location of Damages

Identification details

Artist: Clark, Octavius Thomas (1850–1921)
Signature: Signed bottom left corner in brown (figure 1)
Title: *River Scene*
Date: Undated
Medium: Oil on canvas
Dimensions: 607 x 912 mm
Collection: Melrose House Museum, Pretoria, South Africa

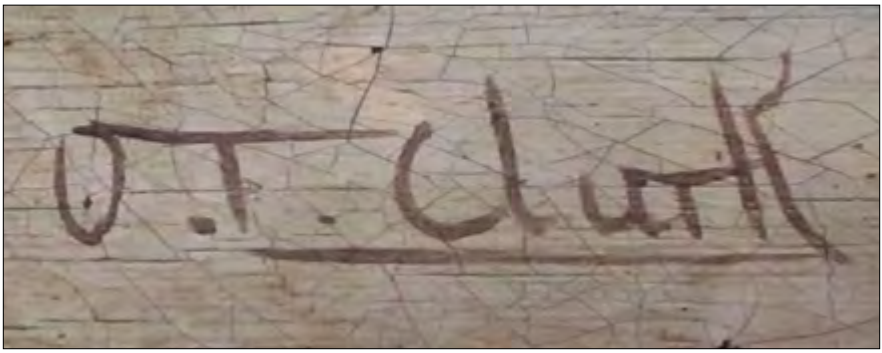


Figure 1: Signature *O.T. Clark* located in the bottom left corner of the picture plane in brown (photograph by Hannes Elsenbroek)

Artist biography

Octavius Thomas Clark was a British painter born on 21 December 1850 in Hoxton New Town, England (Robinson 1973: 70). Octavius was born into a family of artists with both his father and three older brothers practising as painters (Sulis Fine Art 2022). Robinson (1973: 70), however, notes that in 1874, when Octavius Clark married at the age of 23, he noted his profession as 'clerk', suggesting that at that point at least he had not entered the art profession. He did so later as, for the 1881 census, Octavius Clark's profession is noted as 'artist' (The Clark Family of Artists Sa). In addition, during the early 1900s, he did stage appearances as a 'lightning artist': 'Professor OT Clark, the celebrated lightning artist, who will produce on canvas 30in. by 20in. a beautiful oil painting in 10 to 15 minutes' (The Clark Family of Artists Sa).

Octavius Clark primarily painted bucolic landscape scenes imbued with the

serenity of the countryside—as seen in the example of this particular case study. His technique involved painting on-site, where he worked swiftly to record the prevailing light and weather conditions of the area with great skill (Antiques Atlas 2022). He became the most prolific painter of the Clark family due to his practice of painting his landscapes in sets of six at a time, which appeared nearly identical (Sulis Fine Art 2022). His work was never exhibited but rather directly sold to art dealers who sold much of it in America (Sulis Fine Art 2022). In America, several of his paintings were reproduced in lithographs, making his work more accessible and affordable to the settlers for whom it functioned as a means of remembering their home country (Antiques Atlas 2022). These lithographs were screen-printed on canvas in colour, and then a coat of clear glaze was brushed on by hand to make the lithograph appear more like an original hand-painted oil painting (Jody 2022).

Octavius produced most of his paintings in oils on canvas. He also occasionally worked with watercolours and sometimes produced paintings under the name of Louis Edgar (Leland Little Sa). Octavius continuously produced paintings until his death on 7 February 1921 at the age of 70 (Robinson 1973: 72).

Provenance

As a result of dissociation, the provenance of this painting is no longer known. Dissociation is regarded as one of those factors which can cause deterioration or loss to artefacts and is defined by the Canadian Conservation Institute as 'the tendency for order systems to fall apart of time . . . this results in the loss of objects, object-related data or the ability to retrieve or associate objects and data.' In this case, the records associated with the painting's provenance and history of ownership are no longer available. It currently belongs to the Melrose House Museum Collection and was loaned to the Ditsong National Museum of Cultural Heritage in 1990. In 2020, it was returned to Melrose House and subsequently loaned to the University of Pretoria's Tangible Heritage Conservation programme with the hope of getting the painting restored.

In light of the fact that Octavius Clark often painted the same subject in batches of six at a time, a painting (represented in figure 2) has been found that appears very similar to the one on which this condition report is based (represented in figure 3). This painting (figure 2) appears on the Invaluable Auction House website as part of an auctioning event hosted by Gildings Auctioneers in January 2018 at Market Harborough in the United Kingdom (Invaluable 2022).

Figure 2: Octavius Thomas Clark, *River Scene*, undated. Oil on canvas, 490 x 740 mm, Private Collection. (Invaluable 2022).

Figure 3: Octavius Thomas Clark, *Landscape river scene with bridge and settlements* (provisionally titled), undated. Oil on canvas, 607 x 912 mm, Melrose House Museum Collection (photograph by Salomé Le Roux)

These paintings display the exact same arch bridge at the right foreground of the picture plane, leading the viewer's gaze over the river into the middle ground. Here, one sees the square tower of a fortress emerging out of a forest of tall trees to the right. Towards the centre of the middle-ground, a dirt path, occupied by people, leads towards a group of cottages that recede into the vanishing point of the background. The path also leads towards the riverbank, at the left side of the picture plane, where small river boats are docked. Behind the bank where the boats are docked, there is a white picket fence that surrounds a building with two chimneys. The entrance to this building is marked with an arched sign that reads 'White Hart' as seen in the detailed image of the painting (figure 4).

This building is most probably an inn since many inns adopted the name The White Hart as a way of pledging allegiance to the king, whose personal badge was a white stag (Holt 2020). Royal names for pubs had always been popular, but in 1393, when King Richard II passed a law that made it compulsory for all inns to display an identifying sign, many of them chose the name The White Hart (Holt 2020).

Figure 4: Detail of the painting showing White Hart sign (photograph by Hannes Elsenbroek)

There is an instance in 1907, when Octavius Clark was 56, where he requested, through a letter, a loan of 10 shillings from Mr Sewell—the owner of the White Hart in Green Street, Forest Gate (Robinson 1973: 70). Could this perhaps be the same White Hart as portrayed in the painting(s)? If so, then the area which appears in the painting can be ascertained to be Forest Gate. It is also, however,

entirely possible that the White Hart in the painting may be in another area since this name for taverns and hotels was, and still is, rather widespread.

Useful information that will prove vital to the restoration attempt of the battered Melrose House painting (figure 3) can be obtained by comparing it with its sibling painting (figure 2), which appears to be in pristine condition. This information includes the overall fresh appearance of the colours in the picture, unaffected by surface dirt and varnish discolouration. The wholeness of the picture plane in figure 2 will also aid in the interpretation and reconstruction of areas of loss that are so prevalent in the Melrose House painting (figure 3). However, before a treatment decision-making discussion can take place, it is first necessary to document and identify the damage present in the painting, which can be found in the following condition report.

Condition report

Figure 5: Recto view of painting (with scale bar) upon its arrival at the Van Wouw House. Due to its poor condition, it was difficult to take a proper photo without risking further damage. When positioned upright, the extensive tears (along with gravity) cause certain areas to flap and fold (as indicated by the red stippled lines), thus further weakening the brittle canvas support and risking an extension of the tears, which could cause further material loss (photograph by Hannes Elsenbroek)

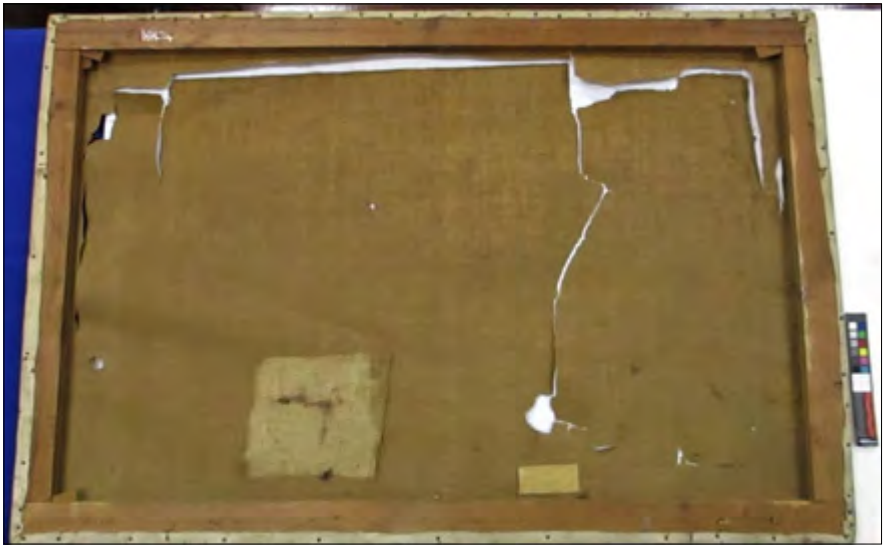


Figure 6: Verso view of painting (with scale bar) (photograph by Hannes Elsenbroek)

266 **Secondary support:**

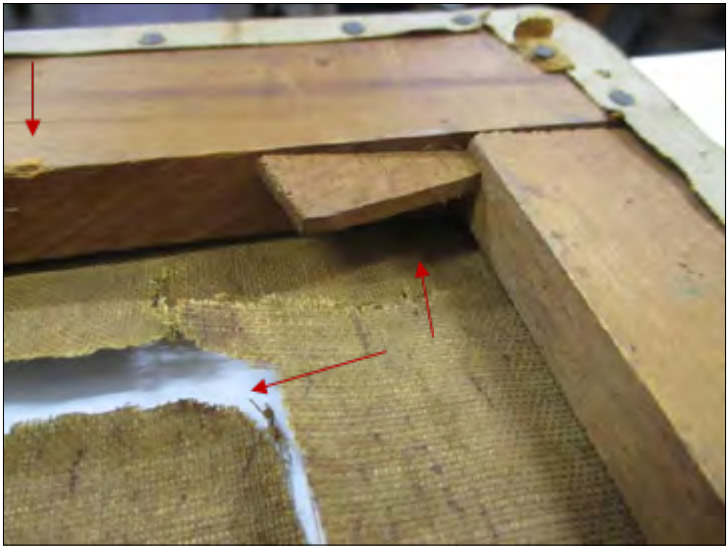


Figure 7: Back of top left corner showing missing stretcher key, extensive tears on canvas, chips along edges and tacks that attach the canvas to the wooden stretcher (photograph by Hannes Elsenbroek)

- Wooden stretcher, fair condition
- 4 members (width: 45 mm x thickness: 15 mm)
- Mortise and tenon joint, top right keys intact, one key missing from top left and bottom right and both keys missing at bottom left (figure 6)
- Arched warping of the left vertical member (causing distortions) (figure 9)
- Accession number MH 24 in white ink and consolidant at top right (figure 10) and accession number MHAA 232 in pencil at bottom left (figure 8)
- Previous tacks and canvas remnants as well as tack holes: This could indicate that the painting was re-stretched or that the canvas was stretched on an already-used frame (figure 8).
- Visible cracks on stretcher members along the grain of the wood (figures 8, 10 and 11)
- Chips and scuff marks on edges of wooden stretcher
- No insect damage present except for webbing on the lateral bottom member (figure 12)
- White stains that remain to be identified visible on the left vertical stretcher member (figure 13)
- Dust visible

Figure 8: Back view of bottom left corner. Previous tacks with canvas remnants visible, previous tack holes as well as accession number MHAA 232 in pencil on stretcher. Crack along the wood grain also visible (encircled with red) (photograph by Hannes Elsenbroek)

Figure 9: Arched warping of the left vertical stretcher member (photograph by Hannes Elsenbroek)

Figure 10: Cracks along the wood grain of the right vertical and lateral members of the secondary support (encircled with red). Accession number in white ink with consolidant also visible (photograph by Hannes Elsenbroek)

Figure 11: Running crack along the wood grain of the right vertical stretcher member (photograph by Hannes Elsenbroek)

Figure 12: Insect webbing on the lateral bottom member of the stretcher. To the right is what it looks like under 100x microscopic magnification (photograph by Hannes Elsenbroek)

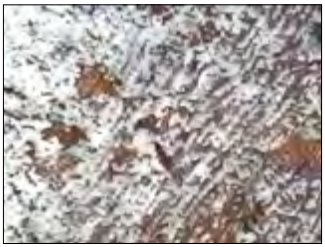


Figure 13: White stains on the left vertical stretcher member. To the right is what it looks like under 100x microscopic magnification (photograph by Hannes Elsenbroek)

Primary support:

- Medium-weight canvas tabby weave pattern (one under and one over) (figure 14) (warp 16 x weft 12 per cm^2). Unsure if it is linen or cotton.
- Accession number MHAA 232 written in pencil on tacking margin on the primary support located on the lower right vertical back of the painting (figure 16)
- No canvas selvedge present
- Only one piece of canvas used for painting
- Extensive tears (both lateral and vertical) and multiple localised tears causing overall slackness of the surface plane (figure 17)
- Poor condition as canvas is very brittle and deteriorated, discoloured to yellow-brown, very dusty

- Multiple areas of material loss (figure 17)
- Serious distortion and buckling on lower half due to lack of tension caused by extensive tears (figure 17)
- Canvas secured to secondary support with tacks (stable condition) on the tacking edge and also on the verso of the secondary support (average tack spacing about 60 mm but varies on tacking edge, and average tack spacing about 80 mm but much more irregular on the verso of the secondary support) (figures 8, 10, 11)
- Tacking margin has stains, material loss and cracks with a width of 15 mm along the side of the painting (figure 14). The corners of the tacking margins along the side edges of the painting have material loss with the wood of the stretcher bars visible. The tacking margin on the verso of the secondary support has an average width of about 12 mm, but it decreases to about 8 mm to the left vertical member of the secondary support (figure 17)
- Previous restorative patchwork on two areas (figure 17). One smaller rectangular patch made from canvas and adhered to the primary support with an adhesive (figure 18). One larger square patch made from canvas and adhered to the primary support with an adhesive and a bitumen-like black substance, which may also have been used as an adhesion agent (figure 19).

Figure 14: Side view of bottom left corner showing canvas with fibre and ground loss as well as stains and also tacks that attach the canvas to the stretcher frame (photograph by Hannes Elsenbroek)

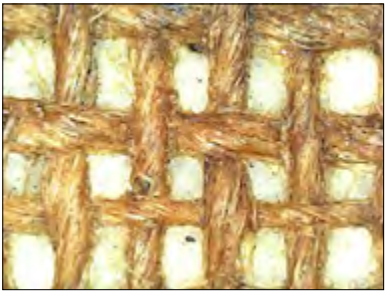


Figure 15: Canvas tabby-weave pattern under 10 x microscope magnification. Note the cream-white ground in between the fibre thread weave pattern (photograph by Hannes Elsenbroek)

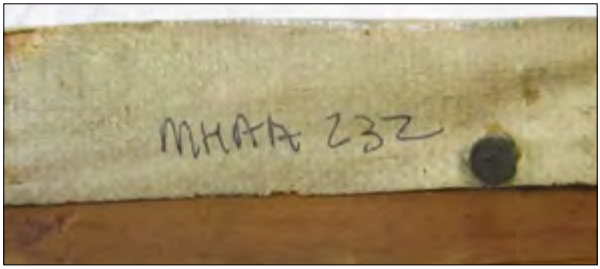


Figure 16: Accession number in pencil on primary support located on the lower right vertical backside of the painting (photograph by Hannes Elsenbroek)

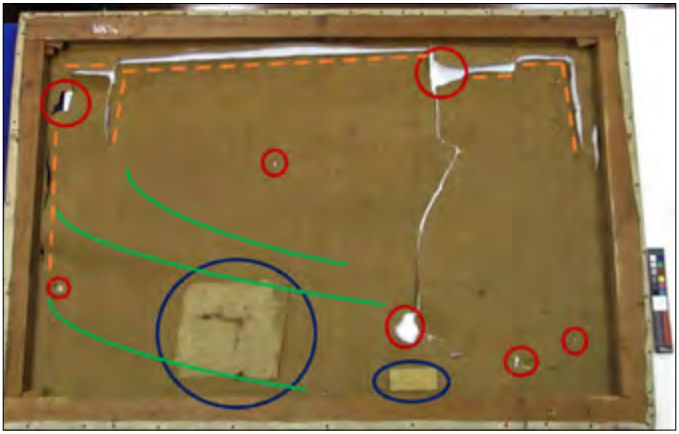


Figure 17: Verso view of the painting with scale bar showing major and smaller areas of material loss of the primary support (encircled in red), previous restorative patchwork (encircled in blue), extensive tears (indicated by the orange stippled lines) and surface plane distortions (indicated by the green curved lines) (photograph by Hannes Elsenbroek)

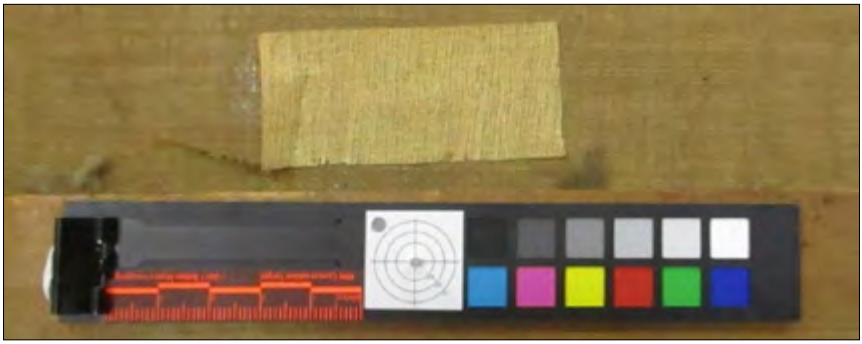
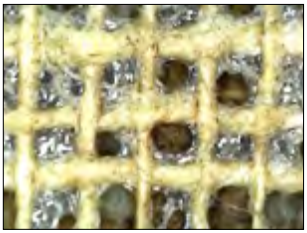


Figure 18: Smaller rectangular canvas patchwork with scale indicator (above). Patchwork under 10x microscopic magnification shows canvas tabby thread weave pattern (bottom left). The surrounding area of patchwork under 10x microscopic magnification reveals that an adhesive was used to adhere the patch to the back of the painting's primary support (bottom right) (photograph by Hannes Elsenbroek)

Figure 19: Larger square patchwork with visible black substance with scale indicator (above). Patchwork under 10x microscopic magnification shows canvas tabby thread weave pattern with adhesive used to adhere the patch to the primary support of the painting (bottom left). Black substance under 10x microscopic magnification may be a bitumen-like substance used as an adhesive and/or filler agent (bottom right) (photograph by Hannes Elsenbroek)



Due to the poor and unstable condition of the painting, there were a few factors that prevented the immediate gathering of other data through various imaging techniques such as reflected infrared photography, raking-light photography, specular axial-light photography or even normal-light photography to serve as a proper working photo. The first of these factors was the instability of the painting due to its extensive tears. The abovementioned investigative imaging techniques require the painting to be positioned upright on an easel facing the camera and other lighting equipment. If the painting were placed upright, the force of gravity would cause the flaps from the tears to pull downwards, creating the risk that the tears would extend, causing further material loss. To prevent any movement of loose canvas material, it was decided to build a backing support for the inner back part of the painting. However, due to age and the atmospheric changes over time, the canvas has distorted along the large lateral tear by curling/buckling up to the side of the upper vertical member of the stretcher frame secondary support, as shown in figure 20.

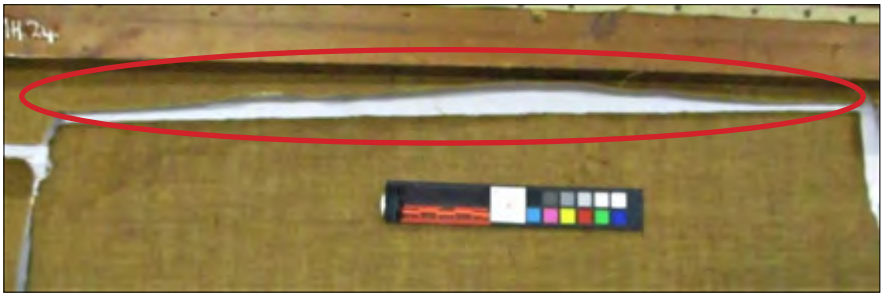


Figure 20: Curling/buckling of canvas at edge of tear up towards the upper vertical member of the secondary support (photograph by Hannes Elsenbroek)

This buckling edge of the canvas has hardened over time, and the backing support risks applying too much constant force to this area, which may cause another crack or tear to form. Therefore, before a backing support could be made, it was first necessary to relax the canvas back into shape and flatten the lifted, buckled area.

But before this form of remedial treatment could be carried out, the surface area of the canvas that required treatment first needed to be dry-cleaned. This step was necessary because the canvas contained a lot of dust and dirt, and

introducing moisture to this dust could cause mudding to occur while also risking transmigration of dirt into the ground layer from behind. The dry-cleaning entailed first stabilising the loose areas of the canvas with small pieces of masking tape, taping up tears along the horizontal or vertical perpendicular tabby canvas thread weave pattern as shown in figure 21. Then, a piece of wax paper and Melinex lining were slid underneath the painting in sizes large enough to cover the entire surface of the painting and wrap around the sides. The wax paper acts as a protective barrier between the paint surface and the Melinex, while the Melinex prevents the wax paper from tearing when wrapped over the painting. A piece of Eska board, cut to the same size as the painting, was clipped onto the front of the painting to secure the Melinex and wax paper wrapped over the front of the painting. The painting was then lifted and leaned upright against the wall so that the pocketed areas between the canvas and the wooden support could be vacuum-cleaned with a micro-attachment as seen in figure 22. The micro-attachment used had a long, flat edge that easily sucked up accumulations of dust or dirt pockets in the slits between the canvas and the stretcher.

Figure 21: Stabilising remedial treatment for dry cleaning (photograph by Hannes Elsenbroek)

Figure 22: Micro-attachment on vacuum cleaner nozzle to remove accumulations of dust or dirt pockets in the gap between the canvas and the stretcher frame (photograph by Hannes Elsenbroek)

Figure 23: Further dry-cleaning of the canvas surface with polyurethane sponge (photograph by Hannes Elsenbroek)

After all the dust accumulations in the pocketed side areas of the painting had been removed, the painting was placed face-down on the table surface and the tape removed. Most pieces of tape could be removed with ease since the canvas surface was very dusty. Another micro-attachment nozzle with a small brush was attached to the vacuum cleaner and the entire backside of the painting was lightly brushed and vacuum cleaned. After this, polyurethane make-up sponges were used to remove the remaining dust in the areas on which the canvas flattening treatment would be carried out as seen in figure 23. After these areas were sufficiently cleaned, the flattening process could begin.

Figure 24: Sympatex covering lifted tears during the flattening process (photograph by Hannes Elsenbroek)

The next step in the flattening process was to cover the lifted tear area with a sheet of Sympatex as seen in figure 24. The Sympatex was applied with its glossy side facing the canvas surface area. This glossy side is a non-porous membrane that prevents the canvas from getting wet while still allowing it to humidify and therefore to relax and flatten out (TALAS 2021).

Figure 25: Humidified blotting paper on top of the Sympatex (photograph by Hannes Elsenbroek)

Next, some blotting paper was humidified using a water-filled spray-nozzle bottle. The paper was given two to three sprays to ensure it was humid but not drenched. The humidified blotting paper was placed on top of the Sympatex as shown in figure 25. After this, small Perspex paperweights were placed on top of the blotting paper to weigh the canvas down as seen in figure 26. The humidified blotting paper allows the localised canvas area to undergo an increase in relative humidity while the Sympatex prevents the canvas from getting into direct contact with moisture. The humidified canvas started changing shape after fifteen minutes and was left overnight; the humidity of the canvas was checked every half hour, two to three times, to ensure that it did not become wet but remained humidified.

Figure 26: Perspex weights on top of the humidified blotting paper and Sympatex (photograph by Hannes Elsenbroek)

The following day, the Perspex weights, blotting paper and Sympatex were removed. It was observed that the canvas had completely flattened out in the area where it was treated as seen in figure 27. The decrease in empty space between the edges of the upper lateral tear indicates that the canvas had relaxed and flattened, resolving the buckling of the canvas along the upper lateral member of the stretcher. The backing support could now be made and applied without risking further tearing or splitting of the canvas.

Figure 27: Verso of painting after canvas flattening treatment of the upper part along the extended lateral tear as indicated by the red circle (photograph by Hannes Elsenbroek)

The backing support was made by cutting a piece of polyethylene foam into a size that fit inside the inner area surrounding the stretcher frame members to cover the entire area of the exposed canvas. The corners of the polyethylene foam were also cut to accommodate the stretcher keys. Then, the polyethylene foam was adhered to a piece of Eksa board that was the same size as the entire painting with a glue gun. The polyethylene foam was adhered to the centre of the Eska board to allow the borders of the Eska board to align with the stretcher frame members, ensuring that the polyethylene foam was secured flush to the inner verso of the painting, providing support to the loose flaps from the extensive tears. Once this process had been completed, the investigative imaging photographs could be taken, and the painting surface could be further analysed.

Ground:

- The ground appears a cream-white colour (figure 15).
- It extends to the tacking margins, which may indicate that the canvas was commercially produced and not applied by the artist himself (figure 28).

  Note the ground loss among the edges of the painting where the canvas is stretched over the secondary support (figure 28).
- The cream-white ground is visible on the picture plane in the bottom right corner (figure 29). It seems that the artist intentionally left the ground unpainted to be incorporated into the composition as a whole, acting as light reflecting off the water surface in between the reeds and other water plants.
- There is ground discolouration in an area surrounding a zig-zag-shaped tear located in the foreground of the picture plane, just below an area of significant material loss (figure 30). It seems that whatever force was responsible for the tear also caused paint loss. The open ground due to paint loss seems to have discoloured to a greenish-grey colour as seen in figure 31. This discolouration may be a result of ageing and/or surface accretions or stains.
- Overall, the ground seems to be in an adequate condition, except for said areas of loss and discolouration.

Figure 28: Cream-white ground extending to the tacking margin on the upper-left corner of the painting. Note the ground loss around the corners and the edges (photograph by Hannes Elsenbroek)

Figure 30: Ground discolouration around the zig-zag tear as indicated by the red circle (photograph by Hannes Elsenbroek)

Figure 29: Exposed ground located in the bottom-right corner of the picture plane. This exposed ground could act as a lighter tone in the picture plane to represent light reflecting off the water surface between reeds and other water plants (photograph by Hannes Elsenbroek)

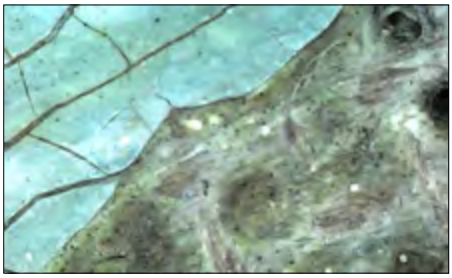


Figure 31: Ground discolouration area under 10x microscopic magnification. Note the cracked paint layer in the upper-left corner section and how the exposed ground due to paint loss in the lower right corner section has discoloured to a greenish-grey (photograph by Hannes Elsenbroek)

Figure 32: Normal visible-light photograph of painting after remedial treatment. Note the polyethylene foam backing support, visible at areas of major material loss, that secures the loose flaps caused by the tears of the canvas. The lighting equipment used to illuminate the painting for photography makes the light masses of the picture plane appear more orange in comparison to its slightly more yellow appearance to the naked eye in normal lighting conditions (photograph by Salomé Le Roux)

The subject of this painting has been painted according to realistic or naturalistic painting conventions to impart a life-like appearance and feeling to the scene. The technique draws on classical academic painting traditions whereby the paint is applied and built up in numerous successive layers. Light masses such as the clouds, sky and reflected light from built structures, plants and the water are applied with thick paint (impasto) where brushstrokes are visible as seen in figure 33. The darker tones, shadows and colour are applied by successive thin, translucent layers of paint (glazes) mixed with a medium such as linseed oil. The darker the tones or shadows and the more saturated the colours, the more layers of glaze have been applied.

Figure 33: Thick application of paint (impasto) with visible brushstrokes encircled with red (photograph by Hannes Elsenbroek)

Figure 34: A mapped-out overview of the locations of the various damage, deterioration and observational data of the painted surface. The fishtail crack is encircled in blue, sigmoid cracks are indicated by the red circles, tape adhesion residue is encircled in yellow, paint and ground loss areas are encircled in purple, paint loss areas are indicated in green, the black-line accretion is indicated by the turquoise circle, gilding residue is encircled in orange, a dark spec is indicated by the pink circle, a light-coloured spec is indicated by the white circle, a bitumen-like substance is shown by the black circle and surface accretions left by the rabbet are indicated by the red stippled line (photograph by Salomé Le Roux)

- No drying cracks or alligator cracks are present. This may be because the painter had knowledge of his technical craft from a traditional academic painting perspective, working fat over lean and waiting for paint layers to dry before applying thin glazes or more paint layers.
- A fishtail crack is present above the treeline on the central left side of the picture plane (figures 34 and 35). Fishtail cracks are mechanical cracks that resemble fish spines and are caused by a line of contact against the back of a painting or a glancing contact on the canvas caused by a hammer when keying out (CCI 2017).
- There are three sigmoid cracks—one located in the sky (figures 34 and 6), one located on the bridge (figures 34 and 37) and one located on the path connecting with the bridge (figures 34 and 38). Sigmoid cracks are also known as concentric or circular cracks and mechanical cracks caused by a knock on the back of the canvas (CCI 2017).
- There is paint and ground loss caused by abrasions (figures 34, 39 and 40) along all edges of the extensive and localised tears. There is also paint

and ground loss where the torn canvas distorted around the upper lateral secondary support member (figures 34 and 41).

- There is paint and ground loss due to flaking located at the trees close to the right vertical stretcher member (figures 32 and 42).
- The entire surface of the painting is covered with ageing cracks. This is inevitable as the painting ages. Ageing cracks are caused by a combination of mechanical forces and the response of the paint, ground and support layers to fluctuations in relative humidity (CCI 2017). Ageing cracks can also be seen surrounding the signature area (figure 43).
- A bitumen-like substance is located on the painting surface in a torn area just below the bridge (figures 34 and 44). This substance had been used as an adhesive for restorative patchwork on the back of the canvas and has transmigrated to the front of the picture plane, leaving dark stains and residues on the paint surface.

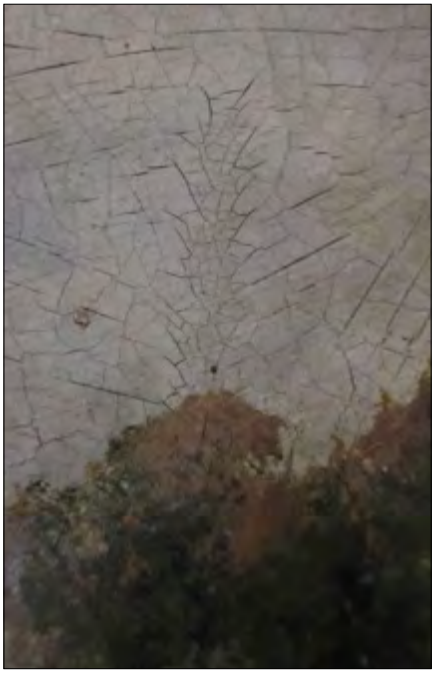


Figure 35: Fishtail crack encircled in red
(photograph by Hannes Elsenbroek)

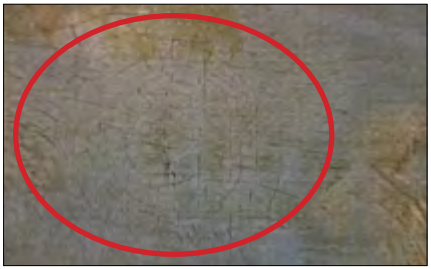


Figure 36: Sigmoid crack in the sky
(photograph by Hannes Elsenbroek)

Figure 37: Sigmoid crack on the bridge
(photograph by Hannes Elsenbroek)

Figure 38: Sigmoid crack on the path connecting with the bridge (photograph by Hannes Elsenbroek)

Figure 39: Paint and ground loss caused by an abrasion located on the left vertical edge of the painting (photograph by Hannes Elsenbroek)

Figure 40: Paint and ground loss caused by an abrasion located close to the upper-right corner of the picture plane (photograph by Hannes Elsenbroek)

Figure 41: Paint and ground loss where the torn canvas distorted around the upper lateral secondary support member (photograph by Hannes Elsenbroek)

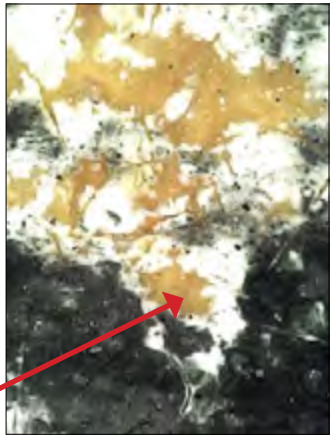
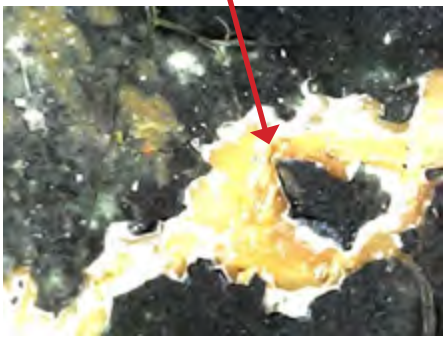


Figure 42: Paint and some ground loss encircled with red and shown under 10x microscopic magnification. Upon close inspection, it seems like the paint and ground flaked off in this area. In the area encircled in blue, it seems like there is a large area of paint loss, although it could also be an area where the artist intentionally left the ground exposed as a lighter tone to indicate reflected light from the foliage of the trees. However, under 10x microscopic magnification, ground loss becomes apparent with the exposed canvas and could rather be seen as ground and paint loss caused by abrasion (photographs by Hannes Elsenbroek)



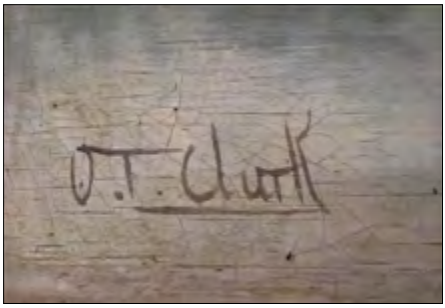


Figure 43: Signature located in the bottom left corner of the painting. Note the aging cracks surrounding the signature (photograph by Hannes Elsenbroek)

Figure 44: Bitumen-like substance from restorative patchwork. To the right is what it looks like under 10x microscopic magnification (photograph by Hannes Elsenbroek)

Varnish layer:

- The whole surface has a coat of varnish which is thinly applied. The varnish has aged to a yellow-brown seen especially in the light areas (figures 45 and 46).
- The overall varnish coat has a matte appearance, although it appears more glossy along the tacking edge (figure 47). This could indicate that the painting was previously displayed in a frame since the glossy strip is where the rabbet of the frame covered the painting surface, decreasing exposure to light and atmospheric factors that cause varnish to fade and discolour.
- The varnish layer appears to be cracked with the age cracks in the paint (figure 48).
- There is a speck (which could be a fly dropping) located in the upper left corner of the painting on top of the varnish layer (figures 34 and 49).
- There is a dirt line along the bottom tacking edge of the painting (figures 34 and 50). Another indication that the painting has been in a frame since, due to gravity, most of the airborne dust particles settle between the gap of the rabbet and the painting surface, leaving a residual dirt line on top of the varnish layer.
- There is a light-coloured speck located in the upper-left corner of the painting. To the naked eye and under microscopic magnification, it seems

like it could be a small area of varnish loss (figures 34 and 51).

- Gilding (gold leaf) residue was found along the bottom tacking edge on top of the varnish layer (figures 34 and 52). The gilding residue could be from its frame where the rabbet made contact with the paint surface. Based on this observation, the frame in which the painting was displayed might have been gilded with gold leaf.
- Tape adhesion residues are visible on the varnish layer situated across the middle vertical tear close to the area of major material loss (figures 34 and 53). This adhesion residue is from tape used as a previous treatment to stabilise the tears, preventing movement that could extend the tears.
- There is black line accretion located in the bottom-right corner along the taking edge (figures 34 and 54). Under microscopic magnification, directional line movement of the accretion is visible and appears to be smeared on the painting surface. Due to its black and tar-like appearance, it is possible that it is the same bitumen-like substance used in the restorative patchwork that can be seen in figure 44.

Figure 45: Varnish discolouration to yellow-brown due to age. Seen especially in the light areas of the painting such as in the foreground light reflected off the water (photograph by Hannes Elsenbroek)

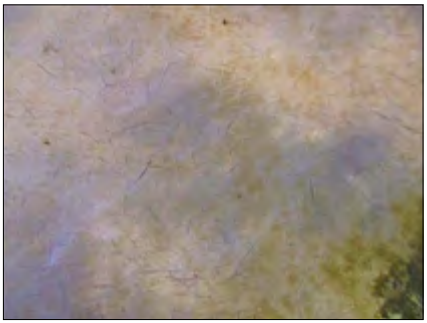


Figure 46: Varnish discolouration to yellow-brown due to age. Seen especially in the light areas of the painting such as in the background sky and clouds (photograph by Hannes Elsenbroek)

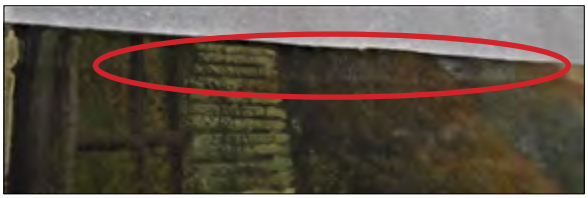


Figure 47: Gloss surface appearance of varnish along the tacking edge of the painting (photograph by Hannes Elsenbroek)

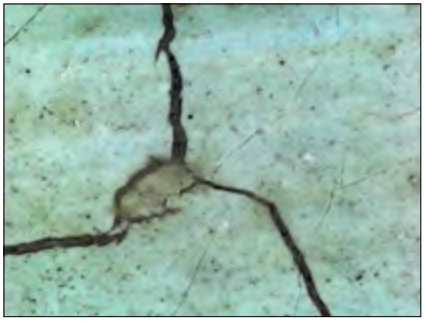
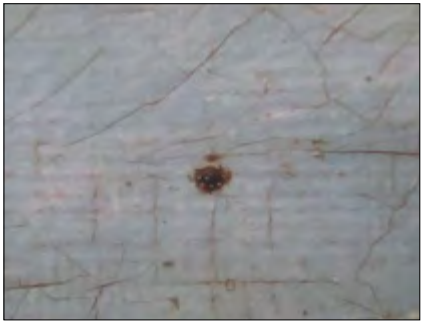


Figure 48: Age cracks surrounding signature under 10x microscopic magnification. It seems that the varnish layer has cracked with the age cracks of the paint layer (photograph by Hannes Elsenbroek)



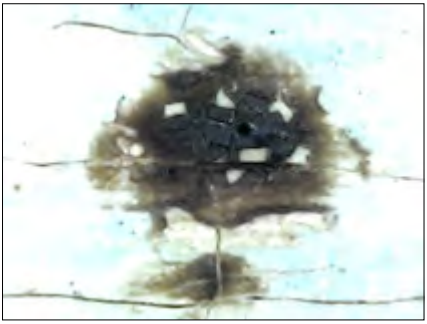


Figure 49: Dark speck (possibly a fly dropping) on the varnish layer. To the right is what it looks like under 10x microscopic magnification (photographs by Hannes Elsenbroek)

Figure 50: Dirt line along the bottom tacking edge of the painting (photograph by Hannes Elsenbroek)

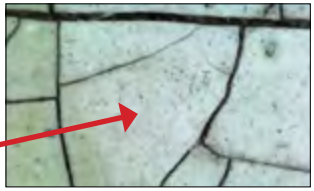
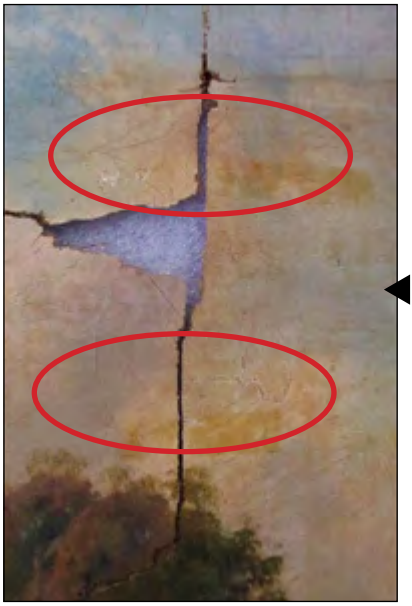


Figure 51: White speck that could be an indication of varnish loss as seen under 10x microscopic magnification to the left. Note the transition from the yellow-brown surface appearance to the lighter white surface on the microscopically magnified image (photographs by Hannes Elsenbroek)

Figure 52: Gilding (gold leaf) residue, possibly from frame. To the right is what it looks like under 10x microscopic magnification (photographs by Hannes Elsenbroek)



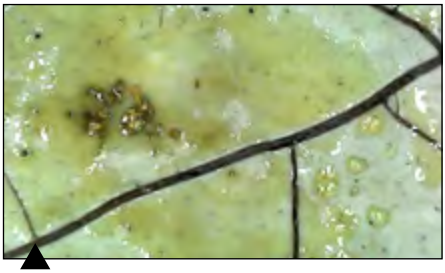


Figure 53: Tape adhesion residue across vertical tear. Appearance under 10x microscopic magnification (to the right). Under microscopic magnification, some foreign organic material can be seen stuck in the adhesion residue (photographs by Hannes Elsenbroek)

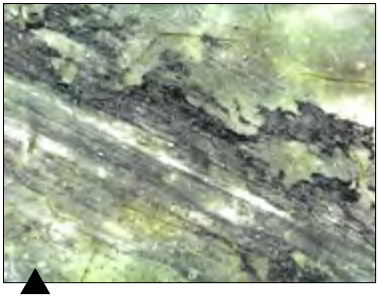


Figure 54: Black line accretion located in the bottom-right corner along the tacking edge. Under 10x microscopic magnification (to the right) (photographs by Hannes Elsenbroek)

Investigative imaging photography

This section involves the examination of the painting under different lighting conditions to reveal more information about it. The normal visible-light photograph, as seen in figure 32, is a record of the reflected light in the visible light spectrum (400–700 nm) from the painting illuminated by visible light. This photograph is very important since it reveals the painting with all its defects visible to the human eye and acts as the point of reference when investigating the painting in different light regions (Dyer, Verri and Cupitt 2013: 3).

An infrared-reflected image, such as figure 55, captures the reflected light spectrum in the infrared region (700–1 100 nm) from the painting when it is illuminated with infrared radiation. Infrared-reflected images may reveal features of a painting hidden from the naked eye such as underdrawings or other concealed features, since infrared radiation is often very penetrative, and numerous materials, such as organic binders and pigments, are usually transparent to it (Dyer, Verri and Cupitt 2013: 4).

Figure 55: Infrared-reflected imaging photograph of the painting under investigation (photograph by Salomé Le Roux)

By studying the infrared-reflected image (figure 55) and comparing it to the normal visible light image (figure 32), it is observed that there are no apparent differences between the two and no underdrawings or concealed features can be found. This means that no preliminary sketch work with carbon medium is present in the painting; however, this does not mean that the artist did not start the painting with an underdrawing or any form of guide sketch since the composition is so complex. Preliminary sketch work could have been done with thinned-out paint, which would have merged with the subsequent paint layers and therefore be undetectable by infrared-reflected photography.

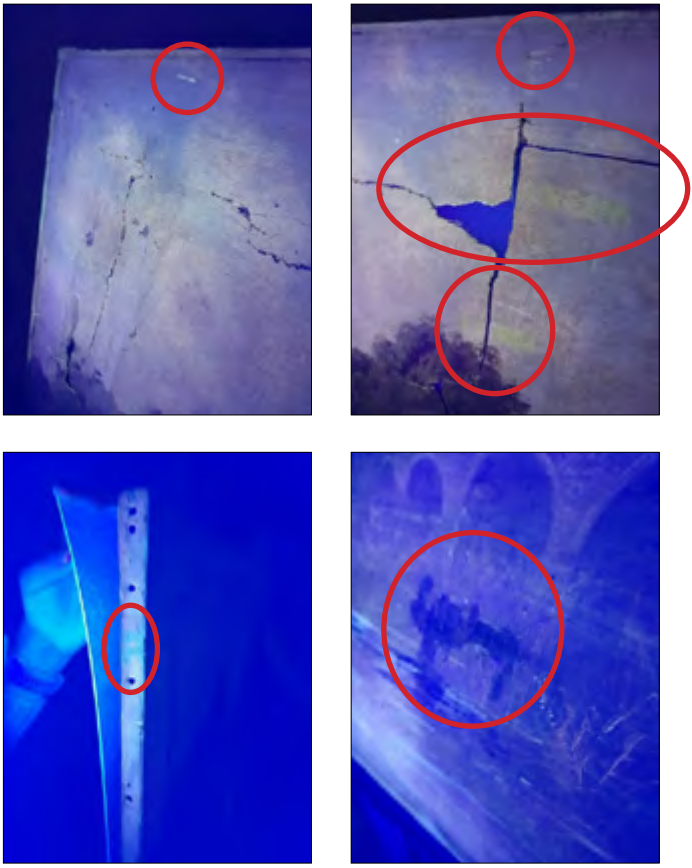


Figure 56: UV-induced luminescence on various parts of the painting (photograph by Hannes Elsenbroek)

Ultraviolet-induced luminescence is another investigative imaging technique used on the painting. Ultraviolet-induced luminescence records the emission of light in the visible light region of the painting when it is illuminated with ultraviolet (UV) radiation (200–400 nm). UV-induced luminescence images reveal the distribution of luminescent material, such as organic binders and pigments, but could also reveal inorganic material on the painting surface. UV examination may also provide information relating to the type of varnish layer and how it was applied to the painting, as well as revealing temporal and methodical information about previous restorations (Dyer, Verri and Cupitt 2013: 5).

As seen in figure 56, UV-induced luminescence revealed some more information about the painting that was difficult to detect with the naked eye. In figure 56 A, the accretion left by the rabbet along the tacking edge becomes more apparent, and another area of paint loss is revealed that had gone unnoticed in normal visible-light conditions. The exposed ground layer luminesces a bright white. This can also be seen in figure 56 B, where more paint loss can be seen above the tear. The tape adhesion residue fluoresces yellow. In figure 56 C, an oil stain can be identified on the side tacking margin as it fluoresces a bright blue. Figure 56 D exposes the full extent of the bitumen-like substance from the restorative patchwork on the painted surface as it fluoresces a mass of bluish-black. The UV examination did not pick up signs of varnish blanching or blooming.

Raking light is another technique that can be employed to reveal more information about the painting. Raking-light examination is one of the simpler forms of imaging; it involves shining an intense light directly across the painting surface, pronouncing irregularities found on the surface. Features relating to the surface topography of a painting such as brush strokes, damage, raised paint and planar deformations become clearer as a result of the shadows they cast across the painting surface. Raking-light examination is often used to examine and document the surface condition of a painting before, during and after conservation treatment (ICOM-CC sa.)

Figure 57: Raking-light photograph of the painting (photograph by Salomé Le Roux)

As seen in figure 57, the application of raking light to the painting under examination reveals the surface topography of the painting in much clearer detail. Tears and folds are more pronounced as are the scattering locations of holes and material loss. Planar distortions such as dents, bulges and distortion curves also become more noticeable.

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Chapter eight

Conclusion

Maggi Loubser and Salomé le Roux

The master's programme in Tangible Heritage Conservation was born from necessity, but also from passion. Isabelle McGinn said that

> Prior to the start of the development grant in 2016, I had been appointed as the University of Pretoria's first in-house museum conservator. Although I had some colleagues who were quite knowledgeable about collections care and the importance of both preventive and remedial conservation, I generally worked in isolation. There are so few practitioners in South Africa and no professional body or networking possibilities for conservator-restorers, and I found this to be enormously challenging as a novice restorer entering the field, particularly when faced with complex treatment options there is limited opportunity for consultation and thinking through problem-solving. It was this sense of isolation and curiosity to know if there were others 'out there' who had the same questions and faced similar challenges.

The reality was that South African heritage resources were neglected, underfunded, mismanaged and unpreserved. The lack of a conservation community and general awareness of conservation led to conservation being put on the back burner in many local and southern African repositories of cultural heritage. Even though the programme began from necessity, it also became the culmination of many individuals' passions and dreams. McGinn inherited the development of the programme in 2016 and made it her goal to bring to fruition a degree that not only taught conservation but also ethical and philosophical aspects of caring for cultural heritage.

McGinn further stated that

> The negotiations with various stakeholders came at a time when South Africa was experiencing an extensive and disruptive period of student protests, and although these were focused on the issue of fees and access to higher education, the protests also focussed on calls for decolonisation and curriculum transformation. Both 'decolonisation' and 'transformation' are particularly relevant to heritage, but specifically, when it comes to heritage preservation, as what is preserved is what is seen to be valued. Who selects what is significant and according to whose criteria allows some voices and narratives to dominate whilst others are silenced. The calls for decolonisation and transformation bolstered further calls for decolonisation and repatriation of cultural material to their originator communities.

Tangible Heritage Conservation is one starting point for ensuring the repatriation of cultural heritage to its people of origin. With the creation of centres of excellence across southern Africa by graduates of the programme, conservators of cultural heritage will understand conservation approaches in both a global and local context. Repatriation has been a consistent theme throughout international museology discussions, and with that came the counter-argument that Africa does not have the resources to care for its own heritage. THC stakeholders beg to differ, but we do know there is a dearth of trained conservation professionals, as in Africa, most people working in conservation enter the profession through various different pathways, often without the broader insight that an academic programme offers. Our initial reach is limited, and UP's THC programme will take many years to even start addressing this gap, but initiating the centres of excellence is a major vision of the programme. These centres can, under THC's guidance, provide training on the different levels necessary to accelerate the development of conservation as a profession across the continent. The programme already has graduates from Namibia and Lesotho who are employed in the museum industry and a Zimbabwean PhD student (whom Loubser is co-supervising), who is a lecturer in museum studies at Midlands University. Another Namibian student, who started her degree in 2022, spent two weeks at the Ethnologisches Museum in Berlin at the beginning of March 2022 as part of a capacity-building workshop on the conservation and preparation of artefacts that were repatriated

to Namibia. She will facilitate a workshop on preventive conservation with a group of museum employees from regional museums in Namibia on her return. This is the kind of model we would like to develop.

Closely related is the employability of the graduates in a challenging economic climate where the heritage sector is very low on national priority lists. Of the first three graduates, one is employed with us as a part-time lecturer (and editor of this book), one is employed with the Museum of Applied Arts and Sciences in Sydney, Australia, and one is furthering her studies with a PhD. Of the second set of graduates, one is about to start a career at Brenthurst Library, one is appointed at UCT to be part of the conservation team (after THC's involvement in the salvaging operation as described in the annual reports), the Lesotho graduate is still employed by the Department of Culture in Lesotho, and the Namibian graduate is employed by Windhoek City Museum.

This publication has brought together multiple voices to reflect on certain aspects of the first three years of the programme. In Chapter Two, the story of the first three years was told from the perspective of Maggi Loubser, course coordinator and senior lecturer. She discussed the students, their progress, and their strengths. Loubser also reflected on the challenges and successes of each year—2019 to 2021. It is evident from Chapter Two that she is strongly invested in the future of the programme and that she has continuously fought for the survival of THC during and towards the end of the period of the Andrew W Mellon grant. From Loubser's three annual reports, it is evident that the programme has grown from strength to strength and that each graduate from the programme has a bright future while always having a home at THC.

Chapter Three gave a glimpse into the marvellous first-year coursework of the THC programme. Although it represents the perspectives of two students who had to survive the rigorous first year during a global pandemic, the chapter reveals their enjoyment of the programme. The first year's five modules—THC 801, THC 802, THC 803, THC 804 and a speciality module—keep the students very busy, but each individual grows in their knowledge and perseverance. Chapter Four provides the description and layout of each of these modules, as well as the internship and the mini-dissertation. The chapter looks at each module's purpose, outcomes, content and articulation with other modules. It ends with an example of a first-year assessment breakdown.

Chapter Five describes the innovative solution devised for one of the modules, THC 804, to keep students on track during level 5 COVID-19 lockdown

in South Africa. Loubser and McGinn carefully put discovery kits together to prevent students from becoming stagnant and enable them to continue their hybrid learning. These kits were a massive success and were distributed again in 2021 and 2022. Chapter Six explores the fruits of year two. Each graduate's thesis title and abstract is included, along with the class of 2022's proposed dissertation titles. From these sections, it is easy to discern the variety of outputs the THC students have investigated and achieved. The future of THC graduates is rooted in their research skills developed during their numerous assignments, tasks, quizzes and reports written during the first year—as seen in some of the examples included in Chapter Seven. The assignments chosen for this book show the diversity of thought encouraged in THC. Because THC is the first course of its kind in southern Africa, the conservation community needs creative thinking and problem-solving to address issues and situations that are unique to our continent.

In three years, the programme has ingrained itself successfully in the local and international conservation community, firstly through community involvement projects as described in the annual reports, but also through contributions to international conferences, including hosting the Global Consortium for the Preservation of Cultural Heritage. Participation in international forums included Maggi Loubser's role as an international advisory member of the Netherlands Institute for Art Conservation and Science Mellon project and active membership of the Academic Conservation Education Sharing Site (AcCESS) and Conservation Science Education Online (CSEO), where she was one of the invited speakers at their inaugural conference. The Yale IPCH collaboration is continuing, and a formal Memorandum of Understanding is currently in place for the next five years. A similar local MOU exists with Javett-UP, another is currently being drawn up with Iziko Museums, and a third is being renewed with Ditsong Museums.

At this point in time, the programme is only a drop in the bucket of cultural heritage conservation in Africa, but the aim remains to change the context of African conservation.