

Ulrich Schiessel PhD Colloquium

UNIVERSITAT POLITÈCNICA DE VALENCIA

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Book of Abstracts



ENCoRE's PhD Colloquiums have been held since 2008 and were first known as *The Oranienbaum Colloquium*. After the sudden and unexpected death of Prof. Ulrich Schiessl (one of ENCoRE's founding members) in summer 2011, the Board of ENCoRE decided to rename the colloquium -in honour of its initiator-, to *Ulrich Schiessl PhD Colloquium*.

The aim of the colloquium is to give postgraduate research conservation students the opportunity to present and discuss their current research with their peers and programme faculty, and to benefit from such an exchange. It will allow sharing of ideas and information amongst PhD candidates and programme faculties in an informal environment. The colloquium seeks to create a European forum for debate and exchange of ideas in research with relevance to the conservation/restoration of cultural heritage. Furthermore, it provides a venue for PhD students to meet, interact and form future collaborations with their peers. The colloquium is open only to current PhD candidates of all specializations in conservation, their supervisors and other academic staff involved in research training in the European conservation programmes of member institutions.

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Thangkas: State of the Art, Current Research Progress and Expected Outcomes in the Study of the Constituent Materials in Ancient and Contemporary Artefacts

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Abstract : The research aims to deepen the knowledge of Eastern paintings on canvas, especially the class of silk paintings and *thangka*.

The variety of Asian artefacts is comparable to the vastness of the continent and the diversity of its peoples and cultures. This diversity is reflected in museum collections throughout.

The research focuses on thangkas from the Himalayan regions - corresponding to the current borders of Nepal, Tibet, and northern India - and their correlation with other easel paintings from the Asian continent.

The word *thangka* (or *sku-thang*) literally means 'rolled up painting'. They are closely associated with the religious sphere and worship, used for meditation and the teaching of Buddhist doctrine [1].

Thangkas are complex artefacts, as they consist of a painting on canvas and a textile mounting. The sacred image is displayed vertically and stored rolled up when not in use, just like the painted scrolls produced in China and Japan. Other Asian scroll paintings share the same complex nature, usually combining silk and paper with a textile mount [2].

Thangkas differ primarily in the support used, which is usually cotton in silk mount, while paper and silk are the most common combination in China and Japan [3].

The techniques and materials used have been passed down through the centuries from masters to painters, but little is known beyond the oral tradition and the literary sources describing the artistic process.

The research aims to contribute new knowledge about these artefacts by comparing literary sources with several case studies with the following goals: provide additional knowledge about their constituent materials and their degradation; elucidate the introduction of new, synthetic materials;

highlight regional characteristics in materials and styles (if any); gather information for the interpretation of exchanges in skills and materials (e. g. Silk Road trade routes).

The goals will be achieved through the analysis of the constituent materials (textile supports, painting layers) with instrumental non-invasive techniques such as multi/hyperspectral imaging, XRF, Raman, FORS, and FT-IR spectroscopy. Given the fragile nature of the artefacts, the analyses will be mostly carried out in situ, using portable instruments wherever possible.

The analytical protocol, inspired by previous experiences on similar artefacts from other cultural contexts, will be preliminarily tested on mock-ups, prepared to cover the full range of possible combinations: from single materials (e. g. pigment, dye, binder, fabric) to the complete stratigraphy. Given the complexity of the artefacts, it will be essential to assess limits and possibilities for each of the instrumental technique employed in the research, therefore concentration of the materials to be detected, and their state of preservation, will be considered in the preparation of the mock-ups. Results from the instrumental survey on mock-ups will be used as a reference to study the artefacts from the collection of the Museo d'Arte Orientale in Torino (Italy).

Finally, all the information collected will be made available organized in an open-source database.

References

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Conservation Studies on the Imperial Crown, Embedded in an Interdisciplinary Research Project

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Abstract : As part of Europe's cultural heritage and a symbol of the nearly thousand-year history of the Holy Roman Empire, the Imperial Crown is one of the most important preserved objects of medieval art. It is therefore not surprising that the crown has been the focus of numerous scientific studies over the past centuries, resulting in a mostly contradictory and unconvincing state of research with many open questions. However, a systematic approach using modern optical and analytical methods has not been pursued. The present thesis is part of an interdisciplinary research project at the Kunsthistorisches Museum Vienna. Its aim is to gain new insights into the materiality, technology, and state of preservation of the Imperial Crown in Vienna, as well as its eventful history.

The thesis addresses questions relating to the study of materials by combining optical methods with scientific analysis, and contextualises these results with the current state of scientific research on topics such as medieval traditions in processing and trade routes, the provenance of raw materials or the degree of alterations. The data obtained is compiled and evaluated by a team of conservators, natural scientists, and art historians from the museum, along with external experts. The discussion will offer new perspectives on the technological environment in which the Imperial Crown was created, as well as possible approaches to dating and localisation.

The crown, in its preserved state, comprises various materials including gold, precious stones, pearls, enamel, niello, and organic adherence. The four enamel plates, which were manufactured in cloisonné technique, are in the centre of the investigations due to the complex composition of enamel and its susceptibility to deterioration. The analytical methods are selected based on various factors, such as questions that can be derived from the object itself, the possibilities offered by state-of-the-art analytical techniques, and any restrictions imposed by the object. For instance, all investigations must be non-destructive and feasible in situ.

To ensure a comprehensive study of the Imperial Crown, it has – virtually – been broken down into approximately 1700 individual components, including structural and decorative gold elements, gemstones, and enamel colours. Each component is identifiable through a logical labelling system. A detailed documentation of all components was carried out using a modern 3D microscope.

Observations regarding their appearance, specific features, or damages were recorded in a customised database, creating a basis for all subsequent investigations. A combination of various scientific analyses should provide further characterization of the materials, such as information about the chemical composition. The methodological concept is primarily based on studies using micro-X-ray fluorescence (μ XRF) and Raman spectroscopy. Comparative measurements were conducted on selected mediaeval enamel objects that may be connected to the Imperial Crown, following the same research concept.

In addition to enhancing our understanding of the Imperial Crown itself, this inter methodological approach aims to provide a basis for decisions regarding (preventive) conservation measures and future scientific research.

Navigating Peaks and Valleys: Advancements in Doctoral Research on Polychrome Conservation on Metal Support

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Abstract : *As the man said, for every complex problem there's a simple solution, and it's wrong.*
Umberto Eco, *Foucault's Pendulum*

The *Ulrich Schiessl PhD Colloquium* aims to provide postgraduate conservation research students with a platform to present and discuss the progress of their current doctoral research with peers and faculty members. These objectives render the PhD Colloquium a uniquely invaluable forum for academic exchange, facilitating young scholars in the field of art conservation to share both their triumphs and challenges encountered in their dissertation topics.

During the presentation, the author will propose a comprehensive exploration of the research and conservation issues related to polychrome on metal supports. The topic will be elucidated through an examination of the diversity of such objects and a comparison of specific examples. Initially, the results of basic instrumental studies demonstrating the nature and manner of corrosion product development and distribution will be presented, focusing on copper and steel supports. The author also suggests delving into the examination and conservation of an altarpiece painting on zinc support, during which a 19th-century icon was discovered. Subsequently, a discussion will ensue regarding a small painting used for private devotion, executed on galvanized steel, which, due to its characteristics and condition, required the application of entirely different types of conservation materials. Using these two objects as examples, the topic of putties as ground losses fillers and the use of gel in the corrosion product removal process will be addressed.

The materials and methods employed in the conservation of polychrome artworks on metal supports straddle the boundary between those used for easel painting conservation and metal objects. Due to the specific nature of these objects - on one hand, the supports' susceptibility to water, and on the other hand, the paint layer's sensitivity to various abrasive materials and chemicals commonly used

in metal conservation - there is a need to develop new formulations and methodologies. The author will thus present research results on conservation materials generally recommended for heritage conservation, possessing good mechanical properties and resistance to aging tests, demonstrating that their combination is not always a viable solution. Finally, progress in the use of chelating chemical compounds and physical methods, such as laser beams, for removing corrosion products from the surfaces of paintings on metal will be presented.

It is evident that in the case of artworks on metal supports, there are no universal recipes or simple answers. For another example, entirely different conservation approaches applied in the conservation of Chinese cloisonné enamel will be showcased.

In conclusion, this presentation will provide an in-depth explanation of the methodologies employed, inviting insights and perspectives from diverse conservation centres. The author eagerly anticipates engaging discussions on potential refinements and alternative approaches, fostering collaborative learning and advancement within the field of art conservation.

“Neonfever” History, Working Techniques and Examination Possibilities of Construction-Bound Technical Systems with Gas Discharge Lamps in GDR Architecture

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Abstract: Especially from the second half of the 1950s, numerous letterings and ornaments with gas discharge tubes – colloquially called “Neon-tubes” – were installed on architectural surfaces all over the territory of the former GDR and colourfully illuminated as well as shaped the appearance of the urban space. With materials typical of their time and with the highest level of craftsmanship, they were often individually coordinated to their architectural context in form and content and built an aesthetical unit with it. The façade of the former “Tanzcafé Milchbar” in Wurzen (Saxonia) for example shows a well thought out design concept not only with regard to the colour-matching individual elements but also regarding their surface qualities, allowing the former artificial light to be reflected by the shiny glaze of the ceramic tiles (fig. 1).

Since the post-reunification era, technical advances inter alia caused the gas filled tubes to be replaced by more efficient lightning techniques and subsequently gradually to disappear. The very few preserved examples are strongly endangered by the current invasive handling, which in most cases implies a complete replacement of the historical substance in favor of functionality and could be described best by the term “technical reparation”. This contradiction between the common practice and the goals and methods of modern scientific conservation-restoration gave rise to the topic of the doctoral thesis.

In order to pave the way for the development of more substance-careful conservation strategies in the future, the project firstly is aimed at a valuation of this special kind of architectural decoration. Regarding this, the development and usage history of gas discharge tubes as well as the historical working techniques are investigated. This includes also a documentation of the typically used materials, the various fabrication processes as well as the different protagonists, like glassblowers, locksmiths, artists, electricians, etc (fig. 2).

The information is gained from historical literature as well as from the conduction of interviews with contemporary witnesses. Secondly, the research focusses on the elaboration of a systematic conservation-restoration examination strategy for this group of objects. This should be as non-invasive as possible and therefore feasible *in situ*.



fig. 1: Tanzcafé Milchbar“ Wurzen (Saxonia), source: AutorInnenkollektiv: Plaste und Elaste, Leuchtreklame in der DDR, Berlin 2010, p. 92-93.



fig. 2: “Neon“-glassblower at work, source: S. Gschlecht 2019.

Within the project, two practical examples are used to evaluate whether the established examination methodology in the field of wall painting and architectural coloration can be transferred in principle to the construction-bound technical systems. The results of the practical examination, thirdly, build the foundation for the formulation of overarching conservational objectives. For this purpose, a guideline for theoreticians and practitioners in monument conservation will be compiled. Furthermore, located at the interface between arts, natural and engineering sciences, the doctoral thesis hopefully opens an interdisciplinary discussion as well as new research approaches concerning, more generally, the future handling of construction-bound technical heritage and the immaterial medium “Light” as an important, yet currently little noticed, historical architectural design medium.

Retouching Colors for Mural Paintings in Hypogea: Finding New Solutions in Highly Favourable Microorganisms Environments

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Abstract : Retouching ancient wall paintings within hypogea environments poses one of the unresolved challenges in the field of cultural heritage conservation. The unique environmental conditions in these sites create a delicate balance of temperature, humidity and biological factors, often interfered by external influences. In addition, high relative humidity values significantly restrict the range of intervention materials that can be used, excluding hygroscopic and bio-receptive ones. These conditions outline a highly complex scenario that, translated into operational reality and intervention practices, often leads to the intentional avoidance of retouching or to its inappropriate execution.

The aim of this project is therefore to contribute to the resolution of this issue through a multidisciplinary approach that involves identifying at least one eco-compatible products for the retouching in hypogea environments. These products will undergo a preliminary laboratory testing and then will be applied in situ to verify their durability and effectiveness over time. This research is built upon the conclusions and research perspectives emerged from a recent thesis study (Giandomenico et al., 2021). This experimental study highlighted the potential of two synthetic resins (Regalrez 1094 and Laropal A81) as painting mediums in conditions of high relative humidity, since they did not significantly alter the water transfer between the environment and the painted plasters. However, both resins demonstrated to be slightly bioreceptive (Giandomenico et al., 2023) in such environmental conditions.

The objective of this study will be to test the effects of adding growth inhibitors to these resins, addressing their chemical compatibility with the binding media over time through artificial ageing, as well as with ancient materials, also focusing on the health issues for environment and operators.

Following a state of art review in this field, attention will be focused on two lines of research:

- 1) use of mesoporous nanosilica as carriers for broad-spectrum biocides to be added to resins, in order to ensure their longer release and antimicrobial effectiveness over time;

- 2) addition of nanoparticles of metals or metallic compounds (Ag, ZnO, ZnCO₃ and Zn stearate) to retouching binding media, which possess inhibitory properties for microbiological growth.

The research will begin by finding the minimum concentrations of inhibiting product to be added to the resins, aiming to ensure simultaneously good aesthetic performance, color applicability and biological inhibition. To evaluate the latter point, microorganisms isolated from selected hypogea (Roman Villa in Positano (SA, Italy), crypt of Ss. Pietro e Paolo in Matera (Italy) and crypt of Santa Maria del Piano in Ausonia (FR, Italy)) will be used as test organisms. Those hypogea will also be the locations for in-situ applications of testing and monitoring of effects of selected products.

In conclusion, this project aims to address the complexities of mural painting reintegration techniques in hypogea environments, exploring innovative solutions, combining scientific research with practical application, in order to enhance the preservation of cultural heritage assets.

Effect of Deep-Freezing on Sustainable Graffiti Removal from Non-Porous Substrates

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Abstract : Graffiti has become a major problem in urban areas, affecting public spaces and cultural sites. Traditional graffiti removal methods often involve the use of aggressive chemicals or abrasive techniques that can damage the surfaces of historic structures. In response to this challenge, alternative approaches such as CO₂ blasting have been investigated.

Dry ice blasting and snow blasting are innovative methods that cause thermal shock to the substrate. These techniques use compressed air and carbon dioxide to rapidly freeze the graffiti, rendering it brittle and altering its bond to the underlying material. CO₂ cryogenics is characterised by its ability to remove graffiti and other materials such as grease, soot, cement or rust from a variety of surfaces including brick, stone, metal and wood, making it particularly suitable for investigation as a method of cleaning cultural heritage. Unlike traditional methods, which may require the use of highly toxic solvents or mechanical abrasion, cryogenics can provide a non-invasive and environmentally friendly solution for removing unwanted materials. However, the research has led us to propose improvements to the sustainability of the method by proposing the replacement of CO₂. In this way, we aim to induce the cryogenic shock with ambient air for its application as a cryogenic jet.

The experimental study has been carried out in collaboration with researchers from CMT - Clean Mobility & Thermofluids of the Polytechnic University of Valencia, through the adaptation of a device designed to carry out refrigeration cycles at temperatures below -150°C. This technology has been adapted and transferred to the medical (vaccine preservation), automotive (ultra-fast battery charging) and agri-food (food preservation) industries. Experimental tests were carried out on 13 different aerosols, controlling temperature (<-80°C), pressure (up to 3 bar), projection distance (0.5 cm) and exposure times (30"/1'2'/4'/6'/8'/++). The results have shown that ambient air ultra-freezing is a suitable graffiti removal technique, with promising results on non-porous surfaces. It represents a safe, efficient and environmentally friendly solution that can be applied to other types of surfaces and substrates. Advances in this research will allow us to understand the capabilities and limitations of the technique and optimise its application in scenarios beyond laboratory conditions.

Masks In Theatre Collections: Approaches to Sustainable Management and Conservation in The National Theatre of Greece

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Abstract : A special topic for the conservation of cultural heritage objects includes collections of theatrical wardrobes with historical and artistic values. Although the values of costumes, clothing accessories, masks and sceneries are already recognized as a significant part of our cultural heritage, storage and practices applied for recording, documentation, evaluation, and conservation of collections need improvement and changes in order to match the concept of sustainability.

The National Theatre of Greece was established in 1932 and until today has had a pivotal role in shaping the characteristics of the Greek theatre. During the last decade of the 20th century, the Historical Wardrobe was organised containing objects (costumes, accessories, and masks) from important actors, costume designers, etc. More recently a digital archive, containing the performance programs, newspaper clippings, photographic material, audio documents (since 1950), video recordings (since 1994) and musical scores, has been developed as a means of preservation for future generations. Additionally, in collaboration with the Ministry of Culture, a large number of costumes and ten masks from the Historical Wardrobe have been recorded and declared as monuments of contemporary culture. In the context of the collection's management sustainability, and within the aims of the ongoing doctoral research dealing with the conservation and preservation of the mask collection (whether declared as monuments or not) of the National Theatre of Greece, either in their material form or as entries in the digital archive and other sources, the following actions were gradually implemented:

- a) fifty, from over one hundred masks, were gathered, recorded, photographed and stored in a separate space within the storeroom, where environmental conditions have been recorded and are considered appropriate for this task,
- b) the masks are grouped according to the period of construction and the scenographer or the costume designer and an attempt is made to find common and different materials and techniques,
- c) interviews from contemporary masks manufacturers were taken, and

- d) the construction materials of six selected masks were non-invasively studied in situ with a portable FTIR, to assess the integrity of the objects and this ensure the minimum amount of material stress during transport to the laboratory. This technique was chosen as the most appropriate method to provide data about the natural or synthetic materials (mostly organic) used for the mask construction and restoration, such as fabrics, leather, plastics dyes, pigments and adhesives.

The aim of this work is the dissemination of the results obtained so far in the field of theatrical conservation from the National Theatre of Greece to the wider scientific community. Moreover, we want to communicate the actions already submitted or implemented about the sustainability strategies of the National Theatre of Greece Historical Wardrobe masks collection, namely masks management, creation of catalogues, digitalization, modelling of the masks, advocacy and provision of metadata, as well as to support the conservation and management of tangible and intangible values of modern cultural artefacts for future generations.

Transportation of Modern Art Objects. Example of Władysław Hasior's Assemblages

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Abstract : In conservation of traditional art, the already developed methodology enables rather safe functioning within the framework of professional rules of conduct, whereas modern art poses to a conservator entirely new challenges, especially within the orbit of used materials. Works of every modern artist and their "own technique" requires profound research and every seemingly simple step may turn out to cause a vast amount of problems.

Characteristic issues associated with conservation of modern art are perfectly visible in pieces of Władysław Hasior, the classic of Polish artistic avant-garde of the second half of the 20th century. The PhD candidate's project focuses on the conservation issues concerning thirteen of his assemblages. The collection, belonging to the National Museum of Poznań, serves as a very good representation of his artistic achievements – it contains works created over the course of two decades for several cycles, constructed from a wide variety of ready-made objects from everyday life, such as: plastic toys, different fabrics, wood, electric installations, glass pieces, paper cut-outs, metal machinery pieces, etc., most of them originally connected only with glue, nails, or wires. In that it constitutes an excellent starting point to formulate research and conservation proposals not only for this particular artist's legacy but for modern art in general.

It is common knowledge that most damages of pieces of art are a result of improper transportation and storage. Of course, with pieces such as Władysław Hasior's assemblages, the danger is only greater than normal. The reason being their unstable and complicated construction (often causing the artwork to damage itself as time passes) as well as difficulty with recognizing their original state from an actual damage (and its cause). Due to these nonstandard issues and lack of well-known and practiced methodology further destruction of the object is more than possible and a lot of damage can be caused by simple unintended ignorance. Thus, the careful construction recognition and preparation of individualized chests for each assemblages is an essential step a conservator needs to take while dealing with such artworks.

The proper packages of the thirteen assemblages were planned based on the preliminary examination of the objects, containing their construction drawings and 3D scanning. It didn't prevent the inevitable changes that had to be made when the theory faced reality. The whole transportation process turned out to last over two weeks of packing, constructing, and constant plan changing. And even after the safe transportation of the objects to the Centre for Research and Conservation of Cultural Heritage in

Toruń some new conclusions have been drawn. Based on them, the chests were again alternated, considering also the changes of the objects during conservation (arisen from historical analysis of the original shape of each object and practical alternations saving the artwork from further self-damaging).

The presentation aims to contribute the PhD candidate's experience with transportation of modern artworks to the international discussion on protection of 20th century heritage.

The project is conducted in cooperation with: University of Pardubice, Faculty of Restoration, Czech Republic

Painted Granite: Uncovering the Medieval Polychromy of Danish Baptismal Fonts

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Abstract: More than 2000 Danish stone churches trace their origins back to the 11th and 12th centuries, and the majority still preserve their stone baptismal font. The fonts, however, do not stand completely unaltered – they have lost their original surface paint. While the painting of stone was practised from the mediaeval period until the 19th century, an edict of 1861 declared that all stone fonts should be cleaned of paint layers. An estimated 90% of all paint layers were removed, erasing both the polychromy and the knowledge of the craftsmanship.

In recent years, extensive research on the polychromy of mediaeval stone sculpture has been conducted in Europe, but there is a significant lack of knowledge in Denmark concerning both materials and iconography.

What little has been documented, predominantly concerns granite baptismal fonts. Their colours were recorded as early as 1941 but dismissed as an anomaly. Since the 1970's, scholars have put forward the hypothesis of an extensive polychromy applied to enhance carved elements and decorate flat surfaces with figures and ornaments. Nonetheless, no systematic research has so far been carried out.

The project addresses the research gap by examining paint fragments on baptismal fonts. It is assumed that the painting materials and techniques used on the baptismal fonts correspond with those employed in other types of mediaeval art in Denmark and Europe, but local characteristics can be observed due to the predominant use of granite stone in Denmark. Furthermore, the polychromy of the fonts corresponds to that of other painted objects in the church interior; this coherence is found in the original mediaeval layers, as well as in later repaintings.

The methodology includes a literature review and an archival study. Based on archival records – documenting examinations and restorations from 1800 to the present day – a group of potentially relevant fonts is selected for further study. With the aid of non-invasive examinations, a smaller group of fonts is selected for in-depth visual examination, photographic documentation, and material analyses. For the identification of pigments and binding media, microscopy, FTIR, XRF, SEM and GC-MS are employed.

So far, a survey of archival material suggests that 391 baptismal fonts contain remains of paint. More than 80% of these fonts have sporadic paint traces. Of the remaining fonts, 16 retain a fully repainted surface.

Finally, approximately 44 of the fonts have preserved substantial traces. Previous examinations of two fonts have revealed traces of a preparatory layer and a range of common pigments, but no binding media in the mediaeval layers. Analyses of two fully painted fonts have uncovered several layers of repainting; the newest layers have been dated to the 18th century and consist of stone or marble imitations in tune with the other interior decorations.

The research will lead to new knowledge on mediaeval polychromy on stone – thus contributing to a further understanding of mediaeval Denmark in a national and European context – and at the same time aid in the preservation and awareness of the fragmented remains of a forgotten cultural heritage.

Comparative Study of Determination and Effects of Atmospheric Pollutants in the Attica Region in Archaeological Monuments

Case Studies of the Archaeological Sites of Kerameikos, Olympeion and Elefsina

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Abstract: Atmospheric pollution is an important factor in the deterioration of Monuments. It has been found that monuments and works of art that had remained away from the industrial and urban environment of a city are in much better condition than those that are in the polluted atmosphere of an urban one.

Corrosion from environmental factors is of secondary importance in comparison to corrosion due to extreme climatic conditions and high levels of air pollution, while in hot and humid climates with low levels of air pollution, it remains the dominant cause. Especially today, it is evident that human activities have destabilized the climatic conditions of the planet, while the results of this situation have a direct impact on the current conservation status of most Monuments.

The archaeological sites chosen to be studied comparatively in this thesis regarding atmospheric pollutants are those of Keramikos, Olympia and the archaeological site of Elefsina.

Initially, a bibliographic study was carried out in order to outline the effects of atmospheric pollutants on the monuments materials in the open archaeological sites and especially in the area of Athens. This is confirmed by the installation of devices (Air-Sence) of the company A.U.G. Signals Ltd. for measuring environmental parameters in the archaeological sites mentioned above. Essentially, special new technology wireless devices are used to measure the level of atmospheric gaseous pollutants in a specific field of action, within the archaeological sites. Signal processing will be carried out as well as processing of the information received from the sensors (data acquisition, algorithm development etc.).

The research is based on the measurement of air pollutants by Air- Sense devices. The pollutants to be studied are nitrogen oxides (NO, NO₂),

sulphur dioxide (SO₂), ozone (O₃), carbon monoxide and dioxide (CO, CO₂) and suspended particles (PM_{2.5}, PM₁₀). Along with these measurements, other climatic parameters directly related to atmospheric deterioration factors such as relative humidity (RH%), temperature and wind are considered and recorded.

The methodology of the experimental procedure also includes the placement of marble samples in the archaeological sites in order to observe and record the changes that happened during the exposure to the atmospheric factors of deterioration.

Moreover, special atmospheric pollution precipitation collectors were placed inside the archaeological sites in order to collect and record the results of the measurements.

The samples were observed and the surface corrosion was recorded in detail during this procedure. The aim of this thesis is to evaluate the current state of conservation of these open archaeological sites of the Athens Basin, after collecting all the information and studying these measurements that were created from the statistical analysis.

Finally, the research challenge is to create a future model for the prediction and effects of changes in these monuments depending on the pollution data recorded, as well as to incorporate this research into larger frameworks and European programs, so as to make feasible the application of the method in other additional archaeological sites inside and outside the city of Athens.

Applicability of X-Ray Imaging to Monitor the Internal Condition of Waterlogged Archaeological Wood – Pre-, Intra-, and Post-Conservation

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Abstract: The greatest threat to waterlogged archaeological wooden (WAW) objects during conservation treatment is collapse and/or shrinkage which can occur during the drying process. These can leave the treated wood malformed, warped, and weakened, reducing the physical properties, as well as the aesthetic and cultural heritage value of the objects. Recent work undertaken by the CuTAWAY project revealed, using micro-Computed Tomography (μ CT), that the extent of adverse structural changes found internally in conserved WAW was far higher than generally anticipated.

Adverse internal structural changes can occur in wooden objects at many points during their 'lifetime'. This includes the initial after-felling, fluctuating climate during the wood's service life, osmotic pressure during the impregnation process, and most commonly in the drying step of conservation treatment, due to capillary shrinkage or shrinkage. Understanding at what point in the process any adverse structural changes took place would result in a more complete understanding of the conservation process, allowing for future conservation method optimisation, as well as providing a more complete initial condition assessment of objects.

Application of μ CT within the field of conservation of WAW has allowed for a better understanding of the conditions of our treated objects. However, while the use of μ CT allows for the creation of 3D models with high-resolution images, access to the instrument is limited both due to financial and geographic constraints, and the time and knowledge required to compile the information into a usable format are high. X-rays could potentially provide a far more accessible and quicker alternative. They are available in most conservation labs, due to their frequent use in the analysis of metal objects, and the time and skills required to operate them are comparatively low. In conjunction with μ CT, X-rays could provide a screening process able to highlight objects/samples of interest for subsequent μ CT imaging.

This project will evaluate the applicability of X-ray imaging in monitoring the internal condition of waterlogged archaeological wood – pre-, intra-, and post-conservation. To evaluate the use of X-ray imaging at each of these steps, WAW samples with artificial internal voids of various, known, sizes are X-ray imaged in the initial waterlogged state, during impregnation, and after drying. This will identify the resolution and quality of the method i.e. what are the size and quality limitations of this method. In addition, treated samples with naturally occurring adverse internal structural changes, that have already had μ CT images taken, will be x-rayed to identify the comparable accuracy and resolution of X-ray imaging in monitoring the internal condition of WAW in comparison to μ CT.

Colour Production in Indigenous Colombian Communities: A Reflection of Identity and a Partnership with the Territory

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Abstract: The aim of this research project is to list and document the ancestral techniques still used to extract and manufacture pigments and dyes in several indigenous Colombian communities living in different ecosystems. The study of materials (pigments and dyes) enables us to investigate the nature of the link between communities and their territory. Investigating the way they are used, including the emergence of shapes and colours, provides a cosmological approach. Transcribing these aspects of their identity helps to reinforce their cultural specificities. Collaboration with different indigenous communities will enable a comparative study of the development of different pictorial languages, linked to specific environments. Through these different parameters, we will attempt to answer the following questions: can we affirm that pigments and dyes are part of the visible aspects that materialise the bonds of partnership and co-creation with a territory? Does each community living in a specific ecosystem materialise its own language through colours and pigments?

This project fits in with several ongoing processes: it resonates with a broad movement within regional and national indigenous organisations, where the reactivation of millennia-old knowledge is crucial.

The project's themes contribute to the strengthening of community identities and fit in with the peace processes currently under construction, including the safeguarding of knowledge and support for groups that have suffered most from the conflicts.

Using Light to Clean Books?

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Abstract:

Problem: Mould-infested and blocked paper represents a very complex damage, that is still not fully understood nor successfully treated by conservators. Depending on paper's condition and blocking grade, conventional treatment methods such as separating with a spatula is mostly unsuccessful. It can cause even more damage by producing holes, tears und substantial loss. Therefore, investigations of alternative cleaning and separation methods are essential. Among several methods, paper conservation currently focuses on plasma treatments.

Aim: Aim of this thesis is to investigate and evaluate atmospheric cold plasma as an application for the decontamination and unblocking of papers. The investigation will measure, how efficient plasma removes fungal structures and unblocks paper sheets. The work shows, which kind of changes in the paper's surface properties and micro-damages on paper fibres could occur during this procedure. In addition, any influence of the plasma on inks, glue or pigments is to determinate. Furthermore, an important aim of this thesis is to design a mock up- based test regime, which simulates deterioration processes and treatment measures. Due to the fact, that paper blocking is a very complex condition, it is extremely difficult to simulate such phenomena.

Pre-studies: Literature review shows that in conservation and restoration science, plasma treatment is predominantly used to clean metal, stone or textile surface. In paper conservation, plasma treatment is still in the early stage of research. First publications show that plasma treatment can be used on paper to modify the surface e.g., to chance the wettability or improve the stability of acidic paper. The possibility to modify the surface of cellulose fibres has been proved and is used in the paper production process to develop papers with specific characteristics. Also described is an antimicrobial effect, providing the use to sterilise surfaces. The sterilising effect is based on e.g. reactive Oxygen or Nitrogen species (ROS, RNS), thermic reactions or UV-C radiation. The combination of those effects on lower concentration should be less aggressive because own studies showed that a single use of ROS or UV-C damages the paper.

Claim of the work: In conservation it is not an option to damage the original materials. Based on the oxidising or reduction effect of plasma, the cellulose fibre's surfaces are smoothed, which leads to

the conclusion that the upper layers of the surface are altered or damaged. Therefore, as the claim of this thesis, it is highly important to evaluate the plasma source, the application type and duration for a successful treatment. The investigation is based on positive approaches, carried out with cold atmospheric plasma and dielectric barrier discharge or after-glow-plasma treatment with a low oxidising effect. To separate the blocked paper, it is necessary to work in situ with the plasma tool, which allows to site the plasma blast exactly between the blocked pages to “cut” or weaken the hyphae enough to enable a manual separation with a spatula. Thus, a plasma jet with a thin needle attachment allows the creation of stable plasma and the local concentration of plasma ions.

A Study of Chemical Degradation of Iron Gall Inks Based on Historical Byzantine Recipes. Investigation the Role of Metal Ions by Non-Destructive Spectroscopic Techniques

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Abstract : Studying and deciphering iron gall ink degradation mechanisms is of critical importance towards preservation and rescuing of historical archive material.

The present PhD thesis aims to study the mechanism of the physicochemical alteration of iron gall inks by investigating the role of metal ions with non-destructive spectroscopic techniques. In particular, it targets at a more complete understanding of the techniques for the preparation of iron gall inks based on historical Byzantine recipes, at the identification of aggravating factors that affect the stability of the ink and at investigating the correlation of the ink degradation with ageing factors, as well as the type / composition of ink on different substrate (paper, parchment).

The research will be achieved through the application of a combined analytical methodology that will include:

- 1) preparation of inks from historical Byzantine recipes and samples on an inert substrate, as well as on paper and parchment,
- 2) application of appropriate artificially accelerated ageing protocols,
- 3) combined use of diagnostics, non-destructive spectroscopic analysis techniques to determine the composition and chemical environment of metal ions before and after artificially accelerated ageing and
- 4) analytical characterization of iron gall inks from Byzantine and historical manuscripts/ fragments. Through the comparative evaluation of the state of preservation of the inks on historical objects from the Patmian Library with the results of the study on artificially aged samples, it is aspired to offer a protocol towards optimum preservation of unique historical archives.

In sum, the results of this PhD thesis are expected to contribute to a better understanding of the pathology displayed by iron gall inks and the selection of more effective interventive conservation treatments.

Documentation, Restoration, Conservation and Valorization of Educational Photography Collection in the Faculty of Fine Art of Complutense University of Madrid

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Abstract : The Library of the Faculty of Fine Arts of the Complutense University of Madrid (UCM) houses an ancient photographic collection recently rescued from its deposits, thanks to the involvement of the center's staff and some professors from the same university. The poor state of conservation, together with the lack of associated documentation, has been the pretext to develop a project that highlights this unique heritage, from the reconstruction of its material history, through its inventory, digitization, study and restoration of the more compromised pieces, the relocation in containers suitable for photographic material, the planning of preventive conservation measures and, finally, its dissemination.

It is a collection of more than four hundred pieces in different formats, between photographic procedures on paper support and photomechanical procedures mounted on cardboard or cardboard, dated between the end of the 19th century and the first half of the 20th century, from renowned photographic studios such as Laurent, Moreno and Alinari. This collection contains the teaching material that was used when the Faculty of Fine Arts was still the San Fernando School of Fine Arts, and shows the consequences of manipulation by students and faculty: scribbles, drawings, inscriptions, paint stains ...

This research project, enrolled in the Doctorate program in Preservation and Restoration of Cultural Heritage of the *Universitat Politècnica de València*, aims to offer multiple resources to undertake the task of safeguarding the photographic heritage described, following the guidelines of the *Plan Nacional de Conservación del Patrimonio Fotográfico* coordinated by the *Instituto del Patrimonio Cultural de España* (IPCE), and the recommendations of other leading international organizations in the conservation of photographic material, such as the *Image Permanence Institute of Rochester*, the *International Federation of Library Associations and Institutions* (IFLA), the *Canadian Conservation Institute*, the *American Institute for Conservation* (AIC) and the *Istituto centrale per il catalogo e la*

documentazione of Rome (ICCD), which, in addition to developing standards for the conservation of photographic material (in *Scheda F*), is responsible for conservation, restoration and dissemination. In order to manage the description of the pieces, as well as the treatment of some of them, two types of files have been designed, which, in turn, feed two databases: one for cataloguing, and another for restoration. The advantages of these models are found in the integration of standardized terminology, according to the ISAD (G) regulations, the interface being easy to use, and the constant display of the image that identifies the piece.

Likewise, this project offers a systematic study of the identified photographic procedures and a diagnosis of the deterioration they show. In addition, we study how to approach and treat certain pathologies using mechanical cleaning methods and gelled systems, interventions that allow coherent decision-making that is respectful of the needs of each piece.

Finally, we want to propose the valorization of the photographic collection through the *Patrimonio Digital Complutense* web platform, which was presented in 2020, with the aim of disseminating the enormous and invaluable heritage of the Madrid university.

Seeing the Whole Picture: An Interdisciplinary Research Model Applied to the Study of Colour Slide Film Collection

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Abstract: The mass production of colour slide film was carried out by several companies between the mid-1930s and the late 2000s, each one with specific characteristics. Regardless of efforts to improve their properties, these photographs remained unstable. Colour shifts became visible shortly after chemical processing or light exposure, but also occurred after years in dark storage conditions. Slowly but surely, colour slides became part of private and public collections, often in large numbers. With time, other issues such as mould growth or vinegar syndrome would surface as well.

In the last twenty years, visual culture has become dominated by digital images. Yet, before then, the most common colour photographs were analogue. Colour slide projections, once common at family gatherings or school lectures, became obsolete. Memories of first-hand experiences with these objects remain with older generations. As colour slides are stored away or even disposed of, they slip away from society's collective memory. There is an increasing knowledge gap which is detrimental to their care. Documenting the memories behind these objects is as important as preserving their materiality. Before conserving slide collections, it is necessary to understand their, use and decay. The currently available resources are insufficient and address specific aspects surrounding colour slides without integrating them into a bigger picture. Our understanding of these photographs can be enhanced by gathering first-hand accounts of those who participated in the manufacturing stages, as well as those who became slide film users through surveys and interviews.

The collected background information will complement research on case-studies held by Portuguese institutions. These include c. 53.000 examples of slides used in a variety of contexts and types of films, and with different levels of decay. Standardized categories help in the analysis of both single objects and object groups, enabling the comparison of inherent characteristics and condition of objects within collections and across institutions. The information gathered by close observation of samples and discussions with several stakeholders, including those who care for slide collections, will highlight pressing concerns that are transversal to several collections and need further investigation. Such topics include terminology to describe image generations, the long-term effects of slide mounts, and treatment methods for objects affected by mould growth.

This project aims to develop practical tools that help heritage professionals improve their skills in interpreting colour slide film collections and prevent the continuous disappearance of invaluable information. Although the study of samples in Portuguese institutions are essential to this study, the developed methods and outputs are relevant for the care of photograph collections in other parts of the world. Ultimately, this research hopes establish overarching resources that provide a closer connection between the past, present, and future of colour slide collections.

Documenting Damage on Easel Paintings: A Look into Glossaries, Ontologies and Databases.

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Abstract: The existing glossaries, ontology systems, and databases focused on cultural heritage (CH) and their pathologies present various limitations. In some cases, the limitation can be caused by the access options: in digital media, it could be a restricted scientific journal, an obsolete file format or a website no longer available, whereas in printed media, it could be an old publication that has no reprints or no available volumes in libraries. In both cases, the difficulty and specific knowledge required for their understanding, or simply the lack of visibility of such resources contributes to reduce the impact of such comprehensive efforts in the CH field. Another limiting factor can be the field the resource is focused on: whereas there are many resources on architecture, archaeology, mural paintings, and other fields of cultural heritage, the existing databases on easel paintings are scarce and overly focused on either the materials and/or techniques, or just on some of the pathologies. Still, many of them lack both good visual guides and a broad informative content that would offer a better understanding of the very nature of the pathologies often found in easel painting.

This PhD project focuses on developing a non-invasive diagnostic open-access tool to document the condition of easel paintings with the aim to become a resource for researchers, professionals, and students in the field of paintings conservation. The development of the tool is twofold: on the one hand multiband imaging techniques will be compiled as a sort of image library and, on the other hand, a database will be built based on such images and on the ontologies previously designed. The use of ontologies will contribute to organise the information of the case studies considered, as well as their existing pathologies.

Nowadays, there is only a limited number of similar resources; this emphasises the need to develop more resources for the non-invasive diagnostics of artwork pathologies. The multiband imaging technique will allow for a thorough analysis of the pathologies of the paintings, as well as an analytic comparison between the different case studies based on machine learning algorithms. Furthermore, the database would enable the continuous development of the contents in the future, thus its extension and the incorporation of other research areas in the field of cultural heritage conservation.

Using an ontology-based system (based on the CIDOC CRM ontology model for better compatibility with other ontological databases) will allow an optimal way to organise the data for further use (the analytical comparison of the information, diffusion, and transmission of the knowledge, etc.). The glossary of terms considered as the starting point of the ontologies designed in this study is being developed using existing resources –like The Getty Research Institute’s Vocabularies, the European illustrated glossary of conservation terms for wall paintings and architectural surfaces (EwaGlos), or the Conservation & Art Materials Encyclopaedia Online (CAMEO) amongst others– to further facilitate the interoperability and use of the database, either for non-invasive diagnostics of artworks or for academic purposes.

Artists' Acrylic Varnishes: Aligning Archival Research with Analytical Data

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Abstract: The main aim of the research project is to evaluate the effectiveness and suitability of a range of novel and sustainable cleaning methods to remove degraded synthetic varnishes from sensitive modern paint films including acrylic emulsion and polyvinyl acetate (PVAc).

The oral presentation will focus on the work carried out to date, with an emphasis on the challenges and benefits of aligning archival research with analytical data, as well as an evaluation of non-invasive analysis for modern materials.

Acrylic paint manufacturers recommend applying a protective coating to acrylic emulsion paintings and, although it is not standard practice, several artists have followed these recommendations. As with natural resin varnishes, these synthetic varnishes, often acrylic-based, degrade over time. They can discolour, becoming yellow or grey. The gloss and discolouration can be patchy. They can become dull or milky in appearance or could even become fused with the underlying paint layers. Critically, the level of degradation can severely damage the intended aesthetic of the artwork, especially modern works with flat fields of colour.

However, removing an acrylic coating from an acrylic paint film poses serious risks due to the similarity in chemical composition of the two layers (Lomax and Fisher 1990). In recent years there has been extensive research into both surface cleaning of unvarnished acrylic paints (Learner et al 2007; Ormsby et al 2008) and the development of gels, gel composites and microemulsions as alternative cleaning methods to traditional swab cleaning (Angelova et al 2018; Baij et al 2021). However, there has been very little research into the removal of synthetic varnishes from synthetic paint films. There is an urgent need for this research to enable conservators to act and remove the varnish layer when required.



A selection of commercial acrylic varnishes

The research will review the range of synthetic varnishes produced by several leading commercial paint manufacturers through archival research and interviews with both manufacturers and living artists. Testing of possible varnish removal methods, such as microemulsions, rigid nanogels, and spreadable PVA-borax gels, will be carried out on artificially aged paint and varnish samples, and on existing, historic swatches. Varnish degradation processes and the resulting visual effects will be assessed before and after artificial ageing on the samples. Evaluation of the cleaning tests would assess the degree and evenness of varnish removal, gloss/texture changes, residue, control, ease of use, sustainability, and health and safety.

Ten paintings from the National Museum collection (Oslo, Norway) will be used as reference points and case studies throughout the research. The materials and construction of the mock ups used for testing of the varnish removal methods will be based on the collection paintings. Therefore, it is vital to have examined and assessed the varnishes present in the collection, prior to carrying out research and testing into potential cleaning methods. Analysis of these paintings has been carried out by five teams from MOLAB (MOBILE LABORATORY, part of the EU-funded IPERION HS Programme) using multiple non-invasive, portable techniques.

This pioneering research aims to generate an ethical, low-risk, sustainable treatment for practicing conservators, worldwide.

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An Investigation of Modern Paints and Binders in Communist Poland

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Abstract : Paints and binding media used in easel paintings by artists between 1945-1989 in Krakow. This research is focused on paints and binding media used by artists in Krakow in the years 1945-1989. This period spans the existence of the Polish People's Republic (PRL), the communist predecessor to modern-day Poland, during which the country was greatly isolated from Western influences. The 20th century is also a time of many important advancements in painting technology, particularly due to the commercialization of the production of traditional paints and the development of synthetic binding media.

The import of many goods to Poland, then behind the Iron Curtain, was limited and heavily regulated. These difficult circumstances invite many questions regarding the availability of artistic materials: what were the supply options available? Was the art supplies market also regulated? Was there any domestic production of specialized paints? Was it even possible to import foreign supplies, or obtain them via other means? Or maybe artists just had to rely on whatever materials were available to achieve their vision instead?

The aim of this research is to gather information about the painting technology used by artists in Krakow in the second half of the 20th century. Although the research is limited to artists working in the city of Krakow, the results may be relevant to the rest of the country. Krakow has a long artistic history and tradition, and due to the many artists from the discussed era that still live there today, the city provides access to a sufficiently numerous group of artists to carry out a comprehensive exploration of the topic. There are several stories and anecdotes from the discussed period, but they have rarely been recorded. Many artists of Poland's communist period have already passed away, and those still living today are in their elderly years. This may very well be the last chance to capture their testimony in writing.

The research is based on conversations with artists and/or their descendants, as well as on a scientific examination of the binders in the sampled paint layers. The FTIR spectroscopy has been used to examine the paintings, both in microinvasive (ATR) and non-invasive (TR, Total Reflection) regimes. The method of conducting conversations was inspired by the artist interview approach. The findings greatly rely on the cooperation of the interviewed artists, who are the primary source of information, as well as institutions and private collectors for providing access to the analyzed works of art. There are four institutions involved, and twenty-two people have been interviewed so far.

The aim of this thesis is to establish what means of artistic production were available to the Polish artists of the time, and how they differed from those used by their peers in the West. It would also be valuable to establish if there were any delays (or not) in the adaptation of synthetic binding media in Poland.

Polish Artists' Adventures with Synthetics - Tracking the Phenomenon, Identifying Problems

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Abstract : The evolving landscape of 20th-century art has presented unique challenges for art conservators, particularly in the realm of material experimentation and the use of synthetics. Contemporary art blurs the boundaries between professional and non-professional materials as artists abandon traditional rules and frequently mix different types of paint. As a result, deterioration symptoms in contemporary paintings emerge earlier and pose more significant risks than in traditional ones. Conservators face the challenge of preserving these artistic experiments from destruction. This complexity intensifies with synthetic paints, for which the methods used for traditional painting are often inappropriate. A better understanding of what we are dealing with will enable us to carry out conservation treatment effectively and safely.

Polish art needs a separate discussion in this context. The conclusions of Western researchers are not directly applicable to Poland due to the historical isolation enforced by the Iron Curtain and the resulting different availability of chemical formulations on the market. The shortages in the market of artistic supplies pushed Polish artists to use substitute art materials and their inventions. Furthermore, domestically produced supports, paints, and polymers lacked the quality of Western products, leading to poorer technical conditions, notably in Polish paintings from the 1950s to the 1980s.

This research project attempts to identify the use of synthetic binders in Polish paintings from 1955 to 1975 and to propose conservation solutions for these paint layers. The study consists of two parts. The first is a search in museums' collections. Its primary aim is to identify the paint binders in selected paintings and to verify information from museum catalogues. The analysis will also establish a preliminary chronology of introducing each type of paint in Polish art. Activities also include tracing the changes occurring in the appearance and properties of different paints during the ageing process and identifying main conservation problems. Applied techniques include FTIR spectroscopy, analytical light photography, paint layer investigation with a Hirox digital microscope and more.

The subsequent phase of the project focuses on practical issues and consists of the conservation treatment of selected paintings. Meeting the challenges of cleaning and retouching synthetic paint layers will be areas of particular focus.

The presentation will outline the results of the first part of the project to date. Changes in the properties of the tested paints during the ageing process and the possibilities for non-invasive identification of synthetic binders will be discussed.

The results of this comprehensive study will expand our knowledge of synthetic paints in Polish art, facilitating the assessment of the authenticity and attribution of post-war paintings whose market value and popularity are steadily increasing. Additionally, systematising conservation methods for contemporary paintings containing synthetic binders will provide a valuable reference point for future treatments. Ultimately, this research aims to not only deepen our understanding of synthetic paints in Polish art but also provide insights for preserving and authenticating contemporary artworks in general, thus enriching the cultural heritage landscape.

Study of Materials and Techniques in António Carneiro's Painting

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Abstract : António Carneiro (1872-1930) is one of the best Portuguese painters in the transition between the 19th and the 20th centuries and considered to be the first symbolist painter in Portugal. He studied at the Fine Arts Academy of Oporto and then in Paris at the famous Académie Julien. Although he had a quiet and reserved personality, he was a very active painter participating and organising numerous exhibitions in Portugal and abroad (especially in Brazil). His extensive work includes sanguine, charcoal, paint wash, and graphite drawings; watercolour and pastel on paper; and oil on canvas and wood.

The research plan includes: identification of artist' exhibitions and artworks presented through a survey on coeval exhibition' catalogues, photographs and newspapers; identification of personal documents such as letters and photographs and personal objects; gathering of data such as dimensions, marks, stamps and materials/techniques used in paintings selected from public and private collections; characterization of the materials and techniques used through laboratory analysis; characterization of conservation condition.

For the analytical study different techniques are going to be used: Infrared Reflectography; Ultraviolet Fluorescence Photography; Energy Dispersive X-ray Fluorescence; Optical Microscopy; Fourier Transform Infrared Spectroscopy; Raman Spectroscopy; Scanning Electron Microscopy with Energy Dispersive Spectroscopy; Gas Chromatography with Mass Spectrometry.

The first results indicate that António Carneiro used mainly pre-prepared industrial canvases that are thin and dense, have uniform ground layers covering the entire surface of the fabric and pencil-marked clean cuts. There are some original stretchers showing the stamps of its producers or sellers, such as "Araújo & Sobrinho", from Oporto and "Galeria Jorge", from Rio de Janeiro, Brazil. The palette is composed of Pb, Zn, Hg, Cr, Cd, Cu, and Co-based pigments, associated with both traditional and recently introduced materials.

In private and public collections, there are several paintings that are studies for final larger projects, since Antonio Carneiro had the habitude to sell the several studies (paintings and drawings) that he made for the final works. It is the case of the painting "Life" composed by three canvases painted in different years 1899-1901. The Municipality of Oporto is the owner of the study for the final work that belongs to Cupertino Miranda Foundation.

The comparison between these two paintings (study and final work) reveals that António Carneiro was a very disciplined and rigorous painter. He combined hand-free underdrawings with grids and distance marks (probably using graphite) to keep the proportions between the study and the final work corrected. There are very few differences in the painting composition between the study and the final work, being the final work more detailed.

Regarding to paint layers, the study and the final work have similar colours and the pigments used are mostly the same. Since the canvases are painted in different years, we can see an evolution in his technique. At the beginning, he used thicker layers where colours are mixed on the palette but also worked on the canvas. He evolved to use very thin layers, showing the white ground and the texture of the canvas underneath.

Documentation and Conservation Issues of Modern Art Composed of Non-Artistic Materials by Example of Jonasz Stern's Art

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Abstract : The contribution will cover and address main research issues established so far in working with Jonasz Stern's oeuvre. Conservation research issues related to Stern's oeuvre are as diverse and complex as his art. Jonasz Stern is a modern Polish artist mostly active in the second half of the 20th century. His artworks are mainly compounded compositions on canvas consisting of various organic materials such as bones, fishbones, feathers, or plant residues. The doctoral project covers a detailed technological research and deals with complex conservation issues, but for the purposes of the presentation at the colloquium I would like to focus on two specific topics: 3D documentation - its perspectives and limitations, and the effects of unusual construction of objects and atypical selection of materials in terms of the state of preservation and damage of works of art.



Atypical constructions of modern and contemporary art's objects require new documentation standards which are being developed in the Laboratory of Research and Conservation of Modern Art at NCU, Toruń. As a part of a broader reflection on how to properly record all the subtleties of modern artworks, 3D structured light scanners (Artec Eva and Artec Spider) from Artec3D are being used.

Designed for industry services, these apparatuses need frequent modifications, both regarding the scanning process itself and subsequent processing of acquired data. As a part of this contribution, I would like to discuss proper and safe environment set-up requirements for scanning, hardware limitations in processing large, complicated data sets and, as a result, a need for differentiation between 3D models for scientific and promotional purposes. Constructing 3D models serves more than graphic spatial documentation - it also enables varied evaluations of the objects. This will be discussed on examples of measurements of degree of deflection of the canvas, which is crucial in monitoring the state of preservation of works of art.

Painting support deformations is a characteristic problem for Stern's works and is a result of composing, with the use of strong gluing, many objects on canvas, which are then subjected to tensions on the phases boundaries. Many of the artist's paintings are composed as boxes, where a wooden frame fixed to the stretcher is covered with plexiglass creating a closed, completed form. This contributes to the development of specific conditions within the structure of an artwork resulting in many damages, i.a. microbiological deterioration of bones. The presentation will therefore cover a documentation of damages and identification of their causes with an emphasis on relation between the chosen artistic and non-artistic materials, objects' structure, and external factors.

The Use of Nanocrystalline Cellulose for the Consolidation of Depolymerized Cellulosic Textiles. Some Crucial Aspects Regarding the Use of Nanocellulose as a Consolidant

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Abstract : Nanocellulose is an extremely versatile biopolymer that is raising enormous interest for the conservation of cultural heritage because of its peculiar properties, due to the source material and the nanometric size of its particles. Among its features the most interesting are the eco-friendly nature, non-toxicity, large surface area, reinforcing capabilities, low density and stability of its suspensions and possibility of functionalization. Compared to usual conservation products nanocellulose offers possible advantages in terms of compatibility with the constitutive materials of artworks, performances and sustainability. Up to date the research about the use of nanocellulose in the field of conservation mostly concerns wooden and paper artworks, whereas studies related to its use on textiles are more recent.

My master degree thesis has been a chance to examine the potentiality of nanocrystalline cellulose (CNC) to consolidate depolymerized cellulosic textiles of canvas paintings. The CNC was chosen because of its higher degree of crystallinity compared to the nanofibrillated and bacterial nanocellulose. The material has been compared to some common conservation products and turned out to be effective in improving the tensile strength of the canvas. Furthermore, CNC showed a very low impact on the appearance and the hygroscopicity of the canvas. The study eventually allowed the use of CNC on a real artwork from the XVII century achieving an appropriate mechanical resistance of the support, without resorting to the lining.

The current research is set to deepen the knowledge about CNC addressing issues of crucial relevance: penetration into the substrate, adhesion to the canvas and possibility to reduce the amount of water needed for its application. The theme of the penetration of the consolidant inside the microstructure of the canvas is poorly understood at the moment, and needs to be dealt with in order to better define its connection with the mechanical performances of the material and its possible removal. The adhesion of CNC to the textile support is also an essential aspect to consider, since it directly influences the mechanical properties and may be affected by materials on the surface (i.e. adhesives or other conservation products). The combination of nanocellulose and another material designated to improve the adhesion to the canvas is an interesting option that will be considered, evaluating its

implications on the mechanical performances and also the hygroscopic behaviour. The research will also address the issue of the use of CNC on water sensitive artworks, attempting to reduce the amount of moisture related to the application of the suspension. In this regard, an appropriate functionalization of the material would probably represent the ideal answer to the matter, because it would allow the dispersion of CNC in a non-polar solvent.

The second- and third-year's project will also involve the study of CNC as an additive for different polymeric materials, mostly of polysaccharide nature. This part of the research work will aim to evaluate the suitability of CNC to adjust certain physical properties of polymers, in order to obtain ad hoc modified products according to various necessities.

Repair of Tears in an Easel Painting. Study of the Mechanical Behaviour of the Deformation Induced by Localised Treatment

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Abstract: The longstanding practice to address distortions caused by a tear in an easel painting has been to increase the rigidity of the canvas support through lining or through the local application of patches on the back of the canvas. However, in recent years, research on the mechanical behaviour of lining and the study of stress evolution in a painting have significantly changed practices. A fundamental change becomes apparent, which emphasises the preservation of original integrity of the painting and the application of the principle of minimal intervention.

Within this approach, the researches on the tear mending since the years 2000s has focused on the adhesive bonding of the tear to allow the stretching of the painting without additional consolidation of the canvas support. While this choice aligns with the goal of minimal intervention and helps avoid the risk of mechanical distortion of patches glued to the back of the canvas, what flatness does a tear consolidated by simple thread-by-thread mending without lining or patches on the reverse offer over time?

While the criteria of structural integrity and mechanical stability have been highlighted in interventions on easel paintings in recent years, the issue of the deformation in plane induced by a tear has been scarcely explored.

The aim of our research is to study the risks of deformation resulting from a tear repair and to develop tools for understanding the mechanical phenomena involved. It will focus on measuring the deformation in plan and the distribution of mechanical stresses based on different tear mending methods and their evolution over time.

The study employs the Digital Image Correlation (DIC) measurement system, which allows the measurement of deformation fields even in unstable environments such as changes in relative humidity. This method has been successfully applied in the conservation field for monitoring deformations in tapestries.

The first part of this experimental work involved constructing a DIC measurement system adapted to the subject of the study and that can be used in cases of degradation factors variations (climatic variations, creep) for a long-term evaluation. We will then be able to measure the deformation induced by the tear and by the different systems of tear mending and deduce variations in stress fields.

The different systems were chosen based on field studies that identified the most common or the most innovative practices. In parallel, we will compare the measurements obtained by those of the same undeformed system in order to identify the factors responsible for deformation. All specimens will then be subjected to various degradation factors, creep, climatic cycles, oxidation. The last part of the research will compare the results to real artworks.

Exploring the Effectiveness and Consequences of the Removal of Secondary Layers from Easel Paintings: A Focus on Material Safety and Long-Term Impact

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Abstract: During the conservation treatment of easel paintings, conservators almost always encounter the problem of removing secondary layers from their surfaces. In English-language sources, the comprehensive term "cleaning" encompasses procedures such as removing surface dirt, aged and degraded varnishes, as well as intentionally applied secondary paint layers [1,2]. In the currently available sources, particular interest has mainly focused on the removal of dirt and varnishes, with less attention given to overpaint layers, especially oil-based ones which, however, are not uncommon in old easel paintings.

New materials and carriers introduced by Wolbers in the 1980s [3], and further developed in subsequent years, are mainly intended for modern paintings, especially lately - water sensitive acrylic paint layers. Nevertheless, they are also widely used in the conservation of older, historic paintings. Available literature little describes studies [4] on the consequences of commonly used methods for removing those layers, not only immediately after the procedure but also in the longer term. Research up to the present moment focused mainly on introducing new agents, testing their effectiveness, and examining their residues on the surface of the paint layer. There is also a lack of standardized methods for conservators to determine the safety of using these proposed materials, as well as guidance on their selection considering all consequences, including the long-term ones for historical artefact.

To approach answering above-mentioned questions, it was decided to conduct a series of studies that would shed light on the mechanism, effectiveness and consequences of currently popular methods for removing secondary layers from the surfaces of easel paintings. Upon proceeding the work, suitable materials were selected and samples of oil paint layers with specific compositions were prepared, which were then subjected to accelerated aging. Six carriers were selected for a previously determined solvent mixture [5] which proved to be effective in removal of secondary layers such as overpaintings.

Four-time intervals for collecting data, i.e., amount of individual solvent present in the oil paint layer were selected [6]. Research was conducted using headspace gas chromatography to obtain information on how the carrier and its components influence the solvent retention in the paint layer. Measurements of swelling of the paint layers were performed using a 3D microscope which allowed to visualise destructive effects of swelling. Nanoindentation measurements were carried out to determine changes in the properties of the paint layer immediately after the overpaint removal procedure and in the future (aided by accelerated material aging).

The obtained results will allow to determine the justification for the use of specific agents and carriers and will provide guidance for conservators on which direction to take when selecting materials, both in terms of safety for the historical artefacts and for the conservator themselves.

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Exploring Surfactant-Free Microemulsions for The Cleaning of Paintings

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Abstract: Since the 1980s, cleaning of artistic surfaces has gained a new dimension. In addition to organic solvents traditionally used to remove or thin varnishes, a solvent with unique properties has been explored: water. In conservation, aqueous protocols improved significantly, combining low organic solvent concentrations with a larger aqueous phase to remove undesirable compounds while protecting artistic surfaces. These solvent-in-water (O/W) emulsions are also recognized as less ecotoxic alternatives to traditional organic solvents.

In parallel with surfactant-free solvent-in-water (O/W) macroemulsions, microemulsions have specific characteristics:

- a) reduced droplet size of the dispersed phase, on a nanometre scale.
- b) presence of a surfactant and a co-surfactant, usually a co-solvent, enhancing cleaning properties.

To avoid any risks associated with surfactant residues, our research focuses on surfactant-free microemulsions (SFME). To our knowledge, these microemulsions have never been used in conservation.

These SFMEs, suspected since the 1970s and explored since the 2010s¹, feature a simple formulation: two immiscible or slightly miscible solvents made compatible by a third solvent, acting as a hydrotrope². Structurally, a continuous phase, mainly composed of water, hosts dispersed nanodomains rich in a hydrophobic solvent, with the hydrotropic solvent forming a dilute, flexible phase at their interface³.

¹ Yuan Liu, Jie Xu, Huanhuan Deng, Jiabin Song, Wanguo Hou, « A surfactant-free microemulsion composed of isopentyl acetate, n-propanol, and water », *RSC Advances*, 8, 1371, 2018, DOI: 10.1039/c7ra12594a

² Thomas N. Zemb,¹ Michael Klossek, Tobias Lopian, Julien Marcus, Sebastian Schöettl, Dominik Horinek, Sylvain F. Prevost, Didier Touraud, Olivier Diata, Stjepan Marc'eljad, and Werner Kunz, « How to explain microemulsions formed by solvent mixtures without conventional surfactants » *PNAS*, vol. 113, n°16, Avril 2016, p. 4260-4265, DOI : 10.1073/pnas.1515708113

³ Michael Gradzielski, Magali Duvail, Paula Malo de Molina, Miriam Simon, Yeshayahu Talmon, Thomas Zemb, «Using Microemulsions: Formulation Based on Knowledge of Their Mesostructure», *Chem. Rev.* 2021, 121, p. 5671-5740, DOI : 10.1021/acs.chemrev.0c00812

We investigated SFMEs due to their formulation with volatile compounds chosen for low ecotoxicity and versatile application methods, such as cotton swabs, tissues, or poultices. Two SFME formulations were explored during this PhD⁴, employing solvents commonly encountered in painting conservation:

1. Water/ethanol/benzyl alcohol.
2. Water/isopropanol/butanol.

The latter was designed to avoid the high retention of benzyl alcohol in the paint layers. The relative concentrations were adjusted to suit the varnished paint surfaces. These SFMEs were evaluated for their properties in removing varnishes and the risk they can bring on oily paint layers.

Samples of varnishes commonly used in the 19th and 20th centuries were artificially aged on glass slides and on a 19th century painting. The ability of SFME to solubilize these varnishes was studied using Optical Coherence Tomography to obtain a non-contact measurement, with micrometre resolution, of the thickness of the varnish layers before and after treatment. Oil paint flakes dating from the 18th and 19th centuries measured SFME retention using Thermogravimetric Analysis coupled with Gas Chromatography–Mass Spectrometry (TGA-FTIR-GCMS). Leaching was also assessed with these paint samples, comparing SFMEs with traditional solvent mixtures.

Additionally, SFMEs were applied to case studies, including a 17th-century Italian violin by Nicola Amati. Degraded past treatment varnish was removed while preserving the original varnish, validated using OCT imaging.

While SFMEs show promise as greener alternatives to traditional organic solvents, being highly polar systems, they may interact with water-sensitive compounds or even original painting materials. Current known risks include metallic soaps crystallisation due to water addition deep within paint layers. It is thus necessary to continue research before including these microemulsions to the conservator's toolkit, as well as to investigate the risks of high retention of benzyl alcohol in oil paintings.

⁴Ying Han, Ning Pan, Deqiang Li, Shuhui Liu, Bin Sun, Jinling Chai, Dejie Li, *Formation mechanism of surfactant-free microemulsion and a judgment on whether it can be formed in one ternary system*, « Chemical Engineering Journal », 437, 135385, 2022, DOI : 10.1016/j.cej.2022.135385

Future perspectives for research of technique and technology of panel paintings in the region of Małopolska

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Abstract : In my PhD project I want to examine the technique and technology of panel paintings attributed to the workshop of John the Great (Jan Wielki), a guild painter active in Cracow in the second half of XV century. This project has 3 stages, the first of which includes the examination of John the Great workshop works, the second is an analysis of the results, and the third shows the results in higher perspective of other workshops from Małopolska and other European regions.

John the Great is connected by art historians with two altars and nine single panel paintings. The examination of these works of art will include the execution of photographs in analytic lights (infrared reflectography, and UV luminescence), RTG photographs, elemental analysis of pigments, metal foils and grounds by handheld XRF scanners, analysis of constructions of single panels and whole altars, and in some cases also elemental analysis by macro-XRF scanners, as well as, analysis of cross-sections taken from objects, and the analysis of binders using the FTIR method.

Data gathered in that way, lets us be more specific about questions of which paintings are rather works of master's apprentices, and which were rather made by the master himself. Comparison of this data from published materials about workshops in Małopolska and other regions of Europe, will show how typical working methods of John the Great for region of Małopolska are, and are there any similarities between him and painters from other regions of Europe.

This kind of research about techniques and technology of gothic panel paintings has already some tradition in the region of Małopolska. The first person who started these kinds of investigations was Józef Nykiel in the 1960's. Unfortunately, probably because of insufficient access to technology, he was rather an exception during the XX century. The situation changed in the 2010's and from that time, came two big research projects about a specific group of gothic panel paintings in Małopolska. The first of them examined panel paintings presenting the iconographical motive of *Hodegetria* from the Małopolska region (from the beginning of XV c. to end of the first half of XVI c. 79 paintings survived with this motive from this region), and the second one concentrates on the workshop of a Cracow guild painter from the turn of the XVI century called 'The Master of the Holy Kindship'.

This research brings to our attention some very interesting discoveries, the first one for example, is about the usage of the same tracing paper in few different paintings, and the second one is about the differences in preliminary drawings between particular paintings.

The methodology I want to use in my PhD project is continuing this type of research, and on a much smaller scale it was already successfully used by me. In my previous research I was comparing the technique and technology of one of Małopolska's gothic paintings to other gothic paintings from different regions of Europe and found a very specific similarity between it and one painting from Spisz. This similarity was because of the usage of the pouncing technique, which doesn't appear on panel paintings, neither in Spisz nor in Małopolska. This has led me to the conclusion that part of Spisz's painting (character's robes) and the Małopolska's painting were painted by the same painter. What improves the efficiency of this methodology.

The Study of the Funerary Assemblage from the Tomb of Minhotep: First Results on the Three Wooden Sculptures of Offering Bearers

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Abstract : The PhD research would like to highlight the main technical features characterising the production of wooden sculptures in ancient Egypt, a field of study still under-researched, considering both structural and materials characteristic.

Developing a multidisciplinary study supported by scientific and Egyptological insights the main objective of the study is to understand better the collection process of different objects belonging to the funerary assemblages, in terms of technical assonances or differences, to be referred, or not, to the same production field. These data could support the Egyptological studies to reconstruct some possible scenarios related to the presence of different workshops, maybe working in different areas or in different times. Starting from this intent, we selected as reference point the funerary assemblage belonging to Minhotep's tomb in the Asyut necropolis, found in 1908 and nowadays preserved in the Museo Egizio of Turin. Stylistically dated to the early XII Dynasty (1940-1876 BCE), it counts, among other objects, thirteen wooden sculptures of different typologies as: three "offering bearer" statuettes, a bakery model, four boat models, two statues of Minhotep, one sculpture of Upuauthemhat, a male figure, a female figure.

Due to its rather clear provenance and chronology, and considering the high number of wooden sculptures included in, it allows us to develop a uniform diagnostic process that, with a multi-techniques approach. In light of the importance of these objects, on this diagnostic plan the non-invasive techniques, as the X-ray Computed Tomography (CT), X-Ray Fluorescence XRF and Reflection Infrared Spectroscopy (FTIR), play a key role, although micro-invasive techniques are still needed to deepen the comprehension of the decoration process, as for example some stratigraphy observed with Scanning Elctron Microscopy (SEM).

After founding a mismatch between the object in their first photographic record (1924), and their current conditions, the study could also contribute to suggest a more accurate arrangement of the sculptures, with particular reference to the identification of other smaller elements that could have been separated and conserved separately in the museum, supported by the analytical data acquired. The first results, mostly coming from the study of the three wooden sculptures representing the female offering bearers (n° inv. S. 08794; S. 08795; S. 8796), are encouraging and show some important differences in terms of manufacturing techniques and use of materials despite the same provenance context and iconography of the sculptures.

A tool with a Constantly Growing Potential – Fibre IR Laser with High Repetition of Pulses and Laser Cleaning in the Conservation of Cultural Heritage

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Abstract :Laser cleaning is a widely recognised method in the field of conservation, with a constant stream of new devices being introduced to facilitate the process. One such device of this category is nanosecond fibre laser, which operates using a beam in the nanosecond time range within the infrared spectrum, with beam scanning or rotation and a spot size of 200 µm. Despite the increase in its usage, studies examining the advantages and capabilities of this kind of laser equipment remain limited and identified risks associated with its use need to be established. As such, it becomes imperative that their suitability for cultural heritage objects should be tested under controlled conditions. Improved control over this kind of cleaning process for historical objects' surfaces would significantly enhance the safety and quality of laser cleaning services, which are increasingly gaining popularity on the commercial market.

Within this Ph.D. project's framework, the research was mainly focused on polychrome and gilded objects on different supports. The first phase of work—the equipment adaptation process—was challenging and required cooperation with physicists specialised in photonics and programming. After establishing cleaning regimes for various materials and different secondary layers according to the first outcomes from the experiments on mock-ups, the system was ready to solve more complex conservation-restoration problems. However, a survey on pigments popular in modern and antique painting was conducted to prove the reliability of this method in cleaning painted surfaces.

Results were compared right after laser irradiation and after seasoning in the aging chamber. What is worth, to compare it used not only macrophotography, but also colorimetric measurements. Moreover, there was a mock case study of laser cleaning of delaminating and unstable painting layer without pre-consolidation, which led to cleaning tests on an oil painting on canvas with a similar problem. In comparison to laser which was accessible in Toruń, thanks to a European grant IPERION HS – FIXLAB (team leader: prof. Magdalena Iwanicka), were performed experiments with excimer and Nd:YAG lasers at the Institute of Electronic Structure and Laser, Foundation for Research and Technology – Hellas in Heraklion, Greece, on a set of gilded mock-ups on wooden support with

secondary layers common on once restored objects. Examples of cleaning other materials like coated papers from surface dirt, sooty brick, overpainted wood with layers of industrial paint, and medieval wall-paintings covered with resistant, large stains of microorganisms' attack will be presented. Along with the cleaning methods, the monitoring protocol was created to evaluate the laser treatment results. This project would be impossible without cooperation with prominent conservator-restorers and scientists, reminding us that the modern conservation of works of art is interdisciplinary.

Relief Wall Painting Fragments from Knossos

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Abstract : The purpose of the doctoral thesis is the research of the construction techniques and the recording with new technologies, of the Minoan relief wall paintings from the archaeological site of Knossos. The aim is to record, document and analyse mainly the micro-relief of the parts of the frescoes that were saved. Due to the mainly fragmentary finding and poor state of preservation of the Reliefs, their interpretation and understanding is to this day a difficult task with several levels of difficulty. The application of 3D digital imaging to these archaeological artworks will reveal new volumetric and morphological features, facilitating their documentation.

From Conservator's point of view the project of restoring a wall painting from many fragments is a difficult task. In the past Evans in collaboration with valuable partners tried to restore part of these wall paintings. Some of these restored panels are on exhibition in Archaeological Museum of Heraklion but many scholars are sceptical about their reliability. The creation of a digital 3D model can help researchers, to study and have access to many different angles of a fragile or heavy object without touching it. They ensure reliability of the archaeological documentation, as the information recorded is timely and accurate. It provides a clear understanding of the condition state and material of the object, as well as the chronology of modifications and alterations that may occur through time. In the field of conservation, they are proved to be a useful tool for digital recording. It allows visualisation and manipulation, but also, as it is a product with metric characteristics, makes it easier to understand the proportions and other volumetric characteristics.

Experience, sharp eye and focus on minor technical details of the painting are crucial elements for a conservator that can help the team to locate possible candidates for matching fragments. In later time, after examination of the 3D models of the fragments, non-invasive analytical techniques will be applied on the surface of the reliefs, in order to identify the pigments and special manufacturing techniques. Minor technical details will be recorded under the support of analytical techniques, that will be the 'eyes' of a conservator. The combination of different techniques on relief wall painting fragments is the main idea that hope to promote the restoration of cultural heritage.

In nowadays 3D models had proved to be valuable tools for the documentation & study of archaeological objects. The research of relief wall painting with a combination of modern technologies and new methodologies is expected to provide new evidence, revealing geometric information, invisible points and color details with the goal of possibly finding related parts and creating new digital proposals for the Restoration of the Minoan Wall Paintings.

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