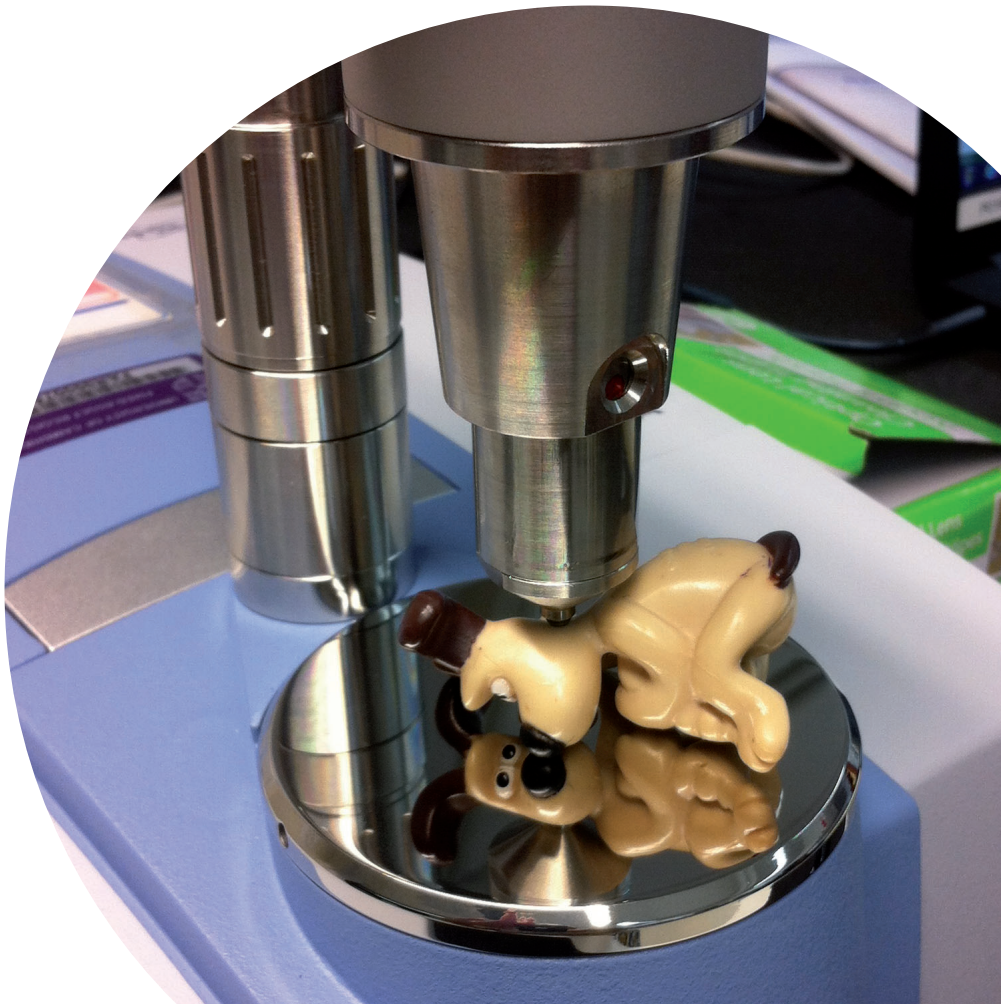
PLASTICS IN PERIL

Focus on Conservation of Polymeric Materials in Cultural Heritage

Virtual conference
November 16th–19th, 2020

BOOK OF ABSTRACTS



WELCOME TO:

Plastics in Peril: Focus on conservation of polymeric materials in cultural heritage

"Plastics in Peril" began life as two separate events, an in-person conference planned by University of Cambridge Museums, and a workshop planned by the Leibniz Association of Research Museums. COVID-19 forced the cancellation of in-person events, but opened up new and unforeseen opportunities to collaborate with colleagues further afield and build new relationships with them. So we are delighted to be able to offer for the first time a conference hosted jointly by the Leibniz Association in Germany and University of Cambridge Museums in the UK. By combining our two events we are able to have a much bigger and richer programme, and by holding the event online we can reach a much larger audience than we could with an in-person event. Almost 1000 people have registered to attend this meeting live, from every continent in the world except Antarctica. Videos of most of the presentations will also be available to view online, for free, after the event.

The programme for this conference focusses very much on practical solutions for managing plastics collections, whether they include artworks, domestic items or objects from the history of science and industry. Plastics have been incredibly useful to us over the last century, and are found in every part of our heritage. But as we know they also present a significant threat to our environment. So in discussing plastic heritage in the 21st century we must always consider the impact of our work in the wider world. This conference therefore also addresses the theme of sustainability of our practice, both in collecting and conserving these objects.

Whether you see plastics as a blessing or a curse in the world, they are an unavoidable part of the stories museums tell about our lives and history. By sharing our experiences and knowledge as widely as possible we will be more able to solve the challenges of managing plastic heritage that we all face.

The Plastics Crew

Peter Giere, Anne Hering, Simon Kunz, Anna Micheluz, Marisa Pamplona, Marieke Piepenburg, Sophie Rowe, Katja Zelljadt

UNIVERSITY OF CAMBRIDGE MUSEUMS & BOTANIC GARDEN

Leibniz Association

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MUSEUM FÜR NATURKUNDE BERLIN

Deutsches Museum

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CONFERENCE DETAILS

Scientific committee

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Kirstie French
Anna Micheluz
Marisa Pamplona
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The Plastics Crew (Organising committee)

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University of Cambridge Museums

Acknowledgements

The Plastics Crew would particularly like to thank panelists Tim Bechthold, Mary Coughlin, Katherine Curran, Joy Mazurek, and Stefan Simon, as well as Maria Elvira Callapez for her concluding remarks. We are grateful to all speakers in MEET the speaker sessions and those who agreed to assist in CHAT about a topic rooms. This conference would not have been possible without the enthusiasm, expertise, and flexibility of our speakers – thank you all!

Conference Date and Venue

The virtual conference takes place all over the world from the 16th to 19th November 2020.

How to get access to the conference platform

Link to homepage: https://www.museumfuernaturkunde.berlin/de/museum/veranstaltungen/virtual-conference-plastics-peril
Link to program: https://www.museums.cam.ac.uk/plastics-programme
Link to slido: https://www.sli.do/
Link to Slack: https://join.slack.com/t/plasticsinperil/shared_invite/zt-j4vs45z5-lB96pBFhBh_J_TR1ceHqHg

Conference platform

The entire conference will take place in Zoom. For best performance and functionality, please install the latest version of Zoom and familiarise yourself in advance with the software. Please also maximise the Zoom window during the conference in order to see all buttons. Note that, if you log in with Chromebooks / Chrome OS or Zoom Rooms you unfortunately cannot participate in the breakout rooms.

To interact more fully, please use Slido, a complementary web-based tool in which you may ask and rate questions and aggregate ideas in parallel to the Zoom interface. Furthermore, a Slack working space will be accessible before and after the conference as a platform to connect, collect and share knowledge. Further information on the digital tools and the conference will also be provided there.

Breakouts

After each keynote, panel, or session, you will have the opportunity to join break out rooms. These are intended to allow face-to-Zoom-face discussion with speakers, chat about specific topics, or free-form conversations. With these, we are attempting to substitute for the buffets and coffee tables at in-person conferences. Unfortunately, in the digital environment, you will have to bring your own lunch.

There will be three categories of breakout rooms:
"MEET" rooms, in which you will be able to meet a speaker from the previous session.
"CHAT" rooms, to discuss a specific and defined topic,
and "COFFEE" rooms which are areas that you may define yourselves.

You may choose your own breakout room and change rooms during the breakout session. As we cannot limit the number of participants in one breakout room, we kindly ask you to follow our meeting etiquette introduced on the conference days.

Netiquette

It goes without saying, but please treat everyone with respect. For ZOOM performance reasons we ask you to turn off your camera as well as mute your microphone when attending the main talks. During breakouts, please show your video if you feel comfortable to do so. Depending on the number of attendees it might be a challenge to self-organise in breakout rooms. Therefore, please use Zoom tools such as hand-raising to facilitate communication.
Please only use the "everyone" function in Zoom chat if you have technical problems. We will have Plastics Crew members standing by to try and help. Furthermore, the channel #troubleshooting in Slack can be used for finding help. Slido is our tool for content questions. Feel free to use the private chat in Zoom with one another whenever you like.

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PROGRAM

PROGRAM

MONDAY, NOVEMBER 16TH, 2020

08:40 – 08:55	Welcome	J. Dawson M. Kleiner S. Brüggerhoff
09:00 – 09:40	**Keynote 1**	
	Maximising information obtained from surveying polymers in museum collections: The importance of iterative terminology development and data curation	P. Nel
	Discussion	
09:45 – 11:25	**1. „What am I?“ — Identification of plastics**	
	Plastification: the plastic identification tool and workshop that helps to identify plastics in your collection	C. van Aubel et al.
	Save the plastics! Identification and condition survey in Belgian museums	H. Hendrickx et al.
	The quest for an affordable identification tool for plastics in museums	S. Rowe
	Q&A session 1	
11:25 – 11:30	Break	
11:30 – 12:00	**„Connect in digital space“ — Meet a speaker, chat about a topic or meet for a coffee**	
12:00 – 12:55	Lunch	
12:55 – 15:00	**2. „A goal without a plan is just a wish“ — Collection management**	
	Beg, borrow and steal: developing preservation strategies for plastics in large multidisciplinary collections	A. Cannon et al.
	Understanding plastics in our collection: a survey at the Harvard Art Museums	G. Rayner, S. D. Costello et al.
	A tale of two national collections, Canada	S. Warren
	The problem of numbers — plastics in Natural History Collections: a case study	P. Giere
	Q&A session 2	
15:00 – 15:05	Break	
15:05 – 15:35	**„Connect in digital space“ — Meet a speaker, chat about a topic or meet for a coffee**	
15:35 – 15:40	Closing day 1	

MEETING TIMEZONE **GREENWICH MEAN TIME** (GMT)

TUESDAY, NOVEMBER 17TH, 2020

09:40 – 09:45	Welcome	
09:45 – 11:25	**3. "Today's and tomorrow's sorrows" — Storage and global warming**	
	Plastic in the Pacific	V. Tomlinson, R. Satele
	How to deal with a self-destructive plastic in museum collections? Storing cellulose nitrate 3D objects at the Deutsches Museum	C. Elsässer et al.
	Cellulose nitrate badges: are they at risk of fading and is it safe to store them in a freezer?	M. Hacke, C. Korenberg
	Q&A session 3	
11:25 – 11:30	Break	
11:30 – 12:00	**„Connect in digital space" — Meet a speaker, chat about a topic or meet for a coffee**	
12:00 – 12:55	Lunch	
12:55 – 13:40	**Keynote 2**	
	Collective Care: Notes from Now	J. Sterrett
	Discussion	
13:40 – 15:25	**4. "From pop to blob" — Science driven decisions in plastics conservation**	
	Helping "Hinz" and "Kunz"? Analysing and conserving two robotic prototypes from the Deutsches Museum in Munich	J. Sawitzki et al.
	Investigating paint materials in street art mural paintings through spectroscopic and mass spectrometric approaches	F. Modugno et al.
	Challenges and chances in surveying plastic objects in an industrial heritage collection. A visual atlas of damage phenomena in plastics.	T. Krieg, C. Mazzon et al.
	Q&A session 4	
15:25 – 15:30	Break	
15:30 – 16:00	**„Connect in digital space" — Meet a speaker, chat about a topic or meet for a coffee**	
16:00 – 17:00	**Panel discussion**	
	„A blessing and a curse" - plastic collections in the modern world	K. Curran, J. Mazurek, M. Coughlin, T. Bechthold, S. Simon
17:00 – 17:05	Closing day 2	

MEETING TIMEZONE **GREENWICH MEAN TIME** (GMT)

PROGRAM

WEDNESDAY, NOVEMBER 18TH, 2020

09:40 – 09:45	Welcome	
09:45 – 11:25	**5a. "Pop, blob and back again" — Treatment techniques**	
	Should we clean plastics like we clean paintings? A study in cleaning plasticised poly (vinyl chloride)	J. Morrison, P. Nel
	Approaching the preservation of polyurethane soles on football boots	G. Flexer, K. Spring
	Pemulen™ and poly (vinyl alcohol)-based treatments: Discussing cleaning applications on poly (methyl methacrylate) museum objects	S. Kavda
	Q&A session 5a	
11:25 – 11:30	Break	
11:30 – 12:00	**„Connect in digital space" — Meet a speaker, chat about a topic or meet for a coffee**	
12:00 – 15:15	Lunch	
15:15 – 17:00	**5b. "Pop, blob and back again" — Treatment techniques (continued)**	
	The plastic bag as art: three case studies on the treatment of clear, flexible plastic sheeting in contemporary art	J. Bloser
	Conserving Line Vautrin's Talosel resin objects	L. Mannina, G. Crowther
	Preserving and recovering the original: Developing conservation treatments for damaged plastic artifacts	A. Laganà
	Q&A session 5b	
17:00 – 17:05	Break	
17:05 – 17:35	**„Connect in digital space" — Meet a speaker, chat about a topic or meet for a coffee**	
17:35 – 17:40	Closing day 3	

MEETING TIMEZONE **GREENWICH MEAN TIME** (GMT)

THURSDAY, NOVEMBER 19TH, 2020

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	The case of the vanishing Gabos: the Gabo Collection at Tate	G. Sofer et al.
	Sustainable strategies using supercritical carbon dioxide for the conservation of plastics: insight from the PlasCO2 project	A. Bartoletti et al.
	The dynamic composition: learning from the CH 1 38 Rho Space Modulator	M. Creamer
	Q&A session 6	
14:10 – 14:15	Break	
14:15 – 14:45	**„Connect in digital space" — Meet a speaker, chat about a topic or meet for a coffee**	
14:45 – 15:15	Lunch	
15:15 – 16:00	**Keynote 3**	
	Working side-by-side: The necessarily close collaboration between conservation scientist(s) and conservator(s) at restoration treatments	T. van Oosten
	Discussion	
16:00 – 17:45	**7. "A good atmosphere" — Packaging and micro-pollutants**	
	Decision making in conservation based on modelling and measuring diethyl phthalate plasticiser loss from cellulose acetate in varied ventilation conditions	A. Gili et al.
	A smart future for cellulose derivatives conservation	A. Neves
	Ozone test strips for PVC plastics?	M. Coughlin
	Q&A session 7	
17:45 – 17:50	Break	
17:50 – 18:20	**„Connect in digital space" — Meet a speaker, chat about a topic or meet for a coffee**	
18:20 – 18:30	Closing remarks	M. E. Callapez

MEETING TIMEZONE **GREENWICH MEAN TIME** (GMT)

KEYNOTE

KEYNOTE

OPTIMISING THE USEFULNESS OF INFORMATION OBTAINED FROM SURVEYING POLYMERS IN MUSEUM COLLECTIONS

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Australia's PolyMuse project originates from early investigations conducted into the identification of polymer-based adhesives associated with archaeological pottery. Unlike equipment used in the 1980s, in the 2000s the non-destructive *in-situ* analysis of organic materials had become possible with the development of portable ATR-FTIR (Attenuated Total Reflection Fourier Transform Infra-Red) spectroscopy. This led to its adoption by materials conservation where it is now a technique commonly used in the museum sector. Consultation and partnering with Museums Victoria by the University of Melbourne led to the early adhesives research being extended to the management of malignant polymers in museum collections. Seed funding developed into a nationally funded collaborative research program. Focusing on four priorities (identification, collection surveys, degradation and conservation), the project aims to discover methods for predicting and extending the lifespan of polymers, informed by and relevant to the needs of the heritage sector. Significantly, it brings together conservators, scientists, and additional relevant expertise, from four universities, five museums and an art gallery located across four major cities, aided by postgraduate student research projects. Careful planning and ongoing improvements have contributed to the usefulness of information obtained for the project and future analysis purposes.

As a starting point it is believed investment into resources and expertise associated with FTIR spectroscopy is vital for the rapid identification and characterisation of polymeric materials. However, success with ATR-FTIR instrumentation requires use of a good reference database. PolyMuse is using a commercial database and an in-house database developed from reference materials and objects. These reference materials are being used to build new databases as promising techniques arise. For instance, external reflectance (ER)-FTIR, unlike ATR-FTIR, does not require contact with an artefact, and is useful for identifying formaldehyde-based polymers and cellulose esters in historic film and photography collections. It is envisaged, that polymer identification data from collection surveys will be made available via a relational database, that will enable and inform: visualisation of large data sets, sharing of information, decision-making around the allocation of resources, future research and the development of expertise in this area, critical for the preservation of vulnerable collections for future generations.

COLLECTIVE CARE: NOTES FROM NOW

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Discovering a process for making celluloid in 1869 was but one of John Wesley Hyatt's inventions, which also included a multi-stitch sewing machine and a system for purifying water. Treating cellulose with camphor to produce plastic that could be molded and shaped to imitate materials such as ivory and horn was heralded in its day as an environmentally sustainable innovation. This pioneering plastic was a savior to the elephant and the tortoise and it promised to liberate people from the social and economic constraints imposed by the scarcity of natural resources. Some two centuries later we see, more fully, the far-reaching effects of plastic on our world.

In 2020, the racial, financial and health impacts of the global pandemic have put every aspect of our society under scrutiny. Cultural organizations of all kinds are reckoning with the ways we have built sustainable systems to help us make meaning in our lives. For conservators, perhaps it is time to connect how individual objects are analyzed and treated with larger institutional ambitions for impact on people. Making objects mean more to more people means addressing sustainability in all of its myriad forms. Are museums financially, environmentally and socially tuned for the 21st century? How will recalibration be made manifest in the ways we understand, care for and conserve the plastics that have defined the modern and contemporary era of the last 150 years?

This presentation will intentionally short-circuit a few museum traditions in order to shake loose old habits and try on new possibilities for the future.

SIDE-BY-SIDE - THE NECESSARY CLOSE COLLABORATION BETWEEN CONSERVATION SCIENTIST(S) AND CONSERVATOR(S) AT RESTORATION

Thea van Oosten
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Conservation of plastics in modern and contemporary art and design, nowadays common practice, is challenging due to the sometimes not well understood physical properties of polymers.

Properties of paper, metals, wood and textiles are not unknown for conservators, but plastics properties are lacking.

Even if properties of plastics are known through datasheets provided by manufacturers, behaviour of plastics as result of physical, chemical, mechanical and thermal properties are complex and is depending on many factors such as the objects design, environment and objects uses and display.

Since 1996 (1), a methodological approach that takes into account the complexity of modern art, is used at the conservation of modern and contemporary art, and is common sense nowadays.

Collaboration between conservators, conservation scientists, artists and curators and other stakeholders is successful. However close collaboration (side-by-side) of conservators and scientists provides even more insight in each other's knowledge world, benefitting the works

In this presentation four types of conservation treatments: cleaning, adhering, replacing and consolidating will show polyvinyl chloride (PVC), polypropylene (PP), cellulose acetate (CA) and polyamide (PA) in works of art. These four plastics, show each in their own way, unexpected problems. Solutions for these problems solved by working side-by-side are highlighted.

The importance of knowledge of physical/mechanical properties at restoring plastics, as well as the usage of analytical equipment, will be discussed.

(1) Hummelen, Ijsbrand M. C., and Dionne Sillé, eds. 1999. Modern Art, Who Cares?*: An Interdisciplinary Research Project and an International Symposium on the Conservation of Modern and Contemporary Art.* Amsterdam: The Foundation for the Conservation of Modern Art; Netherlands Institute for Cultural Heritage.

1. “WHAT AM I?” — IDENTIFICATION OF PLASTICS

PLASTIFICATION: THE PLASTIC IDENTIFICATION TOOL AND WORKSHOP THAT HELPS TO IDENTIFY PLASTICS IN YOUR COLLECTION

Carien van Aubel, Olivia van Rooijen, Suzan de Groot, Henk van Keulen, Lydia Beerkens
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Unstable plastics are becoming a well-known phenomenon in (contemporary) art collections. To trace those plastics and to inventory the plastics in a collection, it is essential to know the types of plastic. Therefore, the Foundation for the Conservation of Contemporary Art (SBMK) and the Cultural Heritage Agency of the Netherlands (RCE), launched in 2017, Project Plastics, a project within the Netherlands Institute for Conservation, Art and Science (NICAS). During this project, which lasted two-and-a-half-year, a Plastic Identification Tool (1) was developed along with a workshop, which facilitates a learning environment for organisations that care for plastic artworks in their collection. The workshop was initially set-up in Dutch, but due to international interest translated in English and presented at Future Talks 019 in Munich, November 2019.

The practical use of this tool is being taught in a two-day workshop in which plastics are divided in four distinct groups: foams, films, elastomers and rigid materials. While encountering many different plastics in a variety of objects, participants learn to identify plastics by seeing, feeling, smelling and hearing. Following the workshop, participants have the opportunity to identify plastics in the collection of the museum involved during a collection survey.

After the workshop and survey, the participants’ knowledge about plastics is greatly enhanced and they will be able to further identify plastics in their collections with the use of the Plastic Identification Tool. Furthermore, the Plastic Identification Tool provides guidelines regarding the preventive conservation of the plastics. The identification and the created awareness of plastics in the collection may lead to improved circumstances, which can prolong the lifetime of the plastic objects in the collection.

This presentation will outline the shape of the tool by using examples from a collection survey performed during the project.

(1) https://plastic.tool.cultureelerfgoed.nl/

SAVE THE PLASTICS! IDENTIFICATION AND CONDITION SURVEY IN BELGIAN MUSEUMS

Hannah Hendrickx, Eline van der Velde, Griet Kockelkoren, Wim Fremout
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This paper discusses the project 'Know, name and assess your plastics' (Oct. 2018 – June 2021), an initiative taken by Design Museum Gent and S.M.A.K., in cooperation with the Royal Institute for Cultural Heritage in Belgium (KIK), the Cultural Heritage Agency of the Netherlands (RCE) and The Cologne Institute of Conservation Sciences (CICS – TU Köln). The project is a testing ground for building up expertise concerning the care of plastics. We want to develop a workflow which enables collection workers to take better care of the plastics in their collections. As it needs to be applicable on different types of collections we have got several museums engaged with various types of collections in Belgium; photography, fashion, modern and contemporary art, design objects, applied arts and industrial heritage.

The collection of Design Museum Gent and S.M.A.K. comprises approximately 3,500 and 450 objects that are made entirely or partly from plastic. Like in many other museums, these objects are often not further specified and are only categorized under 'plastics'. Whereas the care of plastics starts with knowing what you are dealing with, further identification is necessary. During the first phase of the project (Oct. 2018 – June 2019) we worked on the development and implementation of a thesaurus for plastic materials, as a correct digital database is necessary to write proper inventory. Additionally we thought of a method to categorize plastic objects into groups depending on the urgency for conservation measurements and frequency for monitoring.

In July 2019 we started the second phase of the project. The main goal here is to identify, condition check and categorize as many objects as possible of the collections of Design Museum Gent and S.M.A.K. during the course of a year to optimize the care of our plastics in our brand new depot. We will make use of different identification methods such as artist interviews, literature research, product data sheets, the Plastics Identification Tool (PIT) and the identification flow chart of MoDiP. In phase three (July 2020 – June 2021), the plastics which could not be identified will be analyzed by KIK using analytical equipment. Furthermore guidelines will be implemented for cleaning, storing and exhibiting our plastic collections.

By combining the strengths of both museums, we can combine two different perspectives, i.e., modern and contemporary art on the one hand and applied art and design on the other hand. The collections require a specific approach, both for the identification as well as the future preventive conservation measurements. At the end of February we will finish our survey at Design Museum Gent. At the Plastics in Peril conference we would like to present our project, working method and the initial results of the identification and condition survey.

THE QUEST FOR AN AFFORDABLE IDENTIFICATION TOOL FOR PLASTICS IN MUSEUMS

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The University of Cambridge Museums are home to thousands of artefacts made of plastic or with plastic components. Most of these objects are from the history of science and exploration or part of ethnographic collections where domestic items have been re-purposed to make new objects or artworks. Identifying the materials in these objects is crucial to preserving them in the most way.

Fourier Transform Infrared Spectroscopy (FTIR) provides the gold standard in identifying the plastics found in museum objects, but in practice it is difficult to use for a non-specialist and the equipment is prohibitively expensive for all but the most well-resourced museums. Meanwhile non-analytical methods to identify plastics can be unreliable. There is a need for a more affordable and user-friendly reliable analytical tool to identify plastics in museums and inform conservation decisions.

This presentation will describe an ongoing project at the University of Cambridge Museums to develop such a tool. Focussing on the five most problematic polymers found in museum objects (cellulose nitrate, cellulose acetate, PVC, polyurethane and rubber), we have devised a robust methodology to test how reliably different equipment can identify these materials, using FTIR results as a control.

In the first stage of the project we have tested the SCIO handheld near infra-red spectrometer and a Quality Tek Spec Fibre-Optic Reflectance Spectrometer, successfully demonstrating the feasibility of our method. We have also proved that the SCIO is not suitable for identifying museum plastics. We will present these results, and show how we are currently using them to specify the next stage of the project, which will be undertaken in collaboration with sensor specialists in the University of Cambridge.

2. “A GOAL WITHOUT A PLAN IS JUST A WISH”— COLLECTION MANAGEMENT

2. "A GOAL WITHOUT A PLAN IS JUST A WISH"

BEG, BORROW AND STEAL: DEVELOPING PRESERVATION STRATEGIES FOR PLASTICS IN LARGE MULTIDISCIPLINARY COLLECTIONS

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The last two decades have seen many advances in the identification, preservation and conservation of plastics in museum collections. Yet, the scale of the problem still defeats us. Many preservation approaches are relatively quick to implement but can only be applied item-by-item, such as anoxic enclosures or the use of chemical adsorbents. Other approaches can potentially be applied to whole collections, such as cool storage, but have a long lead-in time (to plan, fund and build) and significant capital and ongoing operational costs.

The quantity, physical size and complexity of objects containing plastics in social history collections complicates any decision-making process, particularly when resources are limited. Museums Victoria has invested significant time in conducting condition surveys and FTIR analysis of hundreds of plastics objects within its collection. However, even armed with this information, we will still have to make 'educated best guesses' about how to manage the rest.

The issues of size, quantity, complexity and uncertainty are not unknown to cultural organisations. For example, archives and libraries have long dealt with huge quantities of material (film, newspapers), devising management strategies such as 'distributed' digitisation programs (where libraries keep physical copies only of their home state newspapers and share digitised copies with the rest) and the concept of 'sentencing', where the lifespan of records is designated on acquisition and subject to disposal schedules. The conservation of contemporary art, kinetic art and time-based media has seen a growing focus on thorough component documentation and frank discussions with creators about which short-lived components can be replicated or replaced once they are no longer fit-for-purpose. In other cases, a strict 'do no resuscitate' approach is taken, with the work living on only in its degraded form or in documentation. Can such deliberate approaches also be used to manage plastics in large, multidisciplinary museum collections?

Of course, to effectively choose and use any preservation strategy we must first assess the significance of the objects in question—either whole, by component, or even by collection. We need to define what it is about the plastic parts that are important to its value and purpose, and what we are willing to let go. But even this step is hard and labour-intensive, particularly as we will need to apply it retrospectively to a huge number of objects. In this as in all other areas, we will need to make informed judgements about whole groups of objects, based on what we know about a sample.

By doing nothing, we effectively choose the 'do not resuscitate' approach for many plastics. Even if this is determined to be the most appropriate course for many items, it is preferable that we choose to do it—and to document why we did. This paper presents a range of management options begged, borrowed and stolen from related disciplines—including scaled storage approaches, documentation and decision-making protocols, triage and access-driven prioritisation, disposal schedules, and distributed resource networks— and shares Museums Victoria's path and progress towards a deliberate preservation strategy for plastics.

UNDERSTANDING PLASTICS IN OUR COLLECTION: A SURVEY AT THE HARVARD ART MUSEUMS

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In 2016, the conservation department at the Harvard Art Museums began the first comprehensive survey of polymeric materials in the collection. The severe degradation of objects like Claes Oldenburg's False Food Selection (1966, M26457) highlighted the need for this survey. Its ready-made plastic food elements have discolored, deflated and bloomed. The spoiling of the food is undoubtedly due to its unstable materials; a combination of polyurethane, poly(vinyl chloride) and rubber – three of the most at-risk plastics in museum collections. The survey sought to determine the scope of plastics in the collection, to identify the plastics using analytical research methods, to update the media information in the museums' collection database (TMS), to upgrade storage and housing and to undertake conservation treatments as necessary. This talk will present an overview of the survey process and techniques, highlight findings and case studies, and share challenges encountered during this ongoing project.

The objects surveyed were initially identified in TMS. Museum records for plastic-containing objects were not systematic; plastic materials could be labelled simply as a 'plastic' or 'acrylic,' or as a specific brand name such as 'Plexiglas,' and even fall under the generic category of 'mixed-media.' Since mid-2016 over 400 objects containing plastic have been examined. Each object was assigned a condition rating on a scale of 1 to 4, with 1 being stable and in good condition and 4 being unstable and in need of immediate attention. Keywords, developed using plastic survey frameworks from the Victoria and Albert Museum and the POPART (Preservation of Plastics Artefacts in Museum collections) project, were assigned to each object to describe the deterioration fitting into the categories of physical, chemical or other damage. Identification of 30 different polymer types, including all five of the most vulnerable plastics, was obtained through the tandem use of FTIR and pyrolysis-GCMS, which required sampling.

Most of the objects surveyed were in stable condition. Only 14 % of the objects were deemed unstable, with 13 in need of immediate attention. As a result of the survey, treatments have been completed on a poly(vinyl chloride) work by Joseph Beuys exhibiting serious plasticizer migration and a regenerated cellulose book cover by Herbert Bayer in multiple pieces. Currently we are planning treatment and preservation for a Naum Gabo sculpture made of cellulose acetate, which has warped and sagged.

We continue to identify plastics in our collection, predominantly objects lacking correct media descriptions in TMS. The current challenges include following up on survey results by undertaking conservation treatments, limiting light exposure where appropriate, improving housing whilst maintaining access to objects, improving art storage while taking into account limited space and cost, increasing awareness throughout the museum of the needs and limitations of plastics, digitizing analog audio/visual materials, identifying plastics for potential new acquisitions, and determining the best way to monitor our plastic objects moving forward.

2. "A GOAL WITHOUT A PLAN IS JUST A WISH"

A TALE OF TWO NATIONAL COLLECTIONS, CANADA.

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This paper offers a unique perspective on how two Canadian National Museums are managing plastics in their collections. The author worked for 30 years with the industrial and social history collection of Ingenium Canada (formerly the Canada Science and Technology Museum Corporation); and now works with the archaeology, ethnology and history collection of the Canadian Museum of History (CMH).

There is a vast difference in the type of objects in each of these two National collections; and this has had an impact on the relative priority for preserving historic plastics within the collections. In objects of technological history, or mass-produced items of social history; there is the expectation that plastics will be present and that they must be preserved. On the other hand, the majority of the collection of the Canadian Museum of History, is archaeological and ethnographic; where there is little to no expectation (or presence) of plastics. It is only in the History collection, which is the fastest growing collecting subject area at CMH, that plastics are a major component. Two other "Collection groups" at CMH which also contain a high number of plastics; are the Children's Museum collection, and the Postal Museum collection. In all, there are almost 22,000 objects containing synthetic materials, recorded in the database.

Despite their differences, the approach to long term preservation planning for both institutions has actually been quite similar. In 2012, the author undertook an internal collection plastics survey of Ingenium collections. This in turn, led to the initiation of a Collection Risk Assessment project for the entire collection; in collaboration with the Canadian Conservation Institute. This was the first collection of this type, complexity and size; that CCI had assessed. The results of the assessment were available in time to inform decisions about the design and functionality of a new Storage facility, on which construction began in 2017. Several of the highest risks were directly related to the deterioration of early plastics, and this paper will discuss those; as well as planning for the new storage facility, and preparing for the move into the new building (still under construction at the time of writing).

In 2017, the Canadian Museum of History initiated their own Collection Risk Assessment project, on a slightly different model; with the intent of long term strategic planning for collections. The summary reports are not yet compiled; however third quarter results are showing a high risk to plastics, even though these materials have not been considered particularly numerous nor problematic in the Museum's past. Full results are anticipated by end of March 2019.

Drawing upon experience at Ingenium with their Plastics survey, their Collection Risk Assessment, and planning for long term storage; the author will discuss the approach to creating a Plastics preservation strategy at CMH. Using the findings of the CMH Risk assessment project, extrapolating some of the mitigation strategies from Ingenium; and linking this with a survey of plastics in the History, Postal and Children's Museum collections; the author will describe the methodology being used to create a long term plan, and to identify and prioritize resources for mitigating risk.

THE PROBLEM OF NUMBERS – PLASTICS IN NATURAL HISTORY COLLECTIONS: A CASE STUDY

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Natural history collections are made up of individuals or series of specimens taken from nature and preserved for study and display. Other than artefacts and objects in collections of cultural and technical history, they are not human-made. Treatment is normally includes the preparation of the specimens for the preservation of the respective physical and biochemical properties or to access the fossilized information hidden in a rock.

Due to the scope of the collection, specimens are derived from nature and as such, rarely contain plastics. However, modern materials are used in many ways for the storage, documentation and presentation of these objects. Thus, natural history collection are not exempt from the conservation issues surrounding other collection types with regard to decaying polymers. Rather, the high numbers of specimens possibly affected by these processes pose a potentially serious threat to the collection if failure of associated plastic elements occurs widespread and within a short time frame.

This presentation provides examples of modern materials used in natural history museums and points out potential problems and hazards due to the varied uses of plastics in conjunction with specimens in storage and on display.

3. “TODAY’S AND TOMORROW’S SORROWS” — STORAGE AND GLOBAL WARMING

3. "TODAY'S AND TOMORROW'S SORROWS"

PLASTIC IN THE PACIFIC

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Auckland Museum is working toward upgrading its storage of high risk plastics to preserve them better, and to keep them from affecting surrounding materials. A new in-house built anoxic system has been planned for storage of such material in cold, anoxic conditions.

This presentation will outline the in existing in-house anoxia systems, it's versatility, the future plans for further developing the system for cold anoxic storage, the impacts of CoViD19 on the plans, and the actual practice that is being put into place in light of the CoViD 19 induced changes.

HOW TO DEAL WITH A SELF-DESTRUCTIVE PLASTIC IN MUSEUM COLLECTIONS? STORING CELLULOSE NITRATE 3D OBJECTS AT THE DEUTSCHES MUSEUM

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The development of moulded cellulose nitrate (CN) at the end of the 19th century is considered a milestone in the history of polymers, marking the starting point of the commercial use of plastics. Items entirely or partly made of CN are an important part of many historical, technological and art museum collections, but the innate instability of the material renders them challenging to preserve. During CN degradation, emitted toxic gases lead to an autocatalytic breakdown and become a substantial threat to materials in close proximity.

For conservation strategies it is important to: 1) locate objects suspected of being made of CN in a museum collection, 2) identify those made of CN and 3) understand the ageing mechanisms that will allow us to delay decomposition. This task reaches and connects different departments across the museum: from the awareness of the curators of early plastics in their collection, to the recognition of possible cellulose ethers by conservators of the collection management and the analysis of the polymer by the conservation science department. In recent years, over 200 3D objects have been investigated in that way. Among objects of daily use, namely combs, toys and eyeglass frames, also parts of iconic objects such as the original X-ray picture of Max von Laue (1912), the keys of Cipher machine 41 (1941-1944) and Hohnerola (1956) of the Siemens studio were identified by means of FTIR-ATR.

The current storage practice at the Deutsches Museum involves the transfer of identified CN artefacts to a separate storage area with improved ventilation. Objects are placed directly on shelves facilitating their monitoring. For the long-term preservation of these objects, other storage possibilities should be considered. The lower the storage temperature is, the slower the chemical processes are and therefore the decay. However, the mechanical and physical stress, as well as condensation phenomena, taking place during cold storage could also play an important role. Therefore, the impact of a range of below room temperature storage conditions on 3D-CN objects and evaluation of their suitability in museum practice are currently being addressed at the Deutsches Museum. All these aspects will be presented and discussed.

INVESTIGATION OF PLASTIC OBJECTS FOR PERMANENT DISPLAY IN THE CITI MONEY GALLERY AND ASSESSMENT OF THE SAFETY OF DISPLAY AND FREEZER STORAGE FOR CELLULOSE NITRATE BADGES

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A selection of plastic objects from the Citi Money Gallery, as well as unregistered surrogate objects available for experimentation, were investigated using FTIR spectroscopy, XRF analysis and SEM and optical microscopy in order to identify object composition and were subjected to microfadometry, accelerated light-ageing and exposed to freeze-thaw experiments in order to gain information regarding their stability. Recommendations were made for some objects on permanent display to be regularly inspected by a conservator (annually or every two years). Tests on cellulose nitrate badges showed that light exposure was of less concern than first anticipated and no special recommendations were required for their display other than those applicable to all sensitive organic materials. Freeze-thaw tests on cellulose nitrate badges showed that this is a safe method for the long-term storage and preservation of these vulnerable materials.

4. “FROM POP TO BLOB” – SCIENCE DRIVEN DECISIONS IN PLASTICS CONSERVATION

HELPING “HINZ” AND “KUNZ”? – ANALYZING AND CONSERVING TWO ROBOTIC PROTOTYPES FROM THE DEUTSCHES MUSEUM IN MUNICH

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In robotic research and the pre-production phase, the goal is to develop an at least short-term functional robotic prototype. Being an initial model for following research or production, mainly built in research facilities, laboratories or workshops, the choice of materials is neither always fully thought through nor designed for long-term preservation. One of the main reasons for the material selection is the short-term functionality of the robot, which is normally not built for a long-term usage or a general longevity. Since the used materials are rarely documented, it is hardly possible to get information via literature or other written sources. Consequently, the preservation of these prototypes and their technology is linked to the mostly unknown materials, challenging collections and museums like the Deutsches Museum in Munich.

An example are the two robots “Hinz” and “Kunz” from 1963. Being the first cybernetic models in Europe, they were built to demonstrate learning processes in the human brain. The two prototypes are mainly consisting of metals and plastics of which the latter show – depending on the component – severe signs of degradation varying from embrittlement, yellowing and cracks to the migration of crystals. To investigate the material composition, the synthetic polymers were closely examined and analysed using Fourier-transform infrared spectroscopy with attenuated total reflectance (FTIR-ATR). Through the achieved information, measures could be taken to prevent or delay deterioration processes and actively influence the aging properties and preservation. Furthermore, it supported the choice of materials and means for conservation.

Besides the conservation, the aim was to reduce risks during storage and exhibition. For this, an installation and a storage solution were developed to ensure the robots were sufficiently supported and their materials were not exposed to tensions nor harmful pollutants as far as possible. This case study demonstrates how complex objects like prototypes have special requirements and the need to be researched, to make sure they remain for further generations.

INVESTIGATING PAINT MATERIALS IN STREET ART MURAL PAINTINGS THROUGH SPECTROSCOPIC AND MASS SPECTROMETRIC APPROACHES

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Street art murals are an artistic expression strictly interwoven in the urban landscape, and in recent years have received increasing attention as cultural heritage at risk. Today there is intense debate regarding the value assessment and choices related to the conservation of urban art; however, the evaluation of the stability of modern paint materials in outdoor environment is preliminary to any possible preservation strategy. In particular, the identification of the materials constituting a street artwork is critical for the preservation of these non-permanent heritage elements and to define the best restoration approaches. In this work we performed a set of analyses of microsamples based on spectroscopy, analytical pyrolysis, gas and liquid chromatography, and mass spectrometry to identify paint materials (binders, pigments, additives, degradation products and conservation/restoration materials) of a selection of mural paintings, covering 60 years of history (1953-2014). The goal of this work was to identify the materials used to produce different mural paintings and to relate and compare their different compositions with previous studies in order to describe the evolution of the materials during the last 60 years. The collected knowledge and the limited data available in literature were exploited to increase the scientific background on the materials used by street artists, and to fill the lack of knowledge on this emerging topic.

CHALLENGES AND CHANCES IN SURVEYING PLASTIC OBJECTS IN AN INDUSTRIAL HERITAGE COLLECTION. A VISUAL ATLAS OF DAMAGE PHENOMENA IN PLASTICS.

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The Deutsches Bergbau-Museum Bochum (German Mining Museum) is presently carrying out a survey of objects containing plastic parts from a materials science and conservation point of view. The museum collection focuses on Industrial Heritage and contains, among others, technical appliances, machines and protective equipment used underground, above ground or otherwise related to mining and metallurgy.

After inspection of the damages and documentation of the present conservation state of a representative selection of the museum collection, materials were analysed by means of a handheld FTIR.

The collected information has been gathered into a dedicated database that includes a comprehensive damage atlas. The multifaceted collection is an ideal basis to compare the ageing of plastic materials, to evaluate different conditions and detect correlations. Evaluating damage phenomena, however, is a challenging task - especially when surveying plastics. While the literature offers (1) an extensive list of possible damages, not all definitions available are unambiguous. (2, 3, 4) There is therefore a need for an established canon of damages in plastics. The present work offers a comprehensive collection of damages with definitions, supported by pictures.

The database can be understood as a tool for future condition assessment. In order to analyse damage processes and perform early interventions, a periodic monitoring is desirable. This talk will also present the first results of the survey and highlight the kind of information that can be won from such an effort.

To date, 95 objects have been inspected and 410 plastic parts examined; until the end of the project 150 objects will have been surveyed. Using FTIR, 35 different plastics have been identified. The main aim of our survey is to identify and locate the so-called “malignant plastics”. Among the plastic parts identified, 91 of these fall within this group, mainly polyvinyl chloride (46 plastified PVC, 18 unplastified) and cellulose nitrate (22 plastic parts, of which 15 are CN coatings).

The interpretation of the collected data also reveals the conservation needs of modern materials in the collection. At this point, 7 % (30 plastic parts) of the total plastic parts are in a poor, very poor or ‘unacceptable’ condition, the latter meaning the object can no longer be exhibited due to its condition.

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5. “POP, BLOB AND BACK AGAIN” — TREATMENT TECHNIQUES

5. "POP, BLOB AND BACK AGAIN"

SHOULD WE CLEAN PLASTICS LIKE WE CLEAN PAINTINGS? A STUDY IN CLEANING PLASTICISED POLY (VINYL CHLORIDE).

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The cleaning of plastics poses a significant issue in cultural collections. Highly susceptible to attack from mechanical, organic and ionic cleaning agents, it can seem impossible to find products that deliver adequate cleaning of plastic materials without causing damage in the process. This paper addresses these issues, and explores how techniques, knowledges and decision making processes used in painting conservation can be used to deliver sophisticated, inexpensive, and accessible strategies for the cleaning of plastics.

Drawing on original research conducted for a minor-thesis project about the cleaning of both aged and new Plasticised Poly (Vinyl Chloride), this paper explores how principles of ion concentration, polarity, chelation, gel-formulations and colloidal interface can be used to arrive at ideal cleaning methods for plastics, and how combinations of FTIR-ATR, optical microscopy, colorimetry and accelerated ageing can be used to evaluate the effectiveness and damage incurred by cleaning processes. The principle finding of this research is that neat solvents, detergents and acidic or basic solutions should not be used unaltered, but should rather be tailored specifically to the needs of the polymeric material being treated.

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APPROACHING THE PRESERVATION OF POLYURETHANE SOLES ON FOOTBALL BOOTS

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The sentimental value of football memorabilia is strong, bringing people within tangible reach to their heroes. When a pair of football boots entered the Conservation and Museums Advisory Service, worn by world renowned player George Best, it was Object Conservator Gabrielle Flexer's role to help preserve that connection.

Supporting museums across Wiltshire, the Conservation and Museum Advisory Service (CMAS) also preserve items of personal value for private individuals. George Best's football boots, owned by a collector and enthusiast, entered the conservation studio in 2014. Luckily plenty of information was available via the Adidas history team regarding the materials, manufacture and style of the boots in question.

Years of deterioration and well-meaning attempts at restoration meant multiple layers of original and added materials needed to be identified and significance understood before any treatment could be considered. Following FTIR analysis kindly undertaken by the V&A the plastic was identified as polyurethane as well as additional materials including plaster fills, adhesive and paint. Many loose pieces, blooming on the original surface and missing areas meant interventive treatment would be needed to meet the request that the object be returned to a displayable condition.

With the desire to avoid the use of solvents, particularly water, a search to identify potential fill materials was undertaken, arriving at a wax resin fill technique used for replicating fills in marble. Extensive tests on different materials, tinting colours and application techniques lead to a difficult to execute but mostly satisfactory result.

5. “POP, BLOB AND BACK AGAIN”

PEMULEN™AND POLY (VINYL ALCOHOL)-BASED TREATMENTS: DISCUSSING CLEANING APPLICATIONS ON POLY (METHYL METHACRYLATE) MUSEUM OBJECTS

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This talk will look at the use of Pemulen™/triethanolamine and 80 % hydrolysed poly (vinyl acetate)/borax for the cleaning of three 20th century objects made of transparent, colourless poly (methyl methacrylate) (PMMA). The treatments were aqueous and coupled with a range of polar and nonpolar solvents. The objects selected as case studies were a half meter long Arabic letter belonging to a neon-shop sign and two smaller flower-shaped lighting lamp shades. The aim of these cleaning applications was to test whether the gel treatments that were optimised on model PMMA surfaces under laboratory conditions, were able to achieve equally successful results in real-life conditions. The talk will focus on the cleaning efficiency of the treatments at removing loose soil, dirt deposits and self-adhesive tapes, and the (dis) advantages of their use. It will discuss the ease of their application and removal that is reliant on the physical properties of the different gel formulations. Potential long-term risks to PMMA as a result of solvent-gel cleaning will also be presented. The case studies showed that the PMMA objects were more effectively cleaned with Pemulen™/triethanolamine treatments. The physical properties of the gel systems were shown to be the most significant factor influencing the cleaning efficiency. It was highlighted that the choice of a gel treatment should be based on physical properties that match the size, shape and surface texture needs of the object to be treated.

THE PLASTIC BAG AS ART: THREE CASE STUDIES ON THE TREATMENT OF CLEAR, FLEXIBLE PLASTIC SHEETING IN CONTEMPORARY ART

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As the world races to ban the plastic bag, its use in art as a reclaimed and repurposed material is still very prominent. Treatment options for clear plastic bags, film, and sheeting, primarily composed of various densities of polyethylene, polypropylene, polystyrene, and polyvinylchloride are not yet codified in the care and conservation of contemporary art materials. Experimental methods are often necessary to achieve conservation goals set by artists, institutions, or the artwork itself. Through the lens of three case studies, both interventive and non-interventive treatment options for different polymer compositions used to make clear plastic bags will be discussed.

Within the collection of the Museum of Modern Art (MoMA) in New York, there is an array of artworks that employ commercially-produced plastic bags. Three artworks spanning from 1961 to 2004 show three unique approaches to plastic bags: as found objects, as a vessel and carrier, and as a material to be manipulated. William Pope.L (b. 1955) includes a printed polypropylene bag packed with uneaten licorice candy as a found object in his *Black Factory Archive* (2004- ongoing). Niki de Saint Phalle (1930-2002) filled clear polyethylene bags with paint that she later shot with a gun to create her *Shooting Painting American Embassy* (1961). Ed Rossbach (1914-2002) collected an array of transparent, translucent, and colored plastic bags and films used in food packaging and heat-bonded them into an intricate plastic textile for his *Slip Cover for a Computer* (1969).

As an exhibition-driven institution, all three artworks required treatment to sustain the requested display cycle for upcoming MoMA exhibitions. Condition issues affecting the different polymeric compositions included loss of transparency, brittleness, blisters, tears, splits, and losses. Each artwork required a different approach to achieve the goals of conservation. For Pope.L's polypropylene bag, I chose an interventive approach of unsealing the bag, isolating the candy from the bag, then resealing with adhesive. In the case of Rossbach's plastic textile, I modified his original method of applying heat to reseal separated seams; I then developed a magnet system to mount the work in a wall vitrine. Finally, in the case of de Saint Phalle's paint-filled crumbling bags, I proposed a non-interventive approach to support the bag structure.

This presentation will explore clear, plastic, flexible sheeting as a material group for treatment, examining the different polymer types used in manufacturing, their commercial history, physical characteristics, and degradation mechanisms useful in identification. Then through the lens of three separate case studies, present options considered and carried out for interventive treatment - including the application of heat, the use of different adhesives, and loss compensation, then finally, share different preventive methods employed in each case for display and storage.

5. "POP, BLOB AND BACK AGAIN"

CONSERVING LINE VAUTRIN'S TALOSEL RESIN OBJECTS

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Line Vautrin was a fascinating and revered French artist of the 20th century. Without receiving a formal art education, she became a self-taught metalsmith at her father's foundry at a very young age. She soon mastered the skills of casting, chasing and gilding, and began creating jewellery. Her career took off in 1937 when she exhibited at the Exposition Universelle in Paris, which attracted enough notoriety for her to open a shop near the Elysee Palace. She produced consistently innovative works in a range of materials including porcelain, ivory and mother-of-pearl. In search of novelty, she hit on her signature style in the mid 1950s; working in cellulose acetate resin, which she patented under the name Talosel.

Like other designers and artists of her time, Vautrin was inspired by the versatility and features of cellulose acetate, including its flexibility, thermoplasticity, translucency, and lightweight nature. Vautrin worked with Talosel the way she worked with metal; melting it down and forming it into unusual shapes. The new material enabled her to expand her repertoire to include larger objects such as the mirrors, for which she is best known today, as well as furniture. She continued executing her designs in Talosel until her death in the mid 1990s.

Vautrin is now recognized as a significant figure in the history of 20th century decorative art. Her creations – particularly those made from Talosel – are highly sought after and can be found in the permanent collections of international museums such as the Victoria & Albert Museum and the Musée des Arts Décoratifs de Paris. Consequently, the value of her work has continued to increase.

Unfortunately, many Talosel objects have proven to be inherently unstable, largely due to the decomposition mechanisms associated with cellulose acetate, which have become familiar to the conservation community in recent decades.

Case studies involving remedial treatment to Vautrin mirrors will be presented. These projects were challenging overall due to the severe chemical and mechanical degradation of these objects, which manifested as warped, brittle, and fragmented material. By deepening Line Vautrin's experimental techniques through creative approaches to treatment, the authors wish to pay tribute to an iconic mid-century Modernist artist and designer, as well as sharing the knowledge gathered through practically treating chemically degraded cellulose acetate functional objects in the private sector with the conservation community.

PRESERVING AND RECOVERING THE ORIGINAL: DEVELOPING CONSERVATION TREATMENTS FOR DAMAGED PLASTIC ARTIFACTS

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Established treatments for the repair of damaged plastics – scratched, chipped, or broken – are currently few, as opposed to those developed for the conservation of traditional materials. This scarcity of treatment options may be attributed to the difficulty of finding conservation materials that fulfill the criteria necessary for completing successful repairs without harming plastics. For instance, many conservation materials generally used to carry out repairs in conservation (fillers or adhesives) contain organic liquids or produce heat during curing that can cause damage to plastics, considerably narrowing the choice of materials. Moreover, if damaged plastic is transparent, finding an optimal conservation material is even more challenging because the product should also be able to produce invisible repairs, which are very difficult to achieve, as evident in glass conservation.

As a result, plastic artifacts that are severely damaged, especially those made with transparent plastics, often undergo invasive treatments entailing the removal of original material. Many are kept in storage and, in extreme cases, are deaccessioned from collections or re-fabricated due to the lack of knowledge to repair them.

Therefore, as part of its Preservation of Plastics Project, the Getty Conservation Institute (GCI) is investigating materials and methods to repair losses, scratches, chips and broken parts on plastic artifacts, with a particular focus on those made of transparent plastics, such unsaturated polyester and poly(methyl methacrylate), given the complex challenges posed by their conservation.

This research has two primary goals: to increase the number of treatment options currently available to conservators and to develop less invasive treatment techniques leading to the ability to successfully preserve the integrity of these artifacts while retaining their original material.

This paper will present some of the findings of this broad project and will describe the approach used to evaluate the suitability of materials and methods investigated for the development of safe and successful treatments.

6. “FIT FOR THE FUTURE”—TREATMENT OPTIONS OVER TIME

6. "FIT FOR THE FUTURE"

THE CASE OF THE VANISHING GABOS: THE GABO COLLECTION AT TATE

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Naum Gabo (1890-1977) was a hugely influential Russian-born constructivist sculptor known for his work with innovative transparent plastics. Tate holds one of the largest collections of Gabo's early sculptures, models and archive, owing to the generosity of the artist and family. Over 40 of these unique artworks and models contain early plastics in their constructions.

Fabricated in the 1920s-1950s, several of Gabo's plastic works are beginning to near the end of their display lives. During his lifetime, Gabo had witnessed some of the plastic degradation that was to come and had even reconstructed some artworks before they arrived at Tate. However, many objects in the collection with original cellulose acetate and cellulose nitrate increasingly smell acidic, while showing the characteristic delamination, cracking, weeping, discolouration and warping.

Since the mid-2000s, Tate has worked with the approval of the Gabo Estate to produce replicas of a select number of the works. This is a very complex procedure and can span several years of working with different specialists. As deterioration escalates with time, Tate is looking to capture as much technical information from each object before that data disappears completely. This presentation will discuss the steps that Tate is actively taking.

Over the past year, replica priorities have been re-evaluated and object condition, material identification, archive connections, packing conditions, all updated. Currently historic 3D-scanned data is being reviewed and discussions are taking place to access the data moving forward, as well as the potential to carry out more updated 3D scanning techniques on Gabo's works. If further approval for replication is given by the Estate, the data already captured along with the newly captured information could allow for replicas to be produced and aid future research by providing vital information towards plastic deterioration.

Understanding the level of measurements and details of construction required to make a replica that the Estate will approve has led to a more thorough level of collecting information before the works and models deteriorate further, losing details such as file direction and bubble ratio in adhesive joins. Tate Photographers capture changes in condition; but detailed macro-photography proved critical during the last replication project. Low-cost procedures, such as detailed measurements recorded by hand, capturing thicknesses and dimensions have also been carried out.

In addition, the monitoring of off-gassing is captured using AD Strips® and packing is reviewed and updated when objects go on loan, displayed or during regular condition checks. Collaborative research projects focussing on plastics in the storage environment are being carried out with external researchers, to help answer further questions surrounding plastic degradation. This works towards the long-term preservation of the Gabo collection that is being carried out concurrently to the replication project.

SUSTAINABLE STRATEGIES USING SUPERCRITICAL CARBON DIOXIDE FOR THE CONSERVATION OF PLASTICS: INSIGHTS FROM THE PLASCO2 PROJECT

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Conservation treatments of plastic objects and works of art, such as cleaning or consolidation, can pose considerable challenges to conservators. These procedures might be associated with several risks; inducing undesired damage to the substrate due to the use of cleaning tools, aqueous/solvent-based cleaning fluids; or involving the use of toxic and dangerous components.

Research projects are nowadays focusing on the development of conservation strategies that can minimise the aforementioned issues and guarantee that the novel proposed methods comply with end-user's safety and have a minimal environmental impact.

The project PlasCO2 - Green CO2 Technologies for the Cleaning of Plastics in Museums and Heritage Collections is an example of such research stream, in which the application of carbon dioxide (CO_2) is evaluated for the treatment of plastic materials.

One of the project goals is to design environmentally friendly cleaning protocols using CO_2 (either in the supercritical or liquid phase) as a solvent. Cleaning efficacy can also be improved by the addition of co-solvents or surfactants, or slightly varying the experimental conditions (temperature, pressure). Proof-of-concept for this strategy has been already achieved for old textiles (1). Within the PlasCO2 framework, this approach is applied and evaluated for polyurethane, other foam/rubber-based materials, and poly(methyl methacrylate).

Trials with supercritical CO_2 are also performed for consolidation treatments of foams (polyurethane or others). Due to its versatile properties, such as low viscosity and high diffusivity, supercritical CO_2 can be used as a carrier for consolidant(s), providing a homogeneous and in-depth treatment, minimal interaction and risk of damage for the tested foams.

Extensive trials are performed on mock-up samples prepared using contemporary material equivalents, artificially soiled and aged to mimic some of the types of dirt and degradation processes that a work of art might have endured in its lifetime. Sacrificial historical objects either bought at flea markets or antique shops are also used.

Initial results from the CO_2 trials will be presented, highlighting the effects of the different parameters (CO_2 phase and density) and conditions (pressure, temperature, presence of a co-solvent, exposure time) on the plastic mock-up samples, both at the surface and bulk levels.

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6. “FIT FOR THE FUTURE”

THE DYNAMIC COMPOSITION: LEARNING FROM THE CH1 38 RHO SPACE MODULATOR

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This paper will present a case study of Bauhaus artist Laszlo Moholy-Nagy's painting CH1 38 Rho Space Modulator, and a corresponding research study used to explore the issues of exhibit and storage of plastic objects that are relevant to historic house museums. In the 1930s and 1940s, Moholy-Nagy experimented with new cellulose-based plastic materials to create CH1 38 as part of a series of "Light Modulators," playing with transparency and luminosity; colour and shadow. Starting as a clear flat-plane sheet of cellulose acetate with oil paint and incised lines, CH1 38 was given to Walter and Ise Gropius in 1945. It hung over the fireplace of the Gropius house, casting shadows from the natural light let in through the expansive windows of Gropius' signature architectural style.

In 1982, the house and its contents were bequeathed to Historic New England, at which point regular documentation and conservation began on the thousands of objects owned and collected by the Gropiuses. For CH1 38, early documentation showed the initial issues of soiling and discolouring, and over time has documented how CH1 38 has buckled and warped as the polymer structure of the transparent plastic decomposes.

The case study tracks the physical changes and conservation efforts across nearly 40 years, looking at how the changing display and storage environments have impacted these changes. Difficult decisions of reproduction and taking original items off display in a historic home will be discussed, along with their ramifications for curatorial narrative and long-term preservation of the authenticity of Gropius House. A corresponding environmental research study then uses new data to explore monitoring and implementation of best practices for plastics materials that are accessible to historic house museums. Through this, Historic New England also looks to examine how the volatile decomposition products of CH1 38 and other cellulose acetate collections with similar inherent vice may be affecting other objects in the open, mixed-material exhibit environments that are common in historic house museums.

7. “A GOOD ATMOSPHERE” — PACKAGING AND MICRO-POLLUTANTS

7. "A GOOD ATMOSPHERE"

DECISION MAKING IN CONSERVATION BASED ON MODELLING AND MEASURING DIETHYL PHTHALATE PLASTICISER LOSS FROM CELLULOSE ACETATE IN VARIED VENTILATION CONDITIONS.

Argyro Gili, Rose King, Luca Mazzei, Simoní Da Ros, Josep Grau-Bové, Robert Koestler, Michael Petr, Odile Madden and Katherine Curran

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Nowadays, plastic artefacts constitute a significant part of contemporary and traditional collections. However, signs of deterioration such as surface deposits, cracking and embrittlement are frequently observed in such objects. Consequently, understanding plastics degradation and ensuring their permanence is highly important.

Deterioration of a plastic artefact may be attributed to several factors that act in synergy in a museum environment. One significant mechanism is plasticiser loss. Plasticisers, additives used in polymers during processing to increase flexibility and decrease toughness, can migrate from the material post-manufacture, as has been observed for diethyl phthalate (DEP); commonly used as a plasticiser for Cellulose Acetate (CA) artefacts. Migration can lead to the deposition of crystals or sticky residues at an artefact's surface and subsequently can lead to cracking and brittleness, affecting severely and irreversibly the artefact's aesthetics and stability. It is urgent, therefore, to minimise plasticiser loss and maintain the value of artefacts.

Storing plastic artefacts in sealed or vented boxes are common methods by which conservators seek to limit degradation. However, sealing creates a microenvironment in which ventilation is obstructed. To evaluate the effect of storage on plasticiser loss, a novel mixture of mathematical modelling focusing on diffusion and mass transfer mechanisms and accelerated ageing experiments is used. CA samples (20 wt. %DEP) were aged at 70 °C / 50 %RH inside aluminium tubes replicating sealed and vented storage conditions. Plasticiser content was measured by ^{1}H-NMR and FTIR spectroscopies.

Our analysis reveals greater plasticiser loss in vented open environments compared to closed environments and highlights the benefit of enclosure. Since open environments accelerate deterioration, predictions of plasticiser loss over time in an open environment could facilitate conservation in decisions on exposing an artefact in display, or not, and for how long, depending on its current condition.

Furthermore, plasticiser loss can be predicted for samples over space. This could facilitate conservators in assessing future damage for a specific area of the artefact, that could be of high-risk because of an existing crack or a defect. We also consider sample thickness; as the thickness increases, the bulk remains intact for longer periods, and the degradation rate is slower compared to thinner material. Therefore, predictions of varied degradation rates due to different thickness and predictions of deterioration rates of defective areas allow for an individual treatment of artefacts tailored to mitigate future deterioration.

Predictions can also be associated with the volume of enclosure. The rate of loss is greater in a higher volume container. Hence, dimensions of enclosure define loss and conservators could make decisions on dimensions for storage systems based on this principle.

Our model is validated against our experimental data successfully and could be a promising tool for conservation allowing for decisions on storage systems, exhibition planning and individual treatments. Furthermore, CA/DEP artefacts' lifetime in different ventilation conditions and storage can be predicted. Ultimately, our model seeks to balance the benefit of ventilation of CA to prevent the build-up of acetic acid, with the benefits of enclosure in inhibiting plasticiser loss, to inform conservation strategies during storage or display.

A SMART FUTURE FOR CELLULOSE DERIVATIVES CONSERVATION

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A vast percentage of our cultural heritage is found in cinematographic films and photography produced since the late 19th century using cellulose derivatives. Due to their chemical instability, efforts for conservation methods can be traced back to 1970, when low-temperature storage was first proposed by Adelstein, Graham and West. This conservation technique is based on the finding that the colder the temperature the longer the useful lifetime of the collection. Innovative alternatives have been sought because low-temperature storage is price-sensitive, has high energy costs, there are concerns about its effects on the physical stability of the materials and is prohibitive for access. However, the benefits of low temperature on the preservation of cellulose derivatives have never been superseded.

A smart future is where innovation will help develop intelligent solutions to complex problems through collective work and by applying the available technology and knowledge to create new value in a fundamentally different way from the past. This talk will be about the NEMOSINE project (https://nemosineproject.eu/) and how it grasps this definition. This European project is developing an intelligent system for the conservation of image heritage. With a great collaboration between project partners, ranging from archives to research groups and industry, this project will create modular smart packages for storage and conservation. Inside, selective acid adsorbers based in functionalized metal-organic frameworks (MOFs) and anti-fungal additives will extend conservation time. Sensors for the continuous detection of volatiles (acetic acid and nitrogen oxides) correlated with a deterioration predictive model, based on an in-depth knowledge of the fundamental degradation mechanisms, will allow an automated monitorization of the collection. Stakeholders will be able to make better conservation decisions.

The NEMOSINE project is one of the first efforts for a smart future in image conservation. The outcomes will lead to the development of intelligent conservation methodologies for cellulose derivatives' cultural heritage as a whole, namely for the storage of tridimensional objects of celluloid and cellulose acetate. Ultimately, smart will be a concept well established in plastics conservation, as the digital era imparts with it the use of big data, smart analytics or networked smart sensors.

7. "A GOOD ATMOSPHERE"

OZONE TEST STRIPS FOR PVC PLASTICS?

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Poly(vinyl chloride) or PVC is one of the most commonly used thermoplastic polymers in the world and most PVC contains a high level of chlorine as part of its manufacture. Dehydrochlorination, a reaction in which hydrogen chloride is removed, is the primary degradation pathway for PVC. This is an autocatalytic reaction so allowing the hydrogen chloride to remain in the surrounding environment accelerates the rate of degradation. The gaseous hydrogen chloride forms hydrochloric acid with atmospheric water. In a museum context, knowing if PVC is emitting an oxidant such as hydrogen chloride that can become hydrochloric acid could provide insight into how collections are aging and influence storage and display decisions. Since the majority of museums are small, understaffed, and underfunded institutions, access to scientific analysis is limited. The application of an inexpensive, easy-to-use test strip that identifies degrading PVC would enable more museums to identify potentially harmful PVC plastics in their collections.

Macherey-Nagel produces commercially available Ozone Test strips that are marketed for ozone detection but according to the directions can get a false positive with other oxidants such as chlorine. The strips turn through shades of light yellowish beige to brown with the darker the reaction, the more oxidant present. Testing that occurred in spring 2017 at the Smithsonian's Museum Conservation Institute and then continued at The George Washington University indicated that Ozone Test strips will react to chlorine, as demonstrated by exposure to hydrochloric acid solution and testing with a chlorine gas wafer in a pollutant generator. The Ozone Test strips reacted to known PVC samples that were identified with FTIR that were obviously degrading (weeping, warped, sticky) and to a few PVC items that visually appeared to be in good condition. Each PVC object that was monitored was sealed in a glass beaker for two weeks with an A-D test strip to check for acidic off-gassing and an Ozone Test strip. Some of the plastics caused a reaction of the Ozone Strip to occur within one day and continued to darken over the testing period while others took longer to react.

The testing that occurred in this study indicates that Ozone Test strips may have an important role as a low tech, low cost monitor for collections with PVC plastics. However, a lack of reaction does not mean that the plastic being monitored is not PVC, it just means that the plastic in question is not releasing an oxidant that will react with the test strip at this moment. If it is suspected that the plastic is PVC, particularly plasticized PVC, then periodic monitoring with Ozone Test strips is recommended.

BIOGRAPHIES

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CARIEN VAN AUBEL

Completed her postgraduate training in conservation at the University of Amsterdam, specialising in modern and contemporary art. She has worked as a conservation researcher at the Victoria and Albert Museum (V&A). Here she developed a method for identifying plastics in museum collections without the use of analytical techniques. In 'Project Plastic', a project by the Foundation for the Preservation of Contemporary Art (SBMK) and the Netherlands Institute for Conservation, Art and Science (NICAS), she developed an online identification tool resulting in workshops that enable art care takers to identify plastics in their collection themselves. Next to her work as a project-based conservator at Tate, she works freelance on a wide range of projects in both The Netherlands and United Kingdom and has a London based studio.

ANGELICA BARTOLETTI

Is a Postdoctoral Research Fellow at the Department of Conservation and Restoration of the Faculty of Sciences and Technology - NOVA University of Lisbon (DCR/FCT-UNL). She completed a Ph.D. in Nanometrology applied to Heritage Science at University College London (UCL) in 2016, and worked at Tate (London, U.K.) as a postdoctoral fellow on the NANORESTART project, and then as a conservation scientist (2017-2019). Her research interests include assessing the impact of traditional and innovative conservation treatments for cellulose, collagen-based artefacts, modern and contemporary materials (paints and plastics), with a focus on cleaning strategies.

TIM BECHTHOLD

He trained as a cabinet-maker in Bad Tölz, Germany from 1991 to 1993. The following three years he studied conservation at the College Goering-Institute, Munich, Germany, where he graduated in 1996 as a state-approved conservator for furniture and wooden sculptures. The following year he worked as a freelance furniture conservator in Munich, Germany. From 1997 to 2002 he proceeded to study at the Chair of Conservation, Arts Technology and Conservation Science at the Technical University Munich, Germany, focusing on modern materials. At that time he worked on several conservation projects on the degradation of plastics, among others at the Museum of Applied Arts (MAK) in Vienna, Austria, and at the Vitra Design Museum in Weil am Rhein, Germany. In 2002 he graduated with a diploma thesis on "Polyurethane in 1960's furniture design". Since 2002 he is Head of Conservation at Die Neue Sammlung - The Design Museum, Munich, Germany. He set up the Conservation Department which has become an important hub for the conservation and maintenance of modern design objects, through research into the deterioration and preservation of the collections, the development of new conservation processes and the knowledge of its original technology. Since 2009 Tim has initiated and organised the biennal international conference series FUTURE TALKS which focuses on the conservation of modern materials in design and art. He is editor of the FUTURE TALKS postprints. Tim Bechthold has given numerous lectures on the conservation of plastics inter alia at the Technische Universität München, the University College London at Doha, Katar, at the Akademie der Bildenden Künste in Stuttgart, Germany and the Akademie der Bildenden Künste in Vienna, Austria.

DEBORAH CANE

Is the Conservation Manager for the Sculpture and Installation Art team at Tate. She originally trained as an objects conservator and updated her training in 2010 with an MA in preventive conservation. She has worked at National Museums Scotland, National Museums Liverpool and Birmingham Museums Trust where she has worked with decorative arts and social history plastic collections as well as modern materials and contemporary art. She represents Tate in the COMPLEX UCL project, within which she is supervising a doctoral student and supporting the understanding of which analytical techniques are valuable in the on-site ID of materials.

JOY BLOSER

She is an objects conservator specialized in modern and contemporary art and is the Assistant Conservator, Public Outreach at the MFA Boston. She completed a two-year sculpture conservation fellowship at the Museum of Modern Art, New York, and holds an MS in Conservation and MA in Art History from NYU and BA in Chinese and Art History from Middlebury College. She is a contributing translator to LEAP Magazine and Yishu Journal and is the ECPN liaison for AIC's Contemporary Art Network.

ALICE CANNON

Manages Museums Victoria‘s collection risk management program. She trained in the early 1990s and has worked in a number of organisations as a paper, photographic materials and/or preventive conservator. Her Master of Arts by Research investigated late 19th and early 20th century adhesives for paper substrates.

ANGELA CHANG

She serves as Assistant Director, Objects Conservator, and Head of the Objects Lab at the Straus Center for Conservation and Technical Studies at the Harvard Art Museums. Her recent research and publication topics include medieval Japanese sculpture, ancient Chinese jade, and ancient silvers. Large-scale-projects she has worked on include the recent renovation of the Harvard Art Museums, the re-installation of two Sol LeWitt wall drawings, and the conservation of John Singer Sargent’s murals at the Boston Public Library. Angela earned her M.S. from the Winterthur/University of Delaware Program in Art Conservation.

SUSAN COSTELLO

She received her MS from the Winterthur/University of Delaware Program in Art Conservation. After graduating, she completed fellowships at the Straus Center for Conservation and Technical Studies, Harvard Art Museums and the Worcester Art Museum. Currently, she is an associate conservator of objects and sculpture at the Straus Center where she is responsible for the examination, treatment and technical study of three-dimensional objects spanning the collection. Her research interests include the preservation of plastic objects and ancient art with a focus on Chinese bronzes and Greek ceramics.

BIOGRAPHIES

MARY COUGHLIN

She is an Associate Professor in Museum Studies at The George Washington University in Washington, DC where she has taught preventive conservation in person and online since 2006. She earned her Masters of Science from the Winterthur / University of Delaware Program in Art Conservation. Before teaching full time, Mary worked for five years in the Objects Conservation Laboratory at the Smithsonian's National Museum of American History where she conserved objects as diverse as FDR's leg braces and Star War's C-3PO and R2-D2. She has an interest in the challenges of contemporary museum collections, particularly with respect to plastic.

MEGAN CREAMER

She is the Isabel Bader Fellow in Art Conservation for the Queen's University Master of Art Conservation (MAC) program. Creamer earned graduate degrees from the University of Glasgow's Centre for Textile Conservation and Technical Art History, and Harvard University's museum studies program, preceded by an BFA in industrial design from Massachusetts College of Art and Design. Current research focuses on informing preventive and interventive treatment of cellulose acetate objects, and outdoor steel sculptures, while previous research has included ultrasound in immersion cleaning of historical textiles, and the use of insecticidal netting as a tool in IPM at museums.

GABRIELLE CROWTHER

She is Assistant Conservator at Art Conservation Group in New York. She graduated with a dual MA/MSc in Object Conservation from University College London in 2018. Prior to this, she completed internships and worked at Brooklyn Museum, Central Park Conservancy, the Victoria & Albert Museum, and Plowden & Smith, Ltd. She is an Associate Member of the American Institute of Conservation (AIC), the International Council of Museums (ICOM), and the International Network for the Conservation of Contemporary Art (INCCA).

KATHERINE CURRAN

She is an Associate Professor in Sustainable Heritage at the UCL Institute for Sustainable Heritage. She is the Principal Investigator for the ERC Starting Grant funded project "COMPLEX: The Degradation of Complex Modern Polymeric Objects in Heritage Collections: A System Dynamics Approach" which will develop new approaches to understanding and modelling the degradation of modern polymeric materials in collections. Katherine obtained her PhD in polymer chemistry in 2009 from University College Dublin (UCD), Ireland.

CHRISTINA ELSÄSSER

She is a PhD candidate at the Conservation Science Department of the Deutsches Museum and the Chair of Non-destructive Testing of the Technical University in Munich. She holds a MA and BA in Conservation-Restoration, Art Technology and Conservation Science from the Technical University in Munich. Since 2019 she pursues a PhD in the cold storage of three-dimensional cellulose nitrate. Her research aims to assess the effectiveness and harmfulness of various storage conditions below room temperature on three-dimensional cellulose nitrate with the use of imaging methods, chemical analysis and mechanical testing methods.

GABRIELLE FLEXER

She studied conservation at Durham University, before gaining experience in the treatment of archaeological and historic objects, preventative conservation and provision of training whilst working for Wiltshire Council's CMAS. Here she also developed her interest in modern materials, researching the suitability of using 3D printed plastics with museum collections.

As Senior Conservator with the Science Museum Group working on a collection's store move, Gabrielle oversaw the inventory, hazard assessment, packing and transport of over 9,000 objects. She is now Conservation and Collections Care Manager at the National Science and Media Museum enjoying supporting the busy loans and exhibitions programmes.

PETER GIERE

Trained as a biologist with a PhD in zoology, Peter Giere became curator of the Embryological Collection at the Museum für Naturkunde Berlin where he has developed a deep interest in the conservation, management and history of natural history collections. His work now includes dealing with many overarching issues related to these topics. Besides being involved in conservation networks, he facilitates the transfer of knowledge related to collection work through the organization of seminars, workshops and conferences.

ARGYRO GILI

She received the MSc degree in Applied Mathematics and Physical Sciences in 2005. Subsequently she obtained an M.Eng and a Ph.D in Electrical and Computer Engineering in 2010 and 2016 respectively, from the National Technical University of Athens in Greece. She worked initially in Biophysics Research. Her PhD deals with modelling transport phenomena in nano-electronics. She is currently working as a Research Associate at the Institute for Sustainable Heritage at University College London. Her research focuses on mathematical modelling of the physicochemical mechanisms and transport phenomena involved in polymer degradation applied to plastic museum artefacts within the framework of the European project COMPLEX.

BIOGRAPHIES

ELENA GÓMEZ-SÁNCHEZ

After finishing her PhD in Organic Chemistry in 2008 (Spanish National Research Council), Dr. Elena Gómez Sánchez started her specialisation in Conservation Science at the Spanish Cultural Heritage Institute. From 2009 to 2015 she was a researcher at the Rathgen-Forschungslabor (Staatliche Museen zu Berlin), focusing in the organic analysis of museum objects, polymer degradation and the management of biocide contamination in large institutions. Since 2015 she is a scientist at the Materials Science Research Department of the Deutsches Bergbau-Museum Bochum. Her main research area is the natural degradation of polymer materials in museums and their conservation issues.

ROSEMARY GOODALL

A Materials Scientist at the Museums Victoria who is involved in the identification of materials in collections focusing on the identification of hazardous substances utilizing elemental and vibrational spectroscopy. Recent research includes poisons on Malaysian darts, plastics and polymer coatings and pharmaceuticals in the Museum‘s collections.

HANNAH HENDRICKX

Holds a Master in the conservation and restoration of wooden artefacts, University of Antwerp. Previously depot manager at Design Museum Ghent and currently working as a researcher on the “Know Name and Assess your Plastics” project, a collaboration between Design Museum Ghent and S.M.A.K.

MAREI HACKE

She is a conservation scientist at the Swedish National Heritage Board (since 2015), previously at the British Museum (2007-2015) and the Smithsonian Museum Conservation Institute (fellowship 2006-2007). Her areas of expertise include scientific investigations of cultural heritage and conservation methods with a focus on organic materials. Marei is the Swedish national coordinator for the European Research Infrastructure for Heritage Science (E-RIHS). She is from Berlin and studied textile chemistry and technology at the universities in Berlin and Manchester, were she received her PhD in 2006 within a European research project on the monitoring of damage in historic tapestries.

STEFANI KAVDA

She is a Postdoctoral Visiting Scholar at the Conservation Science Department of the Deutsches Museum in Munich. In 2020 she received her PhD in Conservation Science from UCL in London and UCL Qatar. Her research focuses on the use of aqueous solvent-gel systems for the cleaning of plastics, particularly pristine transparent and high gloss acrylic surfaces found in cultural heritage collections. Currently she investigates the chemical and mechanical degradation of camphor-plasticised cellulose nitrate with the use of Gel Permeation Chromatography (GPC/SEC) and Thermomechanical Analysis (TMA).

GRIET KOCKELKOREN

Holds a Master in the conservation and restoration of historical textiles (Antwerp) and is specialised in active and preventive conservation of textiles and plastics. Griet is head of the conservation studio of Historical & Contemporary Textiles, Costume and Accessories at the Royal Institute for Cultural Heritage (KIK-IRPA).

CAPUCINE KORENBERG

She has worked as a conservation scientist at the British Museum for more than 17 years. Her research focuses on assessing the suitability of conservation treatments for artworks and antiquities and understanding the deterioration processes in these objects with a view of finding ways to better preserve them. More specifically, she is currently working on laser cleaning and microfading. Capucine has also recently developed a strong interest in the technical study of Japanese ukiyo-e woodblock prints.

TILL KRIEG

During Conservation studies at University of Applied Science Erfurt, Till Krieg specialised in polymer degradation and conservation treatments of plastics objects. In 2016 he focused on painted cellulose nitrate in his Bachelor thesis, and 2019 his Master thesis dealt with curing processes and deterioration of unsaturated polyester resins. Since June 2019 he is a research associate at the Montanhistorisches Dokumentationszentrum of the Deutsches Bergbau-Museum Bochum. Together with the Materials Science Research Department he works on surveying plastic objects in the museum collection.

ELIZABETH LA DUC

She is an art conservator and archaeologist who specializes in the conservation and scientific analysis of inorganic materials. She received a M.Sc. in archaeological science from University College London, a M.A. in art conservation from Buffalo State College, and a B.A. in archaeological studies from Yale University. Elizabeth has completed post-graduate fellowships in objects conservation at the Harvard Art Museums and at Historic New England. She has also worked at the Walters Art Museum, the Philadelphia Museum of Art, and Winterthur Museum and has undertaken archaeological fieldwork in the United States, Turkey, and Italy.

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ANNA LAGANÀ

She is a modern and contemporary art conservator and researcher, specializing in the conservation of plastics. Since 2016, she has been working as a Research Specialist at the Getty Conservation Institute (GCI) within the Modern and Contemporary Art Initiative, where she leads projects, including the investigation of treatment options for plastics in collections, and she develops workshops on their conservation. Before joining the GCI, Anna has worked as Coordinator of the Contemporary Art Conservation Laboratory at the CCR in Turin; as a conservator/researcher at the Cultural Heritage Agency of the Netherlands conducting research on plastics conservation; and most recently as a lecturer at the University of Amsterdam coordinating the Postgraduate program 1 in Conservation of Modern and Contemporary Art. Currently Anna is also coordinator for the Modern Materials and Contemporary Art working group of ICOM-CC.

LOREDANA MANNINA

She completed postgraduate conservation studies in 2011 at the Università di Palermo, in Italy, where she also achieved official accreditation in 2013. She has experience from both private practice and public institutions, such as the Victoria and Albert Museum, La Venaria Reale Conservation Centre and the Houses of Parliament. Loredana has worked on a wide variety of objects from different regions of the world and date, from the New Kingdom of Egypt to the present day, conserving artworks by artists including Magritte, Duchamp and Salvador Dalì. She became Conservation Officer for the Historic Collections of Furniture and Decorative Arts at the Houses of Parliament in 2019. She is also lecturer in Leather Conservation for the students of the MS in Conservation at the Università di Torino.

JOY MAZUREK

She has worked at the Getty Conservation Institute since 1998. She specializes in the identification of binding media in modern and contemporary paint, the characterization and degradation of plastics, and the application of biological methods to study artwork. She obtained her MS in microbiology from California State University, Northridge and her BS degree in biology from the University of California, Davis.

CRISTIAN MAZZON

Born in Motta di Livenza, Italy, in 1982, he studied Chemistry for the Conservation and Restoration of Works of Art at the University of Ca'Foscari in Venice. In May 2014 he started his PhD at the Deutsches Bergbau-Museum Bochum in Germany, in the Material Science Section. His work includes corrosion and protection of metallic surfaces with transparent organic coatings applied on Industrial Cultural Heritage. The aim is to develop a monitoring strategy based on a practical tool for better conservation practice, i.e. monitoring and evaluation of the effectiveness properties of protective coating under application of Electrochemical Impedance Spectroscopy (EIS).

ELIZABETH MCCARTNEY

She is the Manager of Conservation at Museums Victoria and the current President of the Victorian Division of the AICCM. She holds a Masters in the Principles of Conservation from University College London (2005) and a Masters in Cultural Materials Conservation from the University of Melbourne (2008).

ANNA MICHELUZ

She is a conservation scientist working at the Deutsches Museum (DM) in Munich, Germany. Her research focuses on the characterization of organic materials, i.e. plastic objects, by means of pyrolysis-gas chromatography-mass spectroscopy. She is also involved in the management of the analytical laboratory of the conservation science department of the DM, including thermogravimetric analysis coupled with infrared spectroscopy and gel-permeation chromatography. She studied chemistry for conservation and restoration at the Ca´ Foscari University of Venice (Italy) and holds a PhD (2016) in environmental science about biodeterioration phenomena inside libraries and archives at the same institution.

FRANCESCA MODUGNO

She obtained M.Sc. degree in Chemistry (1997) and a Ph.D. in Chemical Sciences in (2001) at the University of Pisa. At present, she is Professor in Analytical Chemistry at the Department of Chemistry and Industrial Chemistry of University of Pisa, where she teaches analytical chemistry and chemometrics. Her research deals with the development and application of analytical methods based on analytical pyrolysis, mass spectrometry and chromatography to study natural and synthetic organic compounds. Analytical chemistry applied to heritage science and environmental science are her main research interests (SCIBEC, www.scich.it). She focus on the characterisation and the study of the degradation of organic materials in historical and artistic objects and in environmental samples, with specific attention to lipids, resins, synthetic polymers, proteins and lignocellulosic materials.

JOHN MORRISON

He is an emerging conservator from Melbourne, Australia. Trained in conservation at the University of Melbourne, John is developing his skills and expertise in the fields of conservation of built heritage, with a focus on the preservation of decorative and construction materials. In parallel to his career as a conservator, John strives to preserve and revitalise heritage trade skills by creating furniture and joinery using restored antique hands tools, and pre-modern materials and techniques.

BIOGRAPHIES

PETRONELLA NEL

She is a Senior Lecturer at the Grimwade Centre of the University of Melbourne. She has a BSc (Honours, 1990) in Chemistry, a PhD in Chemistry (2000) and an MA in Cultural Materials Conservation (2006), from the University of Melbourne. She is leading a collaborative ARC Linkage Project 'A national framework for managing malignant plastics in Museum Collections'. She is interested in developing analytical techniques for characterising materials in order to inform their preservation.

ARTUR NEVES

He finished his MSc (2017) in Conservation and Restoration from the Department of Conservation and Restoration of NOVA School of Science and Technology. Currently, he is a PhD student in the same institution. Focused on cellulose nitrate degradation mechanisms, his project aims for better preservation of cellulose nitrate heritage by the coactive contribution of conservation science and history of science and technology. He is under the supervision of Maria João Melo, Maria Elvira Callapez and Robert Friedel. In 2020 he received a research fellowship within the NEMOSINE European project to study the degradation of cellulose derivative cinematographic films.

THEA VAN OOSTEN

Since 1975, Dr. Thea B. van Oosten has been employed as a conservation scientist at the Cultural Heritage Agency of the Netherlands (RCE). She was specialised in Fourier Transform Infrared Spectroscopy (FTIR), Differential Scanning Calorimetry (DSC) and Raman spectroscopy of Plastics in objects of cultural heritage and modern materials in modern and contemporary art objects. She has contributed to several publications and books, such as 'Modern Art, who Cares', 'Plastics, Collecting and Conserving' and 'Plastics in Art'. One of her research topics was the consolidation of Polyurethane foams, which resulted in a book published in May 2011, called PUR Facts, Conservation of Polyurethane foam in Art and Design. Since her retirement in 2013, she regularly disseminates her knowledge on plastics through professional development, workshops for conservators in several institutes and universities in the Netherlands and in various workshops around the world. From January till March 2016, she was a guest scholar at the Getty Conservation Institute, writing a book about Physical Properties of Plastics, that will be published spring 2021 by Getty publications. From January 2017 till May 2017 she was teaching the properties of plastics at the Conservation Centre of the Institute of Fine Arts (NYU) in New York. She is currently associate researcher at the University of Amsterdam, the Netherlands.

KARINA PALMER

She works at Museums Victoria as Senior Conservator of Collection Preservation. She graduated as an objects conservator in 2001. Her work involves the development and implementation of processes that favour access and preservation of collections. Current projects include managing plastics, and preservation environments.

MARISA PAMPLONA

She is Head of the Conservation Science Department and Research Laboratory (ATR-FTIR, py/GC-MS, GPC, TGA-FTIR and TMA) that she established at the Deutsches Museum in 2014. Together with her research team, she specializes in the identification of synthetic polymers from historical collections (characterizing production techniques and decay phenomena), assessing the effectiveness of treatments and implementing preventive conservation measures. From November 2008 until Dezember 2013 she was employed as a conservation scientist at the Rathgen Research Laboratory with the National Museums Berlin. She obtained her Ph.D. in Engineering Sciences from the Technical University of Lisbon (2008) dedicated to assessing the effectiveness and durability of synthetic polymers used for consolidating stone monuments.

GEORGINA RAYNER

She is the Associate Conservation Scientist at the Straus Center for Conservation and Technical Studies, Harvard Art Museums. Prior to this role Georgina was the Andrew W. Mellon Postdoctoral Fellow in Conservation Science at the same institution. Georgina received her Masters in Chemistry in 2008 from the University of Warwick, UK, and her PhD in Chemistry, with a focus on polymer chemistry, from the same institution in 2012. Georgina's research focuses on the technical analysis of organic materials in artworks with a specialization in polymeric materials.

OLIVIA VAN ROOIJEN

She completed her MA in Chemistry at the University of Amsterdam. Her final research project resulted in a publication in Science. After finishing her studies she joined Project Plastics, a project coordinated by the SBMK and NICAS which focused on the identification of plastics in modern and contemporary artworks and design objects. She successfully combined her studies and the project with rowing at the highest international level.

SOPHIE ROWE

She has an MSc in conservation from the Institute of Archaeology, UCL, London and is an ICON Accredited conservator specialising in organic artefacts and collections care. She currently works at the University of Cambridge Museums, providing conservation and collections care support across a consortium of 8 museums. She also works part-time for the United Kingdom Antarctic Heritage Trust, setting up a conservation programme for 20th century artefacts in historic sites on the Antarctic peninsula.

BIOGRAPHIES

RUBY SATELE

She is a Sāmoan woman (Mulifanua, Vaito'omuli, Saipipi and Vailoa-tai), born and raised in Aotearoa New Zealand. She is Collection Manager, Pacific at Tāmaki Paenga Hira Auckland War Memorial Museum, where she cares for Pacific treasures in the Human History, Pacific collection. Over the last six years, she has worked several roles in the cultural heritage sector, working closely with Pacific collections in each role. Ruby completed her PGDip and MA degree in Museums and Cultural Heritage at the University of Auckland, having completed her thesis that focused on the continuum of selu Samoa (Samoan combs) and exploring its changes from the 19th century.

JULIA SAWITZKI

She received her Master's degree in restoration, conservation science and art technology at the Technical University Munich in 2018. Her work concentrates on the conservation of modern and contemporary artworks and cultural objects. From April 2018 she was part of the Conservation Science Department at the Deutsches Museum in Munich as a scholar. Her research focused on the materials used in robotic prototypes, especially plastics, and their degradation properties. Since January 2019 she has been working as assistant conservator at the Kunsthaus Zurich.

STEFAN SIMON

Since 2005, Stefan Simon is Director of the Rathgen Research Laboratory with the National Museums Berlin. Trained as a heritage scientist, Simon earned his Ph.D. in Chemistry from the Ludwig Maximilian University, Munich. He served as a Council Member and Vice President of ICCROM, the International Centre for the Study of the Preservation and Restoration of Cultural Property. As Inaugural Director of Yale's Institute for the Preservation of Cultural Heritage and Director of the Yale's Global Cultural Heritage Initiatives (2014-2019), Stefan Simon prioritized the advancement of sustainable conservation strategies triggered by global climate change, the green museum debate, and questions of conservation documentation, authenticity and access in the digital age. Between 2001 and 2005 he led the Building Materials Section at the Getty Conservation Institute, Los Angeles. Simon is a corresponding member of the German Archaeological Institute, and has been recognized with Honorary Professorships at X´ian Jiaotong University, China, and the Technical University Berlin. He has co-authored and published more than 150 articles on the preservation of cultural heritage.

GATES SOFER

She is the Sculpture and Installation Conservator for Tate Britain. After training at the Institute of Archaeology, UCL and West Dean College she worked as a Metalwork Conservator at the Victoria & Albert Museum before coming to Tate in 2010. She was recently a case study conservator within the NANORESTART project 2016-18, testing novel nano-structured fluids in hydrogels compared to traditional cleaning methods for PMMA.

KAYLEIGH SPRING

She entered conservation, after graduating with a First-Class BA Honours degree in Conservation & Restoration from the University of Lincoln in 2008, working for the Science Museum in London as an Object Conservator. She relocated to the South West in 2012, working for the National Trust. A break from conservation working with a bioplastics manufacturer in the 3D Printing Sector, provided insight into 3D Design, Printing and the understanding of plastics, before joining the Conservation and Museums Advisory Service in 2019. She utilises her experience carrying out object treatments, and sharing her knowledge with individuals, organisations and museums across Wiltshire.

JILL STERRETT

Her work focuses on the role of museums in contemporary society and she works at the intersection of contemporary art practice, materials, conservation and collections. Jill is versed in artists from the 1950s to the present and engaged in ways to revitalize museums for our times. She has played an active role in the formation of Voices in Contemporary Art, an international consortium of conservators, curators, collectors, educators, and students who recognize the need for new forms of collaboration. She has held leadership roles at the San Francisco Museum of Modern Art and the Smart Museum of Art at the University of Chicago. She is now an independent arts advisor on national and international projects, including for Toward Common Cause: Art Social Practice and the MacArthur Fellows Program at 40, a Smart Museum project opening in July 2021 across the city of Chicago.

VALERIE TOMLINSON

She is a conservator of Canadian origin working in New Zealand. She has been at Auckland Museum/Tamaki Paenga Hira for the last 10 years where she works on general objects conservation for the Museum's collections, including significant input into the preventive conservation needs of the collections. Previously Valerie has worked around the globe, across Canada in various institutions (including several years in the Canadian Arctic), in Norway, and interned in England. She received her Masters in Art Conservation from Queens University in Kingston Ontario.

BIOGRAPHIES

JOYCE H. TOWNSEND

She has been Senior Conservation Scientist at Tate for three decades. She has been involved in collections care projects round plastics since the later 1980s, has supervised analytical projects at masters and doctoral level, and works on the analysis of modern materials as well as traditional artists‘ materials, their use by artists and their deterioration. She represents Tate in the COMPLEX UCL project, within which she is supervising a doctoral student, facilitating their long-term experiments on the degradation of Tate artworks, and assessing the use of A-D strips in relation to other methods for the detection of VOCs from packed sculptures.

ELINE VAN DER VELDE

Holds a Master in the conservation and restoration of contemporary art, University of Amsterdam and is specialised in the identification and conservation of plastics. She works as a researcher on the “Know Name and Assess your Plastics” project – a collaboration between Design Museum Gent and S.M.A.K – and as a conservator at MoMu Fashion Museum Antwerp.

SUE WARREN

She is Manager of Conservation and Preservation at the Canadian Museum of History in Ottawa, Canada. She has held the position for a year and a half. She was previously Manager of Conservation at Ingenium Canada for 10 years, and prior to that Conservator at Ingenium for 20 years. She has undertaken Collection Risk Assessments and Plastics Surveys at both National Museums, and has extensive treatment and preventive conservation experience with plastics, most particularly in collections of technological and social history objects. Sue holds a Master’s Degree in Art Conservation from Queen’s University, Kingston, Canada.

INSTITUTES

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UNIVERSITY OF CAMBRIDGE MUSEUMS

www.museums.cam.ac.uk/

The University of Cambridge Museums is a consortium of the eight University Museums and the Cambridge University Botanic Garden. It represents the highest concentration of internationally important collections outside London in the United Kingdom. With more than five million works of art, artefacts, and specimens, the collections span four and a half billion years. The Museums and Garden open up the University's cutting-edge research and marvellous objects for everyone to learn from and enjoy. The consortium aims at enabling more people to engage with its collections, expertise and research and works closely with the University's other collections, as well as local and national partners. It is a proud member of the national University Museums Group and Cambridge Arts and Cultural Leaders.

LEIBNIZ RESEARCH MUSEUMS

www.leibniz-gemeinschaft.de/en/research/research-museums.html

The eight Research Museums within the Leibniz Association collect objects, conduct research, and provide education-based learning through exhibitions and programs. Together, the Research Museums' collections contain well over 100 million objects that provide the basis for research into the earth, its history and biodiversity. Scientific conservation programmes help to preserve objects as well as natural and cultural heritage. With research-based permanent and special exhibitions at 12 locations across Germany, Leibniz Research Museums increase understanding of research as a process, and allow people to critically evaluate science and society. The workshop series Conservation in focus was established by the Leibniz Research Museum network on restoration and conservation.

DEUTSCHES BERGBAU-MUSEUM BOCHUM

https://www.bergbaumuseum.de/

Founded in 1930, the Deutsches Bergbau-Museum Bochum – as the Leibniz Research Museum for Geo-resources – is tasked with collecting, preserving, investigating, exhibiting and teaching the material heritage of the mining industry.
This is a duty that we honour both above and below ground, whether it be here in Bochum, or regionally, nationally or even internationally. Our mission statement reads: To spread the knowledge and experience of mining. And we do all of this under one roof.
Our areas of research comprise archaeometallurgy, mining history, materials science, mining archaeology, alongside our Research Laboratory and the Montanhistorisches Dokumentationszentrum (the Mining History Document Centre, or montan.dok).
Through the four tours of our permanent exhibition – Hard Coal, Mining, Mineral Resources and Art – and with the visitor's mine, we relate the fascination of mining in all its various guises.

MUSEUM FÜR NATURKUNDE BERLIN

https://www.museumfuernaturkunde.berlin/

The Museum für Naturkunde Berlin – Leibniz Institute for Evolution and Biodiversity Science – is an integrated research museum within the Leibniz Association. It is one of the most important research institutions worldwide in the areas of biological and geological evolution and biodiversity.

Our mission is to discover and describe life and earth – with people, through dialogue. As an excellent research museum and innovative communication platform, we want to engage with and influence the scientific and societal discourse about the future of our planet, worldwide. Our vision, strategy and structure make the museum an excellent research museum. We have research partners in Berlin, Germany and approximately 60 other countries. Over 700,000 visitors per year as well as steadily increasing participation in educational and other events show that we have become an innovative communication centre that helps shaping the scientific and social dialogue about the future of our earth.

Alongside knowledge transfer, our research and our collection are the main pillars of the museum's work. The collection is a unique natural and cultural asset, inextricably linked to our research and comprises over 30 million items covering zoology, palaeontology, geology and mineralogy and is of highest scientific and historical importance.

The permanent exhibitions together with regular special exhibitions give the public insights into current research at the museum and highlight original research objects. Visitors are encouraged and inspired to find their own route into science and experience 'Evolution in Action' rather than following a given pathway.

DEUTSCHES MUSEUM

https://www.deutsches-museum.de/

The Deutsches Museum with its branch museums is an outstanding place for communicating scientific and technical knowledge and for a constructive dialogue between science and society. Established in 1903, it is among the world's oldest museums of science and technology and, with total exhibition space of 66,000 square m^2, one of the largest. Its unique collection of original exhibits makes Deutsches Museum a leading international venue for celebrating science and technology as a cultural endeavour. As a major German research museum of national significance, it is supported by the state of Bavaria, the federal government and the German states and is a member of the Leibniz Association.

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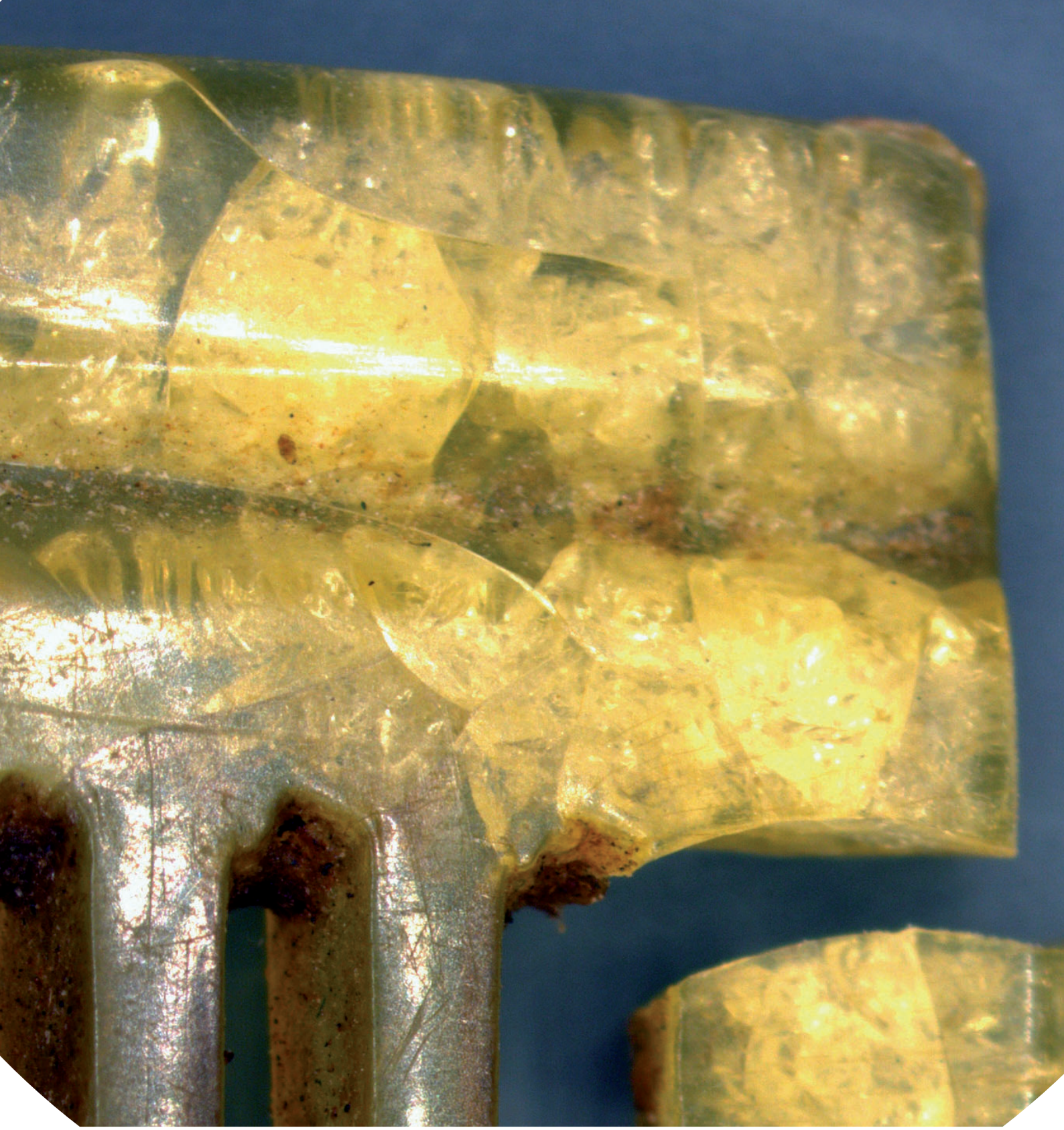

UNIVERSITY OF CAMBRIDGE
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