Presentation Descriptions and Speaker Biographies

Day 1: Monday, October 25, 2021

Approaching the Challenge: Caring for 3D-printed Art and Design
Martina Haidvogl, *Lecturer, Conservation of Contemporary Art, Bern University of the Arts*
Emily Hamilton, *Assistant Professor of Objects Conservation, SUNY Buffalo State College*

This session introduces the themes, scope, and goals of the conference. As 3D-printed objects enter institutional and private collections, they present caretakers with the challenges of evolving technology, material degradation, and questions of authenticity and originality. The inherent duality of their existence—digital files used to produce printed objects—requires collaboration across disciplines to gain an understanding of both aspects when addressing preservation. Situating such a discussion within the broader context of contemporary art conservation, this presentation considers how 3D-printed works compare to other cultural heritage and what long-term stewardship may require for these works.

The Eames Secret: Real 3D Modeling
Llisa Demetrios, *Chief Curator, Eames Collection*
Daniel Ostroff, *Consultant, Eames Office*

Charles & Ray Eames were very hands-on when solving problems. From their earliest experiments in molded plywood, they observed that how something is made influences its design. To make the best finished product they found that they needed to make not only the prototypes but the machines that produced the prototypes and then scale up the production. They worked directly with the materials—molded plywood, wire rod, aluminum, plastic and fiberglass. The 3D prototypes were their sketches. They did not want to get bogged down in assumptions but rather work within constraints.

This presentation shares the story of what Charles & Ray Eames learned from the Organic Design Competition and the issues with making the seating. Two examples of modeling, *Eames Aluminum Group* and *Glimpses of the USA,* are also explored.

Applications of 3D Printing
Dr. James C. Weaver, *Senior Staff Scientist, Harvard John A. Paulson School of Engineering and Applied Sciences*

Nature produces a remarkable diversity of intricately architectured mineralized composites that in many instances far exceeds the performance of their modern engineering analogs. Despite significant investigations into structure-function relationships in these complex biological materials, in many instances, there is a lack of critical information regarding the specific functional roles of many components of these structural hierarchies. Here we introduce the technique of multi-material additive manufacturing, which we employ as a research tool to unravel the functional complexities of a wide range of biological materials including laminated composites, photonic architectures, and low drag surface coatings.

Overview of Technology: Workflows
Mark Hellar, *Technology Consultant, Hellar Studios LLC*

This presentation will outline the workflow of the 3D printing process, from creating a 3D object file within CAD software, converting it in a slicer, and generating the g-code for sending it to a printer. Walking through all the steps involved in this technology, this talk will show the decision-making process and how it affects the final product.

Overview of Technology: Printing Methods
Nic Lee, *Research Assistant,* MIT Media Lab

The advancement of additive manufacturing has provided unparalleled control over the material composition and form of designed objects. While the central goal of 3D printing – creating a physical manifestation of a digital object – remains largely unified, a vast array of methods for achieving this goal have evolved over time. From rapid, desktop-based extrusion systems that allow for rapid manufacturing at a low cost to large-scale metal sintering gantries, each method comes with its own unique capabilities, costs, limitations and advantages. This presentation provides an overview of state-of-the-art additive manufacturing methods and the key distinctions between the most prevalent methods. Specific topics include the digital representation of printed objects in various formats, machine systems and code, and the trajectory of emerging technologies.

Overview of Technology: Printing Materials
Dr. Charlotte Eng, *Conservation Scientist, Private Practice*

As 3D printing technologies become more mainstream, it is getting easier and cheaper for artists to render their digital objects to physical ones. There are many types of materials to print with and the creative possibilities are increasingly being explored and embraced by artists. This presentation will highlight the common materials that are used, their associated 3D printing technique(s) and how they may be identified. Plastic material can range from PLA filament to photopolymer resin while glass, metals and ceramics tend to be built up layer by layer with organic binders. As more of these objects are being collected by private owners and public institutions alike, it will be important to understand the materials used and the possible implications on storage needs and exhibition requirements.

This presentation examines several projects that apply 3D printing methods to the creation of objects in the fields of art, science, engineering, and architecture. A particular focus is applied to multi-material 3D printing with photopolymers, novel organic and biodegradable materials, and custom systems for additive manufacturing in a research setting. Through the examination of these subjects, the presentation is intended to provide an overview of emerging technologies in the field and their implications for researchers, designers, and conservators.

Overview of Technology: Post-Processing
Daniel Lütolf, *CL-Y GmbH Zurich*

Sanding, polishing, coating, coloring, gluing--this talk will address the many techniques and methods applied to the 3D print once it comes out of the printer. From support removal to smoothing to adding internal structure, the post processing options are manifold and have substantial effect on the final print. This talk will outline the ones printers most commonly use, discussing possible benefits and downsides, and present the decision making that goes into this step of the process.

Demo: Opening and looking at 3D printing files
Mark Hellar, *Technology Consultant, Hellar Studios LLC*

What does one see among the digital components of 3D printing? What do 3D files formats like OBJ and STL, and g-code reveal? Are there equivalents to an artist's fingerprints when we investigate 3D printing files? This presentation will look at the software environments of 3D printing technology and, through a demonstration, familiarize participants with some standard file formats used in 3D printing.

Day 2: Wednesday, October 27, 2021

Curatorial Keynote
Paola Antonelli, *Senior Curator, Department of Architecture & Design, The Museum of Modern Art (MoMA)*

When it was introduced in the 1980s, 3D printing only produced friable sculpted foam models—not truly manufacturing anything but rather giving volume to ideas, whether at life-size or in scale. The materials employed got progressively better, more structural, and "finished." MoMA began collecting 3D-printed objects in 2003, right at the time when they could begin being called products, and not just models, and in 2006 we organized a collection exhibition entitled Digitally Mastered. On that occasion, Antonelli outlined her multi-pronged Rapid Manufacturing (RM) dream, which listed a whole menu of positive consequences should mankind decide to invest in RM. In the 15 years since, the practice of collecting objects–of all kinds, material and immaterial–that begin as code has profoundly transformed not only the museum's holdings and conservation approaches but also MoMA's ideas about what collecting means.

Acquiring 3D-printed Objects
Emily Hamilton, *Assistant Professor of Objects Conservation, SUNY Buffalo State College*

What does a museum acquire when bringing 3D-printed works into a collection? This session introduces the scope of possible acquisitions, which may include a physical print, printing or working files, or supplemental or related materials such as drawings, photographic or video documentation, and samples of tests. This variability depends on the capacity and interest of the caretakers as much as the nature of an individual work, and this session will explore the responsibility of an institution to define and manage parameters for use when reprinting is considered. Like other works of contemporary art, an acquisition of 3D-printed works may necessitate flexibility, openness to iteration, and living with a work before making firm decisions. Pre-acquisition research and documentation processes will be discussed, including building communication structures within an institution to nurture complex discussions.

Acquiring 3D Printing Files
Peter Oleksik, *Associate Media Conservator, Museum of Modern Art (MoMA)*

This presentation provides an overview of best practices in the acquisition and long-term care of 3D printing files. It introduces the history and development of the various file formats for 3D printing and reviews different applications for the files within collections, from reference to reprinting. Basics of digital preservation are discussed as they apply to 3D printing files and a

holistic review of the file formats, software and hardware dependencies that are necessary for their accessibility in the future. The talk will familiarize participants with the salient features of 3D printed files to inform their current collecting practices, offer advice on migration and documentation strategies and suggestions on how these files can be useful for the long-term care of the physical objects.

At a Glance: Copyright Considerations in 3D Printing
Sriba Kwadjovie Quintana, J.D., *Intellectual Property Manager, San Francisco Museum of Modern Art (SFMOMA)*

This presentation discusses reprinting 3D-printed objects in museum collections from a legal point of view, how IP law in the U.S. addresses 3D printing and what may be the concerns with managing this technology in cultural institutions. This presentation also discusses best practices when choosing to engage in 3D printing of rights-protected objects.

Scanning in 3D Printing Workflows
Daniel Lütolf, *CL-Y GmbH Zurich*

Not all 3D prints start with a CAD drawing. Some artists and designers use traditional materials, like clay, to create an object before scanning it to reproduce it as a 3D print. This talk addresses the steps involved in scanning an object, the decision making that goes into selecting the right method, the “cleaning” of data as well as the preparation of a scan to be then usable by a printing machine. Outlining the work involved in this process, this talk will at the same time examine whether scanning of a 3D print is a viable conservation strategy, when its original digital file is not available.

Unnatural Materials
Virginia San Fratello, *Partner, Rael San Fratello and Emerging Objects; Chair, Department of Design at San Jose State University*

This presentation focuses on 3D printing with materials such as salt, chardonnay, curry and cochineal by the design studio Emerging Objects. The use of these novel materials within the field of additive manufacturing challenges the status quo of rapid prototyping which typically employs materials such as plastic and nylon for immediate analysis of form and scale, rarely do they offer other tangible qualities such as tactility, strength or aroma. Additionally, many of the materials developed by Emerging Objects for 3D printing, such as sawdust and rubber tires, can also be found in the waste stream as agricultural or industrial by-products and coupled with additive manufacturing can be transformed to offer new and seemingly unnatural possibilities.

Display, Conservation, and the Printed Object: Entangled Identities
Sarah Barack, *Head of Conservation and Senior Objects Conservator, Cooper Hewitt Smithsonian Design Museum*
Jessica Walthew, *Objects Conservator, Cooper Hewitt Smithsonian Design Museum*

In order to properly care for a collection, the boundaries of each object—its core identity—must be understood. At times, friction between presentation and conservation forces a new

understanding of the object itself. 3D printing, by encompassing both interrelated digital files and physical prints, provides a useful example of identities and boundaries in flux. This presentation examines three examples from the Cooper Hewitt Smithsonian Design Museum, which together elucidate varying philosophical approaches towards the display and care of 3D-printed works. The presentation begins by exploring 3D-printed objects originally displayed in part for an ephemeral quality, scent. While the central identity of the works was preserved according to curatorial priorities, modification prior to permanent acquisition meant the original display is not replicable. Questions about long-term preservation also arose when an entire suite of objects deliberately designed to degrade entered the collection. Discomfort surrounding this intentional physical instability resulted in multiple parallel collections tracks—curatorial and conservation—creating "same but different" positions from one original set.

Finally, digitization and 3D-printing have opened possibilities for collections surrogacy, allowing the museum to maintain its goal of broadening collections access while also maintaining its preservation goals and values. Operating adjacent to accessioned objects, these files and prints have their own requirements. Moving forward, as the museum continues to collect 3D prints and files, we foresee a continual blurring of boundaries that once seemed firm—the collection, its display, and its conservation.

Objects and .obj Files: Caring for Josh Kline's *Cost of Living (Aleyda)*

Margo Delidow, *Assistant Conservator, Whitney Museum of American Art*
Savannah Campbell, *Video and Digital Media Preservation Specialist, Media Preservation Network, Whitney Museum of American Art*

Josh Kline's *Cost of Living (Aleyda)*, 2014, comprises a commercially produced utility cart illuminated with LED lights, 3D-printed body parts of a hotel cleaning staff, and printed cleaning tools placed on the cart's shelves.

Kline used photogrammetry to capture the head, hands, and tools of *Aleyda*, a cleaning staff member of a boutique New York City hotel. The files were imported into a Computer Aided Design program that mapped and translated them into a three-dimensional surface model. The textures were mapped on the surfaces and forms were printed in color variations from a polymerized plaster.

Kline views himself as a sculptor and has clearly stated in interviews that the files are not the artwork; the object is the artwork. Complicating this assertion is his instruction for the museum to print new components if they are ever needed. Currently, 3D printing technology has not caught up to the information stored in Kline's model files. The prints have the telltale step pattern indicative of digital printing processes. As printing advances, the step patterns will most likely diminish. And, as intended by Kline, over time the print output will have as much resolution as the file data.

As a custodian of this work, the Whitney is committed to preserving *Cost of Living (Aleyda)* according to the artist's specifications, which includes preserving the 3D printing files and migrating them to new formats as needed. As printing technology advances, the files themselves need to be maintained in the likely event that the work is reprinted in the future.

This presentation aims to introduce the theoretical, ethical and practical implications of this work that was examined by the staff at the Whitney Museum of American Art during the sculpture's acquisition and subsequent exhibition.

Day 3: Friday, October 29, 2021

21st Century Readymade and Copyleft

Shirley Tse, *Artist*

Tse's practice is concerned with the idea of heterogeneity, or the coming together of different and contrasting elements. The use of 3D printing in Tse's practice allows the merging of the analog and the digital, ancient craft and state of the art technology, hand-made and readymade, unique and reproducible. Tse sees the 3D-printed connectors used in *Negotiated Differences* (2019-2020) as a form of **21st century readymade**—readymade objects existing in cyberspace that can be actualized with a 3D printer. *Negotiated Differences* (2019-2020) is part of the exhibition *Stakeholders* in which Tse contemplates individuals holding common stakes in a society. The idea of claiming public domain finds perfect expression in these digital readymades which are **"copyleft"**—files that can be downloaded and used by anyone under a Creative Commons license. The shifting idea of "reality" creates interesting challenges to conservation of contemporary art, where one might wonder if it is the material or the idea that needs to be preserved.

Readymade of the digital epoch: the (im)possible futures of Shirley Tse's Negotiated Differences

Olivia Chow, *Assistant Curator, Visual Art, M+*
Alessandra Guarascio, *Conservator, Installation Art, M+*
Dr. Aga Wielocha, *Conservator, Preventive, M+*

Commissioned for the Hong Kong exhibition at the 58th Venice Biennale, *Negotiated Differences* is Shirley Tse's most expansive sculptural installation to date and has recently been acquired into the M+ permanent collection. The work consists of almost 900 components—hand-crafted wooden pieces joined together with 3D-printed wood, metal, and plastic connectors— in a composition that evolves each time it is assembled in a different site. Focusing on the 3D-printed elements, the presentation unpacks the museum's efforts and investigation into preserving Tse's artistic concepts while understanding the technology-driven materiality of the work.

Firstly, it looks at the criteria of 'unique,' 'replaceable,' and 'replicable' of the 3D-printed components outlined by the artist through extensive conversations with the M+ curatorial and conservation team. This collaborative and practice-based process established a foundation for developing a long-term preservation strategy. Secondly, it looks at the practicalities of fast-paced developing technologies and the 3D printing market from the perspective of conservation while mediating the uncertainties related to this issue. Finally, the presentation evaluates the challenges related to the precarious conditions of the source files shared under the Creative Commons license that are customized and conceptualized by the artist as the readymade of the digital epoch.

Printing Errors: Lucky Accidents and Material Narratives
Tobias Klein (簡鳴謙), *Artist, Architect, and Associate Professor, School of Creative Media, City University of Hong Kong*

Additive Manufacturing, better known as 3D-printing, promises the physical reification of otherwise immaterial data. It promises the possibility of completely tool independent and uninhibited creation of any geometrical complexity. However, looking closely at the processes involved in 3D printing, the physical manifestation of immaterial data is a process of decision making, material behavior and even environmental factors. 3D printing therefore is not the pristine independent materialization of data but is instead a process of transformation of the data to the physical form. This transformation within 3D printing technology, including the possible mistakes and lucky accidents along the way, tells a story that, to the keen eye, reveals a narrative of process, technique, and material uniqueness.

Condition Issues and Degradation of 3D-printed Objects
Carolien Coon, *SEAHA doctoral student, UCL Institute for Sustainable Heritage*

Progress is well underway with complex conservation challenges faced by museums in relation to traditionally manufactured plastics; however, an ever-expanding list of new polymeric 3D printable materials are entering collections. This presentation introduces condition issues pertaining to 3D printed plastics commonly used by artists and designers. These include traditional plastics (ABS and Nylon) but also new formulations of photopolymers, biodegradable plastics (PLA) and composite materials. The impact of variations in printing parameters on the chemical and physical properties of materials means that each object requires a unique approach, and the terminology used by industry adds to confusion with descriptions such as “ABS-like” or “Polypropylene-like.” The presentation explores methods for material identification and characterization and highlights the main degradation pathways to consider when caring for 3D-printed objects.

Tauba Auerbach’s Altar/Engine (2015) Pt.2 A Case Study in Reprinting 4D Mesh
Peter Oleksik, *Associate Media Conservator, Museum of Modern Art (MoMA)*
Megan Randall, *Objects Conservator, Midwest Art Conservation Center (MACC)*

In 2016 MoMA acquired the work *Altar/Engine* by Tauba Auerbach. The work consists of seventy-six individual 3D-printed plastic components of various types, resins, and finishes that are installed in a specific pattern on a nine-foot square, highly finished painted aluminum platform and stainless steel base. During and after acquisition the MoMA conservation department engaged closely with the artist to fully understand the artwork, including the components’ production, installation, and condition.

The components range in complexity and size, and one large central component titled *4D Mesh,* printed by stereolithography (SLA) with Accura 60 resin, was acquired in poor condition. The lattice structure of the component had flattened over time and the color had yellowed. This was acknowledged at the time of acquisition and the condition could be monitored by reviewing the component’s original 3D .stl file. Due to issues of fragility and concerns with long-term storage, the artist and the museum agreed to wait to reprint this component immediately prior to the artwork’s first exhibition at MoMA.

In 2019, in preparation for *Altar/Engine*'s installation for the exhibition *New Order* at MoMA, the conservation team began the process of reprinting *4D Mesh* with the aid of the artist's digital files, vendor, and production notes. This presentation reviews the successes and failures of this endeavor, the speakers' thoughts on reprinting as a treatment method, and how the digital files used for printing can aid in documentation, installation and beyond.

Engineering Fashion: Codes, Patterns, Replications, Reproductions
Sarah Scaturro, *Eric and Jane Nord Chief Conservator, Cleveland Museum of Art*

This presentation explores the emergence of 3D-printed fashion by contextualizing the creation process within the scope of historic fashion design practices. Focusing on fashion designers like Charles James, threeASFOUR, and Iris van Herpen, the role of flat-patterning, draping, coding, prototyping, and material-choice are examined to reveal similarities and divergences between traditionally created and 3D-printed designs. The requirements of fashion (as both an aesthetic and functional system) to clothe a moving and three-dimensional body will ground the discussion. Ultimately, the goal of this presentation is to offer a tantalizing glimpse at the challenges and proactive negotiations that a conservator must engage in to better understand and preserve 3D-printed fashions.

Focusing Forward
Jill Sterrett, *Independent Arts and Culture Advisor*

What next? Reflecting on the themes raised during this conference on 3-D printed objects, this presentation will pose questions and propositions about seeing/accepting/embracing 3-D printing as a vital part of preservation and stewardship strategy in cultural collections. If this newfound method can be extended to other works in our care, are there limits to its usefulness?

Speaker Biographies

Paola Antonelli is Senior Curator at The Museum of Modern Art in the Department of Architecture & Design, as well as MoMA's founding Director of Research & Development. Her most recent exhibition, *Broken Nature*, opened at MoMA in November 2020. She is also currently working on *@design.emergency*, an Instagram and book project that explores design's role in building a better future for all, in collaboration with critic Alice Rawsthorn.

Sarah Barack is the Head of Conservation and Senior Objects Conservator at the Cooper Hewitt Smithsonian Design Museum. She holds a Masters of Art and Certificate of Advanced Conservation from the Conservation Center, Institute of Fine Arts, New York University and a Masters of Business Administration from Columbia Business School. Recent research has ranged from plastics polishing protocols to technical study of 18th Century European porcelain. She served for four years as Treasurer for the American Institute of Conservation/Foundation for the Advancement in Conservation and is the co-founder and co-chair of the AIC K-12 Outreach Working Group.

Savannah Campbell is a Video and Digital Media Preservation Specialist at the Whitney Museum of American Art. She has previously been a Fellow in Magnetic Media Preservation at The Standby Program and has worked on audiovisual preservation projects for the Dance

Heritage Coalition, CUNY TV, and Crawford Media Services. Savannah holds an MA in Moving Image Archiving and Preservation from New York University.

Olivia Chow is Assistant Curator, Visual Art, at M+, the new museum of visual culture in Hong Kong's West Kowloon Cultural District. She participated in the curatorial process for the M+ exhibitions *Shirley Tse: Stakeholders, Hong Kong in Venice* (2019), Hong Kong's presence at the 58th Venice Biennale, and *Shirley Tse: Stakes and Holders* (2020). Before joining M+, she held various curatorial positions at Para Site (Hong Kong) and at The Works Art and Design Festival (Edmonton). At Para Site, she edited *The Unappropriated Recipes*, an unconventional cookbook that responds to Hong Kong through contributions from artists, curators, and collaborators in the local and international art community.

Carolien Coon is a SEAHA doctoral student at UCL Institute for Sustainable Heritage investigating the stability of Additive Manufactured plastics. At UCL she obtained an MRes in Heritage Science (2015) and worked as Research Assistant on the Horizon 2020 project NANORESTART: Nanomaterials for the restoration of works of art. Previously, Coon obtained a Fine Art degree from Central University of Technology, Free State, South Africa (1999) and a BA (Hons) in Conservation at City and Guilds of London Art School (2009). As conservator she has worked for the National Trust, Plowden and Smith Ltd. and the Victoria and Albert Museum.

Margo Delidow, Assistant Conservator for the Whitney Museum of American Art, completed a Masters of Arts and Certificate of Advanced Study in Conservation from The Art Conservation Program at Buffalo State, The State University of New York. She is a partner at Whryta Contemporary Art Conservation and a Professional Associate Member of AIC.

Llisa Demetrios has been archiving the material from the Eames Office at 901 Washington in Los Angeles for over twenty-five years. Most recently, she facilitated the loans for "The World of Charles & Ray Eames" exhibition that started at the Barbican Centre in England in 2015 and continued to Sweden, Portugal, Belgium, Germany, Michigan, and the Oakland Museum of California in February 2019. Demetrios loves how a single object can tell a larger story of how her grandparents, Charles & Ray Eames, approached the problems of their day, like sustainability and conservation, which can help us face similar challenges today.

Charlotte Eng has a PhD in materials science and engineering from Stony Brook University, NY. She was previously a Senior Conservation Scientist at the Los Angeles County Museum of Art (LACMA) where she used noninvasive and micro-invasive methods to examine diverse works of art from LACMA's collection. Projects she enjoyed working on included materials identification of contemporary jewelry, use of spectroradiometry for the evaluation of light sources to be used to illuminate artworks, and preservation issues of 3D printed objects. Currently, she is a staff scientist at the Lawrence Livermore National Laboratory in the Chemical and Isotopic Signatures Group of the Nuclear and Chemical Sciences Division.

Alessandra Guarascio is the Conservator, Installation Art, at M+ Museum in Hong Kong. As part of the conservation team, she is responsible for the day-to-day care and documentation of the installation art collection. She obtained her master's degree in Conservation of Contemporary Art in Milan, with a thesis on the documentation and rearrangement of a complex installation by John Bock. Prior to her current appointment, she collaborated with the Museo del Novecento, Hangar Bicocca, and the Museo del Design Italiano in Milan. In 2013 she moved to

Singapore, where she spent six years working on all phases of conservation at the ArtScience Museum and National Gallery Singapore.

Martina Haidvogl is a lecturer in Conservation of Contemporary Art at the Bern University of the Arts. Prior to this appointment, she was Associate Media Conservator at the San Francisco Museum of Modern Art (2011-2019), where she has piloted documentation and preservation initiatives for SFMOMA's Media Arts collection. Haidvogl has lectured and published internationally on media conservation and its implementation within collecting institutions. Her research focuses on cross-disciplinary collaboration practice fostered through digital tools, serving the needs of the art of our time.

Emily Hamilton is the Assistant Professor of Objects Conservation at Buffalo State College. Previously, she was the Associate Objects Conservator at SFMOMA, Assistant Objects Conservator at the Saint Louis Art Museum, and the Samuel H. Kress Sculpture and Media Conservation Research Fellow at MoMA. Hamilton earned a B.A. in Art History from Reed College and an M.A. in Art Conservation from SUNY Buffalo State College.

Mark Hellar is a technology consultant for cultural institutions and the owner of Hellar Studios LLC. He specializes in innovative yet practical digital media and software-based solutions for multimedia artists and institutions that support their work, with an emphasis on developing systems for exhibition, documentation, and preservation. Hellar is currently working on new media conservation initiatives at SFMOMA, including the conservation and care of their software-based artworks. He is also the software developer for the studio of artist Lynn Hershman Leeson and faculty at the San Francisco Art Institute, teaching on the topics of virtual reality and augmented reality.

Sriba Kwadjovie Quintana, J.D., currently serves as the Intellectual Property Manager at the San Francisco Museum of Modern Art (SFMOMA), where she manages copyright and assesses compliance with intellectual property laws and policies affecting the museum's operation, exhibition programming, events and publications. She has presented on matters involving IP and the arts for the American Bar Association, Western Museums Association and at Stanford University. Kwadjovie Quintana is also a trained dancer and has performed with various modern/contemporary dance companies throughout the Bay Area.

Tobias Klein (簡鳴謙, is a German Artist, Architect and Associate Professor at the School of Creative Media, City University of Hong Kong. His works and writings articulatesa syncretism of contemporary CAD/CAM technologies with site and culturally specific design narratives, intuitive non-linear design processes, and historical cultural references, establishing the notion of Digital Craftsmanship as an operational synthesis between digital and physical materials and tools as poetic (Poïesis) and technical (Technê) expressions. In 2020, The University Museum and Art Gallery, Hong Kong, opened a retrospective exhibition of his works, accompanied by a publication with the same title, Metamorphosis or Confrontation.

Nic Lee is a computational designer at the MIT Media Lab. His research combines design, digital fabrication, material development and energy evaluation in order to create end to end pipelines for sustainable construction. Through his work, he aims to bridge the gap between grown and built environments. Lee graduated from the University of Virginia with bachelor's degrees in biomedical engineering and neuroscience and received his MDes from the Harvard Graduate School of Design. In 2020, he received his MAS at the Mediated Matter Group and he is currently a PhD candidate at the MIT Media Lab.

Daniel Luetolf lives and works in Zurich. In 2001 he obtained a degree in structural engineering in Zurich and 2010 a MSc ETH Zurich in architecture. From 2010 to 2016, he was an art producer for Urs Fischer in New York and Zurich. In 2016, he founded his own company CL-Y GmbH for 3D art production which is realizing national and international projects in art and architecture. He has been researching and teaching at the ETH Zurich since 2016. Furthermore, he is a member of the art collective CKÖ and winner of the 2014 Swiss Art Award.

Alexandra Nichols is a Time-Based Media Conservator at Tate, focusing on exhibitions and displays. Prior to working at Tate, she was a Sherman Fairchild Foundation Fellow at The Metropolitan Museum of Art and a Samuel H. Kress Fellow at the Solomon R. Guggenheim Museum in New York concentrating on the conservation of time-based media. Alexandra Nichols holds an M.S. in Art Conservation from the Winterthur/University of Delaware Program in Art Conservation and a B.A. in Art History from the University of Maryland.

Peter Oleksik is Associate Media Conservator at the Museum of Modern Art (MoMA) where he has been working since 2011 to conserve the museum's vast time-based media collection across curatorial departments. Outside of MoMA, Oleksik regularly writes and teaches various topics within time-based media conservation as well as works with artists, filmmakers and musicians to preserve and provide access to their media collections. Oleksik received his BA in Cinema Studies from the University of Southern California and his MA from New York University's Moving Image Archiving and Preservation (MIAP) program.

Daniel Ostroff has worked with the Eames Office since 2006, during which time he has written 300 blog posts on various aspects of the work of Charles and Ray Eames. Since 2001, he has also advised institutions and private companies, including the Los Angeles County Museum of Art, San Francisco Museum of Modern Art, Victoria and Albert Museum, Vitra Design Museum, Bonham's Auctioneers, The Cummins Foundation, Herman Miller, Gillett and Caudana Appraisers, and J. F. Chen Ltd. Ostroff was the editor of An Eames Anthology: Articles, Film Scripts, Interviews, Letters, Notes and Speeches by Charles and Ray Eames (Yale University Press) and is active as a film and television producer.

Megan Randall is an Objects Conservator at the Midwest Art Conservation Center (MACC) in Minneapolis, Minnesota. Prior to MACC, Randall was an Associate Objects Conservator at the Museum of Modern Art. She earned her graduate degree at the Conservation Center, Institute of Fine Arts, NYU, and completed internships at the Chinati Foundation in Marfa, Texas and the American Museum of Natural History. Prior to entering the field of conservation she worked as a finisher at Modern Art Foundry in Astoria, Queens. She received a master's degree from Christie's Education in 2008 and a bachelor's degree from Carleton College.

Virginia San Fratello draws, builds, 3D prints, teaches, and writes about architecture and interior design as a cultural endeavor deeply influenced by craft traditions and contemporary technologies. She is a founding partner in the Oakland, CA based make-tank Emerging Objects and the co-author of *Printing Architecture: Innovative Recipes for 3D Printing* (Princeton Architectural Press 2018), a book that reexamines the building process from the bottom up and offers illuminating case studies for 3D printing with materials like chardonnay grape skins, salt and sawdust. Her work has been published widely, including in the New York Times, and is recognized by several institutions including: LACMA, The National Building Museum and included in the permanent collection of The Museum of Modern Art in New York, The Cooper

Hewitt Smithsonian Design Museum, The San Francisco Museum of Modern Art, and the Design Museum in London.

Sarah Scaturro is the Eric and Jane Nord Chief Conservator at the Cleveland Museum of Art. From 2012 - 2020 she was the Head Conservator of the Costume Institute, Metropolitan Museum of Art, where she developed a materials-and values-based approach to the conservation of fashion that foregrounds fashion as a time-based phenomenon. Previously, Scaturro was the Textile Conservator and Assistant Curator of Fashion at the Cooper-Hewitt, Smithsonian Design Museum. She graduated with an MA from the Fashion Institute of Technology in Fashion & Textile Studies and is a PhD candidate at Bard Graduate Center, researching the history of costume conservation.

Jill Sterrett is an arts and cultural advisor. She was Interim Director and Deputy Director at the Smart Museum of Art at the University of Chicago (2018-2020) and Director of Collections and Art Conservator at the San Francisco Museum of Art (1990-2018). She is engaged in ways to revitalize museums for our times and plays an active role in *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 lived and practiced on four continents and believes this business of objects has always been about people.

Shirley Tse works in the mediums of sculpture, installation, photography, and text. She deconstructs the world of synthetic objects that carry paradoxical meanings, while constructing models in which differences might come together. Tse's work has been exhibited extensively in the US and internationally in the last 20 years. She represented Hong Kong at the 58th Venice Biennale. Her work is featured in numerous publications including 'Akademie X: Lessons in Art + Life' (2015), 'Sculpture Today' (2007), and others. Tse received the John Simon Guggenheim Memorial Foundation Fellowship in 2009. She has been on the faculty at California Institute of the Arts (CalArts) since 2001.

Jessica Walthew is an objects conservator at Cooper Hewitt, working with both the Product Design & Decorative arts and Digital collections. Her research interests include the history and theory of conservation, and technical research, especially with imaging technologies. Her current work focuses on plastics (both their conservation and cultural history). She served as co-curator of Natural Plastics (2019) at Cooper Hewitt and is currently researching the use of bioplastics in design.

Dr. James C. Weaver is a Senior Scientist at Harvard's School of Engineering and Applied Sciences, where he runs the Wide-Field Electron Optics Laboratory and leads the Biologically Inspired Materials and Design Group. He received his Bachelor's degree in Aquatic Biology and Ph.D. in Marine Science from the University of California, Santa Barbara, and went on to pursue postdoctoral studies in Molecular Biology, Chemical Engineering, Physics, and Earth History. His main research interests focus on investigating structure function relationships in hierarchically ordered biological composites and the advanced fabrication of their synthetic analogues. He has played critical roles in the development of various model systems for the study of a wide range of biomineralization processes and is an internationally recognized and award-winning scanning electron microscopist.

Aga Wielocha is a collection care professional and a researcher specialized in contemporary art. Currently, she holds a position of Conservator, Preventive at M+ in Hong Kong. She holds a PhD from the University of Amsterdam. Her doctoral research carried out within the program 'New Approaches in the Conservation of Contemporary Art' (NACCA), situated at the crossroads of art

history and theory, conservation, museology, and heritage studies, is focused on the lives and futures of contemporary art in institutional collections, particularly on works which are variable and unfold over time. Prior to her doctoral studies, she served as a conservator at the Museum of Modern Art, Warsaw.