Keep It Moving?

Keep It Moving? Conserving Kinetic Art

Rachel Rivenc and Reinhard Bek, Editors

Proceedings from the meeting organized by the Getty Conservation Institute, the ICOM-CC Modern Materials and Contemporary Art Working Group, and Museo del Novecento

Palazzo Reale, Milan, Italy, June 30–July 2, 2016

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Front cover: Analogue projection of Aleksandar Srnec's *Luminoplastic 1*, 1965–67 (fig. 8.6). Museum of Contemporary Art, Zagreb.

Back cover: [TK]

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Contents

Foreword viii
Timothy P. Whalen

Preface ix
Rachel Rivenc

Opening Remarks: The Kinetic Collection at the Museo del Novecento, Milan 1
Iolanda Ratti

PART 1. KEYNOTES

1. A Question of KinEthics 6
Reinhard Bek

2. The Fluid Boundaries between Interpretation and Overinterpretation: Collecting, Conserving, and Staging Kinetic Art Installations 16
Tiziana Caianiello

PART 2. CASE STUDIES

3. Fast and Furious: Operation, Maintenance, and Repair of Chris Burden's *Metropolis II* at LACMA 26
Mark Gilberg, Alison Walker, and Richard Sandomeno

4. Conserving Thomas Wilfred's *Lumia Suite, Opus 158* 34
Carol Snow and Lynda Zycherman

5. Cybernetic *Umbrella*: A Case Study in Collaboration 41
Carla Flack, Louise Lawson, Jack McConchie, and Ming-Yi Tsai

6. Moving with the Times: The Refurbishment and Restoration of a Choreographed Robotic Arm 47
Sherry Phillips and Marcel Verner

PART 3. COLLECTIONS/ARTISTS' OEUVRES

7. Takis and the Fourth Dimension 56
Erin Stephenson and Kari Dodson

8. Preserving Performativity: Conserving the Elusive in Aleksandar Srnec's Artwork 64
Mirta Pavić and Vesna Meštrić

9. Engineering a Solution: Latin American Light-Based Kinetic Art at the Museum of Fine Arts, Houston 73
Jane Gillies and Ingrid Seyb

10. Intertwined Strategies for Conservation and Display of Kinetic Art: Case Studies in the European Neo-Avant-Garde 82
Francesca Pola and Barbara Ferriani

11. The Examination and Conservation of Thirteen Artworks by Jean Tinguely in the Collection of the Stedelijk Museum Amsterdam 88
Esther Meijer, Susanne Meijer, and Sandra Weerdenburg

PART 4. THEORETICAL ISSUES

12. The Hype about ZERO and Its Influence on the Conservation and Presentation of Early Kinetic Works 96
Gunnar Heydenreich and Julia Giebeler

13. Kinetic Multiples: Between Industrial Vocation and Handcrafted Solutions 104
Isabel Plante

14. The Collection of Nicolas Schöffer: From the Artist's Studio to the Museum 113
Manon D'haenens, Muriel Verbeeck, and David Strivay

15. "Pretty Good for the 21st Century": Restoration, Reconstruction, and Realization of Len Lye's "Tangible Motion Sculpture" 120
Paul Brobbel and Simon Rees

PART 5. POSTERS

16. Conserving Mechanical Elements in Technological Artifacts: Three Case Studies from Museo Nazionale della Scienza e della Tecnologia "Leonardo da Vinci," Milan 131
Marianna Cappellina and Claudio Giorgione

17. Think Big! The Conservation of *Ballerina Clown*, a Kinetic Work of Art by Jonathan Borofsky 133
Mine Erhan

18. Conserving a Kinetic "Rotor": *Light Dynamo* by Heinz Mack 135
Paola Iazurlo, Grazia De Cesare, and Mariastella Margozzi

19. Considering the Continuum of Care for Outdoor Kinetic Sculpture 137
Abigail Mack, Friederike Steckling, and Sara Levin

20. Gianni Colombo's *Strutturazione cinevisuale abitabile*: From Flickering to Light 139
Marlies Peller, Gerda Kaltenbruner, and Martina Pfenninger Lepage

21. *Death of a moment*: Management, Installation, and Maintenance of a Site-Specific Kinetic Sculpture 141
Eugenia Stamatopoulou

22. Future in Motion: Conservation Issues of Seven Kinetic Artworks by Dutch Artist Ray Staakman 143
Carien van Aubel, Nikki van Basten, Katja van de Braak, Sjoukje van der Laan, Anouk Verbeek, and Marleen Wagenaar

23. The Conservation Ethics of and Strategies for Preserving and Exhibiting an Operational Car: The Motion and Standstill of Joost Conijn's *Hout Auto* (Wood Car) 145
Arthur van Mourik

Contributors 147

Symposium Participants 155

Index of Videos 159

Bibliography 166

Foreword

In 2007 the Getty Conservation Institute (GCI) launched its Modern and Contemporary Art Research Initiative to address some of the acute challenges raised by the conservation of contemporary art. These include the immense variety of materials—not all intended to last—used by contemporary artists, the lack of established treatments, and, increasingly, the use artists make of new technologies, many of which are prone to obsolescence and call for new competencies for their maintenance and repair.

Although the initiative includes a strong research component, it also recognizes that one of the most effective ways of addressing these challenges is through networking and the dissemination of information among professionals in the field. One of the strategies adopted to achieve this goal is the organization of focused, singled-themed meetings, which present an opportunity to hear a range of different points of view, compare practices, and survey the state of thinking in the field at a certain moment in time. The symposium documented in these proceedings falls under this category. It took place from June 30 to July 2, 2016, at the Palazzo Reale and the Museo del Novecento in Milan and was the result of a collaboration between the GCI, the Museo del Novecento, the International Network for the Conservation of Contemporary Art (INCCA), and the Modern Materials and Contemporary Art (MMCA) working group of the International Council of Museums, Committee for Conservation (ICOM-CC).

The GCI has a long history of partnering with ICOM-CC. This is the third time that the interim meeting of MMCA has been organized in partnership with the GCI, and the second time that proceedings are published as a result of the collaboration. Partnerships and collaborations are an important way for the GCI to maximize the impact of the work we do and reach out to a larger audience. We are thankful to our partners, ICOM-CC, but also INCCA, and especially the Museo del Novecento for their contributions. We also gratefully acknowledge Rachel Rivenc and Reinhard Bek for their thoughtful editing of this volume.

Although the conservation of kinetic art is a very focused topic, the enthusiasm of the symposium participants demonstrated the continued need for research, exchange of ideas, and availability to conservators of reference material. The GCI is therefore delighted that these proceedings will be made available in both digital and print formats, especially since this is the first time we will be including videos in an online publication, taking advantage of the unique opportunity to present kinetic art as it was intended to be viewed … in motion.

Timothy P. Whalen
John E. and Louise Bryson Director, The Getty Conservation Institute

Preface

Rachel Rivenc

> "All of a sudden it hit me why not just movement? If there was such a thing as composing music, there could be such a thing as composing motion." —Len Lye[1]

The word *kinetic* derives from the Greek *kinetikos* and simply means "moving, in motion." Kinetic art not only incorporates movement but often depends on it to produce its intended effect and fully realize its nature as a work of art. Movement can be energy, experience, or matter to be composed. Kinetic art can take a multiplicity of forms and include a wide range of motion, from motorized and electrically driven to that created by wind, light, or other sources of energy. It can include light, sound, and slide or video projections.

Kinetic art emerged throughout the twentieth century. Naum Gabo's *Kinetic Construction (Standing Wave)* (1919–20), often considered one of the earliest examples of kinetic art, is discussed in two papers in this publication; the lesser known *clavilux* (light played with a key) created in 1921 by Thomas Wilfred is also discussed in these pages. Kinetic art had its major developments in the 1950s and 1960s with the groundbreaking efforts of artists such as Jean Tinguely and Nicolas Schöffer as well as collectives such as the ZERO group in Germany, Gruppo T in Italy, and Groupe de Recherche d'Art Visuel (GRAV) in France. In the 1960s, a branch of Op Art or optical art—that is, abstract art based on optical illusion—also started to incorporate actual movement; other artists explored the possibilities offered by interactive kinetic environments, in which the viewer's experience takes precedence over the object in defining the work of art. Kinetic art continues to appeal to contemporary artists, and more recent creations such as Chris Burden's *Metropolis II* (2011), Liz Larner's *Corner Basher* (1988), and Leo Villareal's *Flowers 8* (2005) are also discussed in these papers.

In contemporary art conservation, much thought is devoted to the reconsideration of the concept of authenticity and to the dichotomy of preserving a work's original materials versus its functionality. The conflict is especially acute with kinetic art, where a compromise between the two often seems impossible: when engine parts stop working, when light bulbs go out, the artwork will stop functioning if the components are not replaced. Wear and tear is inherent to the nature of the artworks and inevitable if they are displayed in motion, and issues of technological obsolescence thwart the most well-intentioned maintenance strategies. To further complicate matters, although parts of an artwork might be deemed "only" functional, strong sociological and historical information and meanings are often embedded in a given technology and its use by an artist. *Keep it Moving? Conserving Kinetic Art* is an attempt, if not to answer all of these questions, at least to convene a wide range of professionals who routinely grapple with them and initiate a discussion. Presenters from North and South America, Europe, and Oceania gathered to discuss issues in the preservation of kinetic art. Some of the discussions were very technical, but more general and wide-ranging preoccupations also emerged: the role of the conservator; functionality and experience versus materiality; the question of artist intent and artist involvement; the meaning of longevity and identity; obsolescence not only of materials but also of expertise and competence; and the influence of fame, fashion, and market on conservation. While most presentations originated from

the conservation point of view, broader definitions of preservation were also proposed in a thought-provoking paper (see Brobbel and Rees, this volume) by the Len Lye Foundation. The two keynote articles lay important theoretical ground for the subsequent papers and tackle two major aspects of kinetic art preservation. Tiziana Caianiello focuses on re-creation and restaging to explore the boundaries between interpretation and overinterpretation, while in his paper, Reinhard Bek establishes three main preservation strategies for kinetic art: retirement, replication, and maintenance.

As expected, there is no one-size-fits-all solution, especially considering the wide range of artworks and situations included under the umbrella of "kinetic art." Every decision is a compromise, which means that something is inevitably lost. But of course when works of art need conservation, it is often because something has been lost already, something has changed, and we are reacting to it. Deciding upon a conservation treatment or strategy often implies deciding what is the most acceptable loss, and how to retain as much of the artwork as possible. In this process, conservation emerges as an effort to define, over and over, what a work of art is: the specific work of art in front of us, but also a work of art in general. Each decision, each treatment is a tentative answer to that question. Some refer to conservation as an activity aiming at managing change rather than preventing or stopping it altogether. This especially resonates for kinetic works: Caianiello quotes Umberto Eco writing about Alexander Calder and defining a kinetic work of art as "a field of open possibilities."[2] So perhaps when we think of kinetic art, we can think of it as art in motion, not only because of the movement it incorporates but also because it is art that does not possess a fixed state; rather, the art is in flux, as is our understanding, interpretation, and reception of it.[3]

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I would like to thank the Museo del Novecento for its generosity and wonderful assistance, especially Iolanda Ratti, collections curator, and Claudio Salsi, director, as well as Marina Pugliese, the former director who initially proposed this collaboration. The organization of this symposium would not have been possible without the diligence and tremendous efficiency of Barbara Ferriani and her studio, especially Elena Calasso. Lydia Beerkens and Julia Langenbacher also contributed greatly to the organization of the meeting. Within the GCI, I would like to gratefully acknowledge Jeanne Marie Teutonico, associate director of programs, and Tom Learner, head of science, for their support of the project. I would also like to extend my thanks to Cynthia Godlewski, senior publications manager, and Gary Mattison, senior project coordinator, both at the GCI, who expertly coordinated the preparation for publication of these proceedings.

The quality of the posters and the presentations given at the symposium was impressive, and I am extremely grateful to all the presenters and authors who shared their work during the symposium and in these proceedings. I am also profoundly indebted to Reinhard Bek who coedited this volume—this project would not have been possible without his immense knowledge of and great enthusiasm for the topic, as well as his hard work and dedication. Finally, I am thankful to the talented staff at Getty Publications who turned our proceedings papers into a functional and beautiful publication: Beatrice Hohenegger, project editor; Jennifer Boynton, freelance manuscript editor; Greg Albers, digital publications manager; Eric Gardner, software engineer; Nick Geller, graduate intern; Nina Damavandi, image acquisition and permission; Rachel Barth, assistant editor; Zoe Goldman, editorial assistant; and Tom Fredrickson, proofreader.

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Notes

1. Lye 1984:64, quoted by Brobbel and Rees in this publication.
2. Eco 1989:86, quoted by Caianiello in this publication.

3. The question of change, identity, and authenticity in relationship to the conservation of contemporary art has long preoccupied the field, and much has been written about the topic. For an in-depth discussion of these notions centered around time-based media installations, which present many issues overlapping with kinetic art, see, for example, Pip Laurenson, "Authenticity, Change and Loss in the Conservation of Time-Based Media Installations," *Tate Papers* 6 (Autumn 2006), http://www.tate.org.uk/research/publications/tate-papers/06/authenticity-change-and-loss-conservation-of-time-based-media-installations. For a more recent discussion of identity as a continuum of change, see Muriel Verbeeck, "There Is Nothing More Practical than a Good Theory: Conceptual Tools for Conservation Practice," in *Saving the Now: Crossing Boundaries to Conserve Contemporary Works, September 12–16, 2016*, *Preprints, Studies in Conservation Supplement 2*, International Institute for Conservation of Historic and Artistic Works (IIC), 2016.

Opening Remarks: The Kinetic Collection at the Museo del Novecento, Milan

Iolanda Ratti

The cultural milieu in Milan during the late 1950s and early 1960s was extremely lively. Lucio Fontana's spatial research influenced artists such as Piero Manzoni, Enrico Castellani, and Agostino Bonalumi, as well as groups that sought to upset traditional art practices not only in terms of media but also by stressing the role of the spectator in giving significance to the artwork.

In 1959 Giovanni Anceschi, Davide Boriani, Gianni Colombo, and Gabriele Devecchi met at the Accademia di Belle Arti di Brera and formed Gruppo T (where T stands for "time"). They started producing works together, and these where exhibited for the first time in *Miriorama 1*, organized in January 1960 at Galleria Pater in Milan.

The term *miriorama*, from the Greek *myrio* (meaning "an endless quantity") and *orao* (to see), is the title of the group's manifesto, written in October 1959 and presented for the Galleria Pater exhibition. The manifesto asserts that reality is an expression of the variable perception of space and time. The traditional idea of art is overtaken: artworks have to be realized in the same material as reality. Movement shall therefore represent a continuous variation in terms of space and time and also reflect the rapid improvement of technology.[1]

The group's first environmental artwork, *Grande oggetto pneumatico*, was produced in 1959 and exhibited in *Miriorama 1*. Composed of seven long polyethylene balloons, it occupied the entire space of the gallery. The shape of the artwork changed constantly because the balloons were alternately inflated through an air nozzle and because the visitors had to move them to walk through the space.

From January to February 1960, the Galleria Pater hosted four solo exhibitions (*Miriorama 2* through *Miriorama 5*), seen as a progression of and follow-up to the first show, each dedicated to a member of the group: Boriani, Devecchi, Colombo, and Anceschi. The second group show, *Miriorama 6*, was organized in March 1960, and it was the first time Grazia Varisco was a member of Gruppo T.

In 1962, when Gruppo T participated in the exhibition *Arte programmata: Arte cinetica, opere moltiplicate, opera aperta* at the Olivetti showroom in Milan, Umberto Eco defined the group as "kinetic" and "programmed."[2] Artists introduced the use of new industrial materials and objects in their works, such as plastic, polystyrene, electric motors, UV lights, and strobe lamps. The aim of their research was to invite the public to interact with the art, creating a new relationship between visitors, artwork, and exhibition space.

Gruppo T continued its collaborative activities until the end of the 1960s, establishing relations with European groups researching the idea of movement, such as ZERO in Düsseldorf and Groupe de Recherche d'Art Visuel (GRAV) in Paris, and trying to deconstruct the traditional art system. An ending point of the group's activity could be considered 1968, when Colombo won first prize at the Venice Biennale. From the beginning of the 1970s each artist followed his or her own path, often with interesting experimentations in the field of design.

The history of Milan's municipal collections of twentieth-century art dates to the beginning of the century and includes acquisitions, donations from private collectors, and long-term loans. Yet it was only in 2010 that the Museo del Novecento opened as a permanent venue that provides a narrative for Italian art from the avant-garde to the present, with a focus on Milan. When the committee started planning the new museum in 2008, it dedicated a section to programmed and kinetic art that included space for Gruppo T, which was not yet represented in Milanese institutions. Important artworks referencing the visual-kinetic research from the late 1950s had entered the museum's collections from the 1970s

through the 1990s; Colombo's *Strutturazione pulsante* (1959), Enzo Mari's *Struttura no. 386* (1957), Bruno Munari's *Aconà biconbì* (1964–67), and Dadamaino's *Oggetto ottico dinamico no. 1* (1963) were especially significant acquisitions.

The collaboration of artists, collectors, and archives (specifically the Archivio Gianni Colombo) was essential to attract long-term loans and achieve a panorama of Gruppo T's work. It was also fundamental for the re-creation of some of the group's environmental works from original documents such as drawings and plans and with the direct supervision of the artists. Anceschi's *Ambiente a shock luminosi* (1964), Boriani's *Ambiente stroboscopico no. 4* (1967), Devecchi's *Ambiente-Strutturazione a parametri virtuali* (1969), and Colombo's *Topoestesia (Tre zone contigue—Itinerario programmato)* were re-created in Milan in 2010.[3] These facsimiles provided a better understanding of the boundaries between a kinetic object and a kinetic space, and they enabled research and analysis of the reaction and interaction of the public with the work of art.

Conservation Issues

Kinetic artworks present considerable conservation and maintenance challenges and, beyond the specificities of individual cases, permanent display is the first matter to be considered. The Museo del Novecento is open seventy hours a week, and thirteen hours each on Thursdays and Saturdays. Artworks on view are activated for long periods, and this causes stress to lights and motors, especially to original motors that had not been designed for long-term use. To address the issue, sensors and timers were installed so that the works are activated only when visitors are present and only for about one minute. While this has considerably reduced the need for extraordinary interventions by technicians, wear and tear remain the primary conservation issues, especially after many years of display.

The Museo del Novecento's approach thus far has been that of preserving the original components by preemptively replacing them with new ones, even when the originals still work. In this case, the overall "authenticity" of the artwork is potentially preserved, since its original components, such as motors or rubber drive belts, are intact, functional, and available for a possible future reconstruction.

This approach was used during the restoration of Colombo's *Strutturazione pulsante*, a work composed of rectangular modular polystyrene panels combined orthogonally; behind the panels, a motor-driven system of slats produces the alternating movement of the panels (fig. I.1). In conjunction with a cleaning of the polystyrene parts, the museum decided, with the approval of the Archivio Gianni Colombo, to replace the two still functional but very fragile plastic silicon belts (from the late 1950s) with new belts. The original belts were preserved in the archive, so the artwork could possibly be rebuilt with its original components in the future.

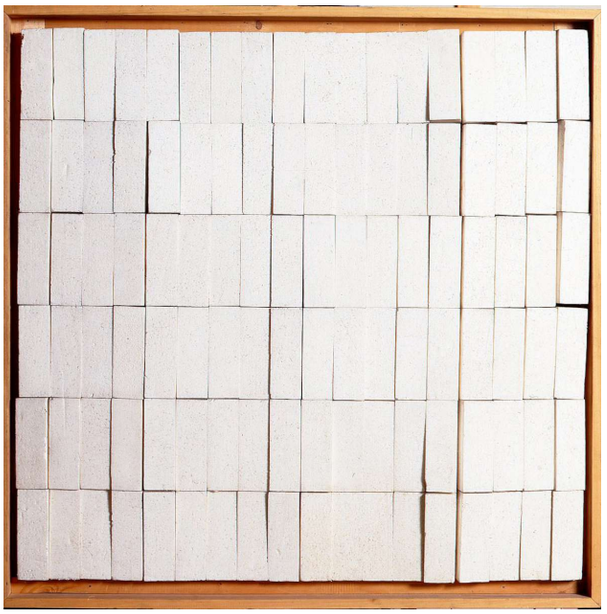

Figure I.1. Gianni Colombo, *Strutturazione pulsante*, 1959, polystyrene foam, wooden structure, metal, rubber foam, and electrical micromotor. The artwork is turned on for one minute every thirty minutes from 10 a.m. Museo del Novecento (long-term loan of the artist).

Figure I.2. Giovanni Anceschi, *Struttura tricroma*, 1964, four cube-shaped elements in wood and metal, inbuilt screen, back projection with additive color synthesis, and four 220V electromechanical motors. Museo del Novecento (long-term loan of the artist, Milan).

Preventive substitution was also adopted for Anceschi's *Struttura tricroma* (1964), a work composed of four motorized cubes and three halogen lamps. The back projection, made by the lamps, creates a regular pattern of colored circles on the "screen" of the cubes' faces (fig. I.2). The four electromechanical 220V motors—one for each cube—were constantly under stress because the rotating blades, which produce the movement of the colored circles, were too heavy. The blades have been preventively replaced with new blades that are lighter in weight.

So far, the museum has limited its substitution of components to those that can be considered "tools" necessary for the artwork's function but not "constitutive" of the artwork's aesthetic value. For display, the focus is on the historical value of the object and respect for its components. Other specific conservation strategies, such as emulation, have been adopted for environmental installations. Although the 2010 reconstruction of Anceschi's *Ambiente a shock luminosi* (fig. I.3) followed the original drawings of 1964 in terms of space and general setup, the artist and the curator decided during the planning process to use strobe lights, which did not exist when the work was conceived. This choice was made because the artist preferred the public's response to the environment rather than a reconstruction completely faithful to the original.

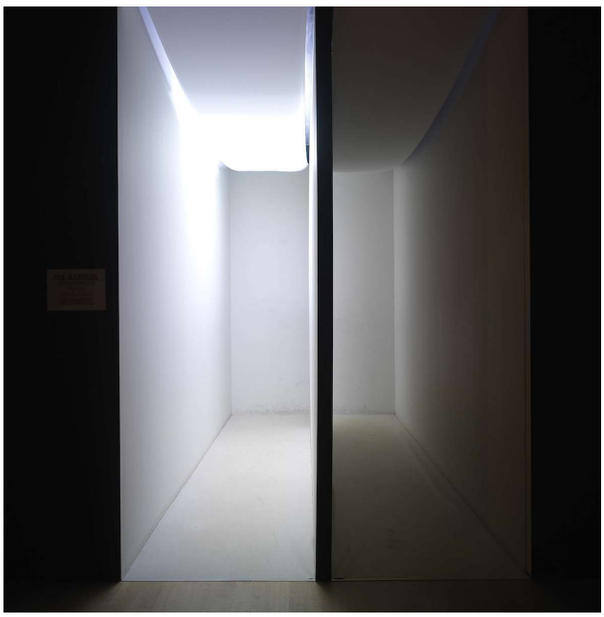

Figure I.3. Giovanni Anceschi, *Ambiente a shock luminosi*, 1964, environment with plasterboard walls and canvas ceiling, two stroboscopic luminous appliqués, and timer. Museo del Novecento.

Preserving kinetic artworks also requires interdisciplinary teamwork: the knowledge required to understand these works often goes beyond the traditional training of curators and conservators. Since its inception, the Museo del Novecento has collaborated with Attitudine Forma, a company providing technical services for contemporary art that, since 1996, has worked with the most important museums and institutions in Italy, as well as with several international artists. The company, and in particular Roberto Dipasquale, was involved in the production of the museum's environments and is in charge, together with the collection curator, of the monitoring and preventive conservation program.

Exhibiting these "spaces/environments" also has a consequence in everyday museum life. Some issues that don't directly relate to the artworks' state of conservation nevertheless enter the realm of preservation, as they can change the perception of the work or alter the artist's intention. If, in traditional artworks, issues of safety and accessibility may not be an immediate concern, they play a role in kinetic environments, where visitors must sign a release form before entering a space that could be dangerous for those with heart conditions or epilepsy. Accessibility is an issue when the disabled are unable to enter the space.

Being partner and host of the *Keep It Moving? Conserving Kinetic Art* symposium was a particularly important occasion for the Museo del Novecento. It was an opportunity to share knowledge and open a dialogue with many institutions worldwide that, every day and with immense professionalism, face similar problems. And, as it turns out, have very similar discussions on if, and how, to keep it moving.

1. "Quindi, considerando l'opera come una realtà fatta con gli stessi elementi che costituiscono quella realtà che ci circonda, è necessario che l'opera stessa sia in continua variazione" (Considering the artwork as a reality made with the same elements that constitute the same reality surrounding us, it is necessary that the artwork itself be in continuous change). "Consideriamo la realtà come continuo divenire di fenomeni che noi percepiamo nella variazione" (we consider reality as an ongoing series of phenomena that we perceive within the variation itself). Gruppo T, *Miriorama 1*, Manifesto, Galleria Pater, Milan, 1960.
2. Olivetti, founded in 1908 in Ivrea, Italy, was one of the first companies to produce typewriters and, at the end of the 1950s, the first computers in Italy. For a bibliography on the relationship between Olivetti and Gruppo T, see Sergio Morando, ed., *Almanacco letterario Bompiani* (Milan: Bompiani, 1961); Umberto Eco, "Arte programmata: Arte cinetica, opere moltiplicate, opera aperta," in *Arte programmata: Arte cinetica, opere moltiplicate, opera aperta* (Milan: Officina Arte Grafica Lucini, 1962), the catalogue for the exhibition curated by Bruno Munari. *Arte programmata* was shown in different venues from 1962 to 1965: Olivetti showroom, Milan, May–June 1962; Olivetti showroom, Venice, July–August 1962; Gallery La Cavana, Trieste, December 1962–January 1963; Goppinger Galerie, Düsseldorf, June–July 1963; Royal College of Art, London, May–June 1964; Loeb Student Center, New York, July–August 1964; Florida State University, Tallahassee, October–November 1964; Columbia Museum of Art (South Carolina), January–February 1965; and the University Art Museum, Andrew Dickson White House (Ithaca, New York), March–April 1965. See also Marco Meneguzzo, Enrico Morteo, and Alberto Saibene, eds., *Programmare l'arte: Olivetti e le neoavanguardie cinetiche* (Monza, Italy: Johan & Levi, 2012), the catalogue of the exhibition held at Olivetti showroom, Venice, August–October 2012, and at Museo del Novecento, Milan, October 2012– February 2013.
3. Giovanni Anceschi's *Ambiente a shock luminosi* was realized for the first time in 1964 for the exhibition *Nouvelle tendance* at the Musée des Arts Décoratifs, Pavillon de Marsan, Louvre. It was rebuilt in Milan in 1983 for the show *Arte programmata e cinetica 1953/1963: L'ultima avanguardia*, and in 2005 for the exhibition *Gli ambienti del Gruppo T: Le origini dell'arte interattiva* at Galleria Nazionale d'Arte Moderna (GNAM), Rome. The environments were always destroyed after the shows. Davide Boriani's *Ambiente stroboscopico no. 4* (1967/2005) was first conceived in 1967 for Paris V Biennale (*Ambiente stroboscopico no. 3)* and rebuilt (in the original version) in 2005 for the exhibition *OP ART* at Schirn Kunsthalle Frankfurt. It is on long-term loan from VAF Foundation. Gabriele Devecchi's *Ambiente-Strutturazione a parametri virtuali* was first realized in 1969 at Galleria Il Diagramma, Milan, and later reinstalled many times with significant variations. The original 1969 version was re-created in 2005 for *Gli ambienti del Gruppo T* at GNAM, Rome, and at Museo del Novecento in 2010. Gianni Colombo's *Topoestesia (Tre zone contigue—Itinerario programmato)* (1964–70) was realized for the 1964 exhibition *Nouvelle tendance* at the Musée des Arts Décoratifs, Pavillon de Marsan, Louvre, dismantled after the show, and not reconstructed until 2010 at Museo del Novecento. See Iolanda Ratti, Denis Viva, and Marina Pugliese, *Arte programmata e cinetica in Museo del Novecento: La collezione* (Milan: Electa, 2010), 285–97.

Part 1. Keynotes

1.

A Question of KinEthics

Reinhard Bek

How do we incorporate artist intent into the preservation of kinetic works when such art is both performative and sculptural? Questions focused on artist intent tend to be passed from artists to art professionals as these works age. Frequently, initial preservation attempts affect future discussions around maintenance, replication, and retirement. As a result, conservators face a unique set of concerns that touch upon evolving technology, art historical discourse, and contextual presentation. The case studies below, which range from the modern to the contemporary, highlight the artist's point of view.

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When the intention of a kinetic artwork is its movement, is it still a kinetic artwork when it does not move? Do we "keep it moving" even when motion is detrimental to its existence? The challenge associated with the preservation of kinetic artwork is encapsulated in this simple conundrum: is retirement from movement an appropriate method of preservation for an artwork meant to move?

As first-generation Op Art and kinetic artworks from the 1960s grow older, they are acquiring a historical status due to the obsolescence of light bulbs, electric timers, and motor controls: art professionals can no longer simply replace parts. When tasked with the care of these works, they are confronted with ethical questions underscoring the conflict between preserving the materials or preserving the function. The tendency for caretakers is to move between two schools of thought: the practical conservation point of view prefers to limit an artwork's activity to reduce wear and tear and eventual failure of parts, while advocates of the artist prefer that a work remain active to honor the artist's intention.

With such opposite perspectives, where does this leave the current and future state of kinetic art preservation? What can be learned from the past to anticipate the challenges of the conservation of contemporary art? And how long should the artist's voice be defended?

Knowing how artists respond to the challenge of preserving their own artwork, and the context of their responses, is invaluable to any preservation approach. Some artists and artists' studios initiate maintenance and preservation from a solely exhibition-focused perspective. This values the artist's intention above all. However, once a work becomes historical and, specifically, enters a collection or museum setting, the "active" mode for an artwork is frequently limited due to concerns about its durability. It is important to bridge the gap between the artist's and the art professional's approaches when establishing guidelines for decision making. The following six case studies underscore three options—retirement, replication, and maintenance—available to conservators of kinetic works.

Retirement, Replication, and Maintenance

Retirement is the most extreme method to conserve the material presence of an artwork. It is considered when excessive wear and tear, neglect, or technological obsolescence prevents the work from functioning. It is the point where an artwork may be considered a relic. In 1988, for the Centre Pompidou, Paris, Jean Tinguely chose this option for his *Sculpture méta-mécanique automobile* (1954).

Replication involves the re-creation of the action as a duplicate or new iteration. This may be acceptable for artworks that present the same key concerns as the retirement option; that is, excessive wear and tear, neglect, or technological obsolescence. However, an additional

factor is the lack of evidence of the artist's hand; for example, when the artist delegated the fabrication of the work. In such cases, greater value may be placed on maintaining an artwork's function rather than preserving its material presence. Naum Gabo and Jean Tinguely were two artists who chose to replicate some of their works when faced with conservation challenges.

Maintenance of an original artwork is the preferred option when there is little evidence of wear and tear or when repair issues are centered on sourcing available parts and supplies. However, over time works originally in this category may well move to replication and eventually retirement. The works of Otto Piene, Liz Larner, and Leo Villareal establish a pathway of escalating intervention. The following discussion draws on these case studies, in chronological order, to illustrate the evolution of such concerns through the last decade.

Naum Gabo

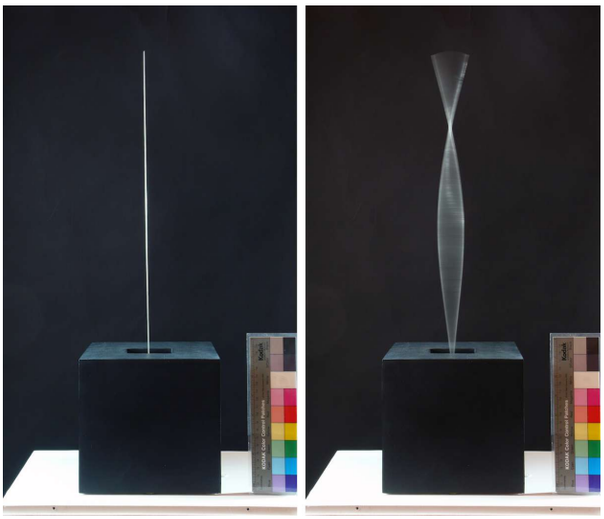

Figure 1.1. *Kinetic Construction* (*Standing Wave*), 1919–20, by Naum Gabo (1890–1977); replica 1985.

The Work of Naum Gabo © Nina & Graham Williams. Photo: © Tate, London 2016.

In 1919 Naum Gabo (1890–1977) fabricated one of the first artworks commonly associated with kinetic sculpture, *Kinetic Construction (Standing Wave)* (1919–20) (fig. 1.1). For the groundbreaking exhibition *The Machine as Seen at the End of the Mechanical Age*, organized by the art historian Pontus Hulten in 1969 at the Museum of Modern Art, New York, Gabo recounted how this sculpture was made, his intention as its creator, and his thoughts about its longevity. His comments were published in the magazine *Techne* the same year. *Standing Wave*, Gabo explained,

> has been given to the Tate Gallery in London. I, being interested in the preservation of that work advised the Tate Gallery that it might suffer should it be lent to exhibition. When Mr. Hulten began to organize the exhibition called *The Machine* for the Museum of Modern Art, he asked my permission to allow him to make a replica of the work (Gabo 1969b:5).

Gabo reflected on many aspects of the artwork. He described how standing waves

> attracted my attention since my student days, in particular the fact that when you look at a standing wave, the image becomes three dimensional. In order to show what I meant by calling for the introduction of kinetic rhythms into a constructed sculpture, I chose that standing wave as a good illustration of the idea (Gabo 1969b:5).

Gabo also discussed the source materials he used in the artwork's manufacture and the conditions during the winter of 1919–20, which he remembered as "the height of civil war, hunger and disorder in Russia. To find any part of machinery or to do any kind of work in a recently nationalized factory in Moscow—most of which were idle and impenetrable—was next to impossible" (Gabo 1969b:5). He explained how he visited the mechanical workshop in the Polytechnic Institute and asked the director if he could perform his experiments there. The workers helped him locate old, unused machinery, and he salvaged a powerful electromagnet from an old factory bell: "What I was looking for was the basic mechanism of an electric bell, but of a bell stronger than the usual household one—strong enough to produce enough vibration in a rigid rod" (Gabo 1969b:5).

Through this retelling of the work's fabrication, Gabo revealed that he thought his

> main task was to create a regular rhythmic wave. It was not difficult to arrange a horizontal iron bar which would vibrate when electricity was on, but to join that bar with a mechanism which would let a vertical steel rod vibrate demanded a great deal of effort and inventiveness. After a lot of experimenting, what I did was to arrange the bar in such a way that at the base of it were two separate springs which would touch the spring on which the iron bar was fixed. I arranged the springs in such a way that together they would produce a rhythmic

> standing wave co-ordinating each other's vibration (Gabo 1969b:5).

The difficulty of his innovative effort is underscored by his comment that "it took me much more time to make the work than to write this explanation—in fact it took me almost three quarters of a year" (Gabo 1969b:5). His pride in this accomplishment is evident: "When I showed it to the students, I made it emphatically clear that this was done by me in order to show what I mean by 'kinetic rhythms.' This piece is only a basic example of one single movement—nothing more" (Gabo 1969b:5).

Gabo provided a clearly articulated explanation of his intention, a description of materials, and the role of experimentation in the act of creating. With his consent for the production of a replica, the artist himself made a strong case for replication, highlighting his workmanship and ingenuity in the first iteration of the work. It also supports a desire to hold his original effort encapsulated in its moment of creation. Therefore, when Gabo's *Standing Wave* entered the Tate collection in 1966, although in working condition, these considerations resulted in the decision to retire the original work of art from its function. With the artist's consent, several copies were fabricated to permit the conceptual intention of the artist to reside in its replication.

Jean Tinguely

Jean Tinguely (1925–1991) also opted to retire his *Sculpture méta-mécanique automobile* of 1954 (fig. 1.2) in 1988, prior to his retrospective at the Centre Pompidou that same year. Such a decision is surprising considering that thirty years earlier, in his 1959 manifesto *Für Statik*, Tinguely proclaimed: "Everything moves, there is no standstill" … "stop resisting change" … "Bind the anxiety and resist the weakness to want to stop movement."[1] Through such statements, he appeared to oppose standstill in general and instead propose flow and vitality, underscoring his belief that art and life should be in constant movement. Ironically, he criticized museums as mausoleums, yet held the most important shows of his career in such institutions. In later years he donated important works to major museums, in addition to planning his own museum.

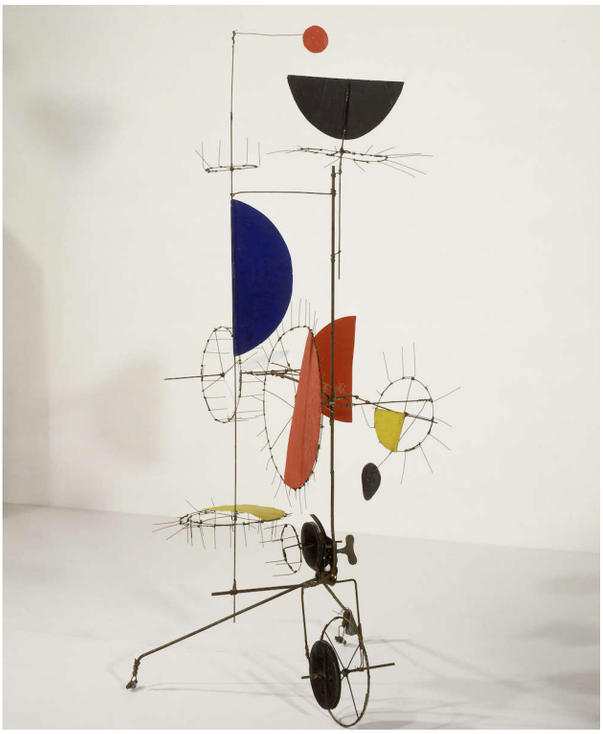

Figure 1.2. Jean Tinguely's *Sculpture méta-mécanique automobile*, 1954. Centre Pompidou.

This contradictory attitude is not unusual among artists who work with ephemeral materials and media prone to obsolescence. It suggests that Tinguely was interested in the preservation of his sculptures, even though he proclaimed in a 1984 interview: "My works are not intended for eternity, they'll wear themselves out and land back on the garbage heap whence they came" (Hahnloser-Ingold and Bezzola 1988:252).

In 1988, before the retrospective at the Centre Pompidou, a curator asked him to restore one of his important early wire sculptures. At the time, *Sculpture méta-mécanique automobile* malfunctioned and had sustained structural damage. Conservator Astrid Lorenzen, then a recent graduate, reflected on her encounter with the work:

> [*Sculpture méta-mécanique automobile*] consists of iron wire, soldered "cogwheels" and geometric colorful shapes, fastened to a central iron rod via axles. The sculpture stands on three wheels, a big one and two smaller. Tinguely had welded a clockwork onto the central iron rod. It made it possible to set the sculpture in motion via a belt, two wooden wheels with circumferential grooves, and a

> wire wheel, which he had secured onto the wooden wheel on the clockwork. The sculpture was able to move freely in space, while the wire wheels interlocked and set the colorfully painted geometric shapes in motion (Lorenzen 2012:200).

From the moment of creation, the work sustained major changes in its condition: the clockwork did not function. The wire structure was corroded and several of the cogwheel's wire rods were missing. Oxidation of the painted sheet-metal pieces caused color changes on the geometric design elements. The Pompidou's conservation department considered retirement for the object, due to its fragility and compromised state, or replication/maintenance to restore the work to a functioning state.

When Tinguely was asked about the work, he felt that the sculpture had lost its movement. Lorenzen recalled:

> As the sculpture was highly sensitive, and the clockwork no longer functioned, he told us neither to attempt to repair this mechanism, nor to replace it. On the other hand, replacing the broken-off and missing wire rods was very important to him. He did not set much store by the color changes in the painted elements; they did not bother him. He proposed to us that he work on the sculpture himself. He came to the conservation department with new, gleaming wire rods and showed us how the wire is bent into a U-shape in order then to be hooked on to the middle spokes of a wheel. Using this technique, it was possible to replace two rods at a time. This technique was also used by Tinguely to manufacture the original cogwheels (Lorenzen 2012:200).

With the artist's input, a preservation plan was conceived that valued the work's physical appearance and the historical importance of the artist's hand over its performativity. The artwork was retired from its active function and efforts were made to conserve the color changes of the geometric shapes and replace the structure of the cogwheels. *Sculpture méta-mécanique automobile* has since been exhibited as a relic, occasionally accompanied by historical photography.

Tinguely did not consider replication here, choosing instead to boldly embrace the inevitable consequence of "failure" inherent in kinetic art. He often played with the concept of the "breakdown" of his own works as a metaphor for the possible "breakdown" of technology and even society.

In contrast, he at times embraced the idea of the replica. In 1959, he introduced art-producing kinetic artworks into his oeuvre and called those sculptures *Méta-Matics*. The Museum Tinguely's collection catalogue describes the works as "drawing machines which, using felt-tip pens, are able to create abstract drawings automatically." To use these machines,

> the spectator is called on to clamp a pen in the machine, fix a sheet of paper, and press a release button. The arm to which the pen is secured moves irregularly up and down, usually very fast, and leaves behind strokes and dots on the paper. It is possible to change the color, and the intensity of the color, by letting the pen operate for a longer or shorter period, and by having it make heavier or lighter contact with the paper. Thus, a drawing is created that, on the one hand, is the result of an art activity—perhaps therefore achieving the status of a souvenir—and, on the other hand, a product of the three artists who jointly created the work: Jean Tinguely, the creator of the drawing mechanical sculpture; the mechanical sculpture itself; and finally, the spectator, who in this context becomes a user and, yes, a creator of art (Pardey 2012:52).

In 1990, to preserve the original *Méta-Matic No. 10* of 1959 (fig. 1.3), which remained in his personal collection, the artist and his studio replicated the artwork (fig. 1.4) for a solo exhibition in Russia titled *Tinguely in Moscow* (Pardey 2012:54). To increase the likelihood of replacing worn parts, the studio fabricated the replica with fewer details than the original. The replica was mounted on a black wooden box that provided storage for paper and felt-tip pens.

Figure 1.3. Jean Tinguely's *Méta-Matic No. 10*, 1959. Museum Tinguely, Basel.

Figure 1.4. Jean Tinguely's *Méta-Matic No. 10*, 1959; replica 1990. Museum Tinguely, Basel.

Both the original *Méta-Matic No. 10* and its replica are in the collection of the Museum Tinguely (Basel, Switzerland). The original has never been exhibited in operation; however, visitors are allowed to operate the replica to produce their own *Méta-Matic* drawings (fig. 1.5). Because, with *Méta-Matic*, Tinguely is questioning the idea of uniqueness by using machines to make art, being open to replication for such an artwork is consistent with the artwork's original concept.

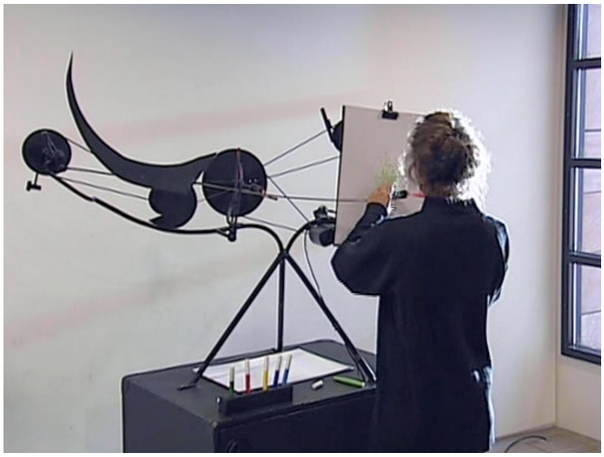

Figure 1.5. Woman creating a drawing on a 1990 replica of Jean Tinguely's *Méta-Matic No. 10*, 1959. Museum Tinguely, Basel. Watch the video at https://youtu.be/Mrvriy6TaEU.

Tinguely's and Gabo's decisions to replicate *Méta-Matic No. 10* and *Kinetic Construction (Standing Wave)* demonstrate a respect for the historical value of the original artwork as the best fragments of the past that we have available. Correspondingly, concepts embedded in the work are valued for the important role they play in engaging public interaction.

Otto Piene

In the late 1960s, with the abundance of off-the-shelf technology available to artists, kinetic and Op Art evolved from artisanal to industrial fabrication, bringing issues of obsolescence to the forefront of conservation. Otto Piene (1928–2014), a founding member of ZERO, established in 1958, epitomized the group's approach to art making. ZERO questioned the role of the artist's hand and placed greater importance on materials and the interaction of the artwork with light and space.

Piene's *Neon Medusa* of 1969 (fig. 1.6) consists of a chromed sphere on a stem and base. Four hundred and forty-nine adjustable, chromed gooseneck lamps are attached to the sphere, each fitted with an orange glow lamp (fig. 1.7). The goosenecks allow the individual positioning of each lamp around the sphere. Piene specifically designed the body of the work for orange glow lamps (an early version of neon lights) that have bulbs

filled with neon gas that produces an orange light. The light pattern of the sphere is programmed to run from a chrome controller box, attached to the sculpture with an electric cable.

Figure 1.6. Otto Piene's *Neon Medusa*, 1969. Collection Neuberger Museum of Art, Purchase College, State University of New York, gift of Leonore F. Rosenthal.

Figure 1.7. Otto Piene's *Neon Medusa*, 1969, in operation. Collection Neuberger Museum of Art, Purchase College, State University of New York, gift of Leonore F. Rosenthal. Watch the video at https://youtu.be/lP8QLUGaupA.

In 2014, forty-five years after its creation, the work underwent a conservation treatment when the Neuberger Museum of Art (New York) requested it for an exhibition. However, *Neon Medusa* did not function, and there was little documentation regarding its programing and conservation history.

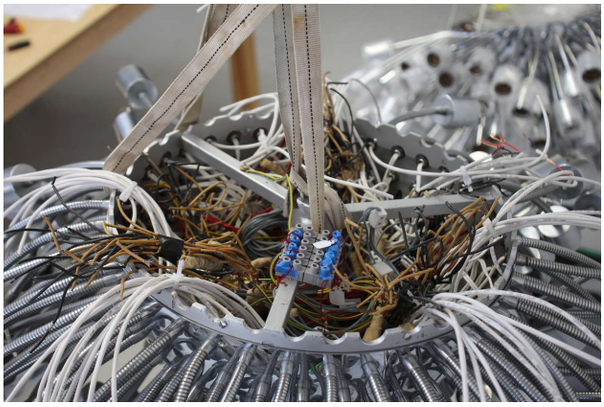

Figure 1.8. Detail of Otto Piene's *Neon Medusa*, 1969. Collection Neuberger Museum of Art, Purchase College, State University of New York, gift of Leonore F. Rosenthal.

More than a thousand cables, invisible to the viewer, are inside the sphere (fig. 1.8). Most of these cables were cracked and missing insulation, and there was a high risk of a short circuit and electrocution. The glow lamps are now obsolete and can no longer be sourced. Complex questions arose around the programming pattern for the light bulbs. The timer/controller still functioned but it was not connected to the sculpture; therefore, it was impossible to document the original programming, written into the analog timer of the controller box.

Because *Neon Medusa* was inoperable, the only way to understand its kinetic function was to reverse engineer the programming of the controller box in combination with the internal wiring of the sphere. Results were precise; however, a thorough understanding of *Neon Medusa*'s programming was elusive, and the diagrams were extremely puzzling to translate into the actual performance. The glow lamps are an immediate concern for the long-term preservation of the work. They are impossible to source, but the Neuberger Museum is in possession of two full sets of glow lamps, which will suffice for now.

In 2014 Otto Piene (OP) responded to an e-mail from Bek & Frohnert LLC (B&F), a conservation studio specialized in contemporary art, about *Neon Medusa*:

> B&F: From your perspective, what are the most important/key qualities of *Neon Medusa*?
>
> OP: The poetic side of art and technology.
>
> B&F: Since the goosenecks are flexible, is the visitor supposed to play with them?

OP: The goosenecks are definitely to be bent and positioned and repositioned (gently) by interested public.

B&F: If we cannot find the original light bulbs anymore, is there an alternative light bulb you could suggest?

OP: Try to find them. There are companies that make new issues of that kind of bulb. They exist in this country (the U.S.), too; otherwise, I recommend Berlin.[2]

Piene conveyed several important points. He confirmed that there is no alternative to the original glow lamps, although he suggested the potential "new issues" of the lamps. He also indicated that the public may move the goosenecks, eliminating specific positioning as a requirement. The artist died shortly after the initial e-mail exchange, so there was no opportunity to discuss issues in greater depth.

Maintaining *Neon Medusa* is still possible by performing acceptable and unnoticeable repairs. In the future, the controller box containing the programming may be replaced with a contemporary version running an identical program. Additionally, a search for bulb sources can continue in anticipation of the day when the replacements are no longer viable.

Liz Larner

Art historian Piper Marshall described *Corner Basher* (fig. 1.9) by California artist Liz Larner (b. 1960) as

> comprised of a column, a drive shaft, a steel ball and a steel chain. Positioned where two walls meet, a long cord extends from the machine—attached is a speed control with an on/off switch. From this panel, visitors can operate the motorized shaft to spin the column and lance the ball against the walls. The repeated blows leave indentations, impressions, and cracks. In some cases whole pieces of the wall flake off, laying bare the many coats of paint underneath as well as the material from which the walls are composed (Marshall 2010:79).

Figure 1.9. Liz Larner's *Corner Basher*, 1988. Gaby and Wilhelm Schürmann.
Courtesy of the artist.

In 2010, when *Corner Basher* (1988) was twenty-two years old and had been exhibited in multiple settings, an incident occurred that required conservation intervention: the screw connecting the steel ball to the chain broke while the machine was running. The artwork was examined, and permission was requested from the artist to exchange not only the broken screw but the entire chain attached to the ball, which showed severe signs of wear and tear. Larner responded:

> The Corner Basher is a machine, not an artifact, and should always be kept in best order. It is correct to change out any chain or part that is becoming worn. Please try and match whichever part to the new part and keep the original as a record of itself. I will leave it to the collector to decide whether these worn parts remain with the piece, with him, or with me. Please note, however, that the parts should remain with the piece until the exhibition closes in Basel and New York and the work is returned.[3]

Larner clearly stated that *Corner Basher* is a "machine, not an artifact," and that it should "be kept in best order": highly precise advice from an artist who is fully aware that her work is a potential hazard to the public if it is not carefully maintained (fig. 1.10).

Figure 1.10. Liz Larner's *Corner Basher*, 1988, in operation. Gaby and Wilhelm Schürmann. Watch the video at https://youtu.be/UkpyR7iLm5Q.
Courtesy of the artist.

The question of *Corner Basher*'s physical decline in relation to its performativity is difficult to foresee. The sculpture is roughly assembled, suggesting that it is mainly about the action of smashing the walls it is chained to. The artist's definition of the work as a machine suggests that replication could be a logical preservation approach; however, it will be some time before periodic replacement of parts is no longer feasible. The way the artist created the work could be especially important for future preservation efforts. According to her studio:

> Liz worked with a couple different people for the construction of this piece. First she came up with the concept and created the design. Afterwards she met with her friend Keith Sawa, the owner of a machine shop, and they brainstormed about what needed to be accomplished. She then gathered together all of the necessary parts (motor, chain, ball, coupling, wheels, bearing, etc.), and brought them back to Keith at his shop. Liz worked with Keith to put everything together, and then had it welded at a different small shop, located in the same alley, by a retired aircraft welder. Liz was a young female artist at the time, and the space where it was to be shown (LACE) was rather worried about her installing such a destructive piece. They required her to consult with Mark Pauline from Survival Research Laboratories, and get his ok before installing the piece.[4]

Leo Villareal

This case study discusses the work of a member of a younger generation of artists who depend mainly on off-the-shelf hardware and produce their own proprietary software. It illustrates how kinetic art and contemporary technology intersect and reveals their similar conservation challenges. *Flowers 8* (figs. 1.11, 1.12) from 2005 by Leo Villareal (b. 1967) comprises eight flowers, each of which consists of sixteen LED fixtures, for a total of 128 LED fixtures. The lights display a range of RGB-color- and light-changing effects. Twelve programmed DMX512[5] sequences are randomly run off two data units linked to the eight flowers, resulting in a colorful light concert.

Figure 1.11. Leo Villareal's *Flowers 8*, 2005.
Courtesy of Donald R. Mullen Jr., with permission from the artist.

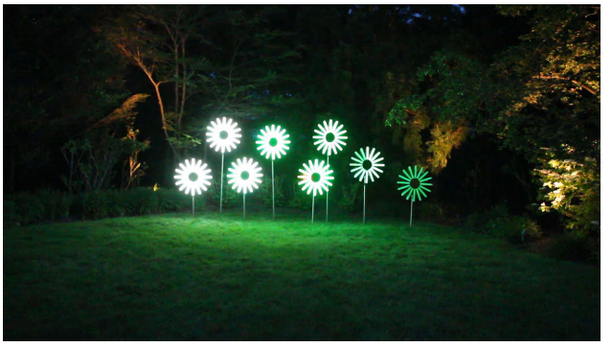

Figure 1.12. Leo Villareal's *Flowers 8*, 2005. Watch the video at https://youtu.be/Kpwfx8Zn0S4.
Courtesy of Donald R. Mullen Jr., with permission from the artist.

Three years after the work's creation, the fabricator of the lightning system, a branch of Philips called Color Kinetics, discontinued the production of the low-voltage LED lamps, controllers, and cables in favor of a newly developed high-voltage system. The original lamps and controllers are no longer produced, and any updated LED lamp will not be supported by the obsolete data supply and vice versa.

To preserve *Flowers 8*'s outdoor installation, the owner and the artist agreed to create an updated replica. The artist will produce this new version in close cooperation with Bek & Frohnert to document and support the transformation of the work from the original. This migration will happen when the LED lamps further deteriorate and become unrepairable. When such a metamorphosis occurs, it can be quite challenging to meet the expectations of the artist, the owner, and the conservator. It is possible that a new version of this work may not look like the original. The artist expressed the desire to archive the original hardware as evidence of the first version, but he did not approve the simultaneous existence of two versions of the same piece.

Some artists would like the appearance of the replica to remain as close to the original as possible. Villareal has specified that the ornamental appearance of the lamp cables is an important feature of the flowers, that all visible parts of *Flowers 8* are of both functional and aesthetic importance. However, the invisible technical components, such as the power/data supplies, may prove to be the greatest challenge. While these elements are exchangeable, they are also dependent on software compatibility. This compatibility or incompatibility may inevitably influence future iterations and is an ongoing discussion with the artist. We anticipate a replication of *Flowers 8* with a completely new setup within the next three to eight years.

Conclusion

Conservators continue to encounter complexities of care with historical kinetic art and Op Art. Our challenges are not limited to the mechanical but extend into the digital, and our main challenge may be the evolution of technology. The ubiquity of technology gives almost anyone the capability of programing and controlling complex operating systems or interactive, computer-based installations. There is a clear tendency by young artists toward custom-built code, computer-controlled showcases, and robotics. At the same time, artists are becoming very aware of the limits of technology as they are challenged by art professionals to collaborate on the installation and repair of their work.

The previous dependency of artists on industrially manufactured devices is comparable to today's dependency on technology. Piene's *Neon Medusa* (1969) and Villareal's *Flowers 8* (2005) use distinct light sources that rely upon off-the shelf, programmable technology. However, the thirty-six years' difference underscores the contemporary trend away from repairable technology and toward replacement technology. *Neon Medusa*'s analog timer control was fabricated when there was a possibility of repair: the simplicity of design allows the motor to be exchanged and the timer wheels to be refabricated. Perhaps even the glow lamps could be refabricated by a specialty light-bulb factory. In contrast, Villareal's *Flowers 8* utilizes a mass-produced lighting system discontinued three years after the artwork's creation. An obsolete system of lamps, cables, plugs, and data supplies comprise 90 percent of the physical artwork. Today's digital technology is very specific, and most devices are not made to be repaired to extend the life of their functions. Modules belonging to a single contained system are exchanged

regularly. Once the system is discontinued, identical parts may be salvaged for the time being, but it is unlikely that the system can be supported in the long term. Facing such dilemmas, the conservation field may need to adapt to the idea of regularly updated versions of complex contemporary artworks, perhaps abandoning the ideal of the artwork anchored in time. This reality becomes even more challenging when the artist's hand is visible or artists modify consumer technology. It is important for the profession to discuss parameters to help us navigate this terrain. Should we elevate the importance of performativity? Do we replicate an artwork's performance to keep it alive and physically authentic at the same time?

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Notes

1. Tinguely 2012:392. "Es bewegt sich alles, Stillstand gibt es nicht" (Everything moves, there is no standstill) … "Hört auf, der Veränderlichkeit zu widerstehen" (stop resisting change) … "Widersteht den angstvollen Schwächeanfällen, Bewegtes anzuhalten" (Bind the anxiety and resist the weakness to want to stop movement).
2. Otto Piene, e-mail to Bek & Frohnert, March 17, 2014.
3. Liz Larner, e-mail to author, 2010.
4. Liz Larner studio, e-mail to author, 2016.
5. DMX512 (Digital Multiplex) is a standard for digital communication networks that are commonly used to control stage lighting and effects.

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2.

The Fluid Boundaries between Interpretation and Overinterpretation: Collecting, Conserving, and Staging Kinetic Art Installations

Tiziana Caianiello

Kinetic art installations can be interpreted and staged in different ways. This paper addresses how the limits of permissible scope for interpretation can be defined and explores the boundaries between interpretation and "overinterpretation," referencing theoretical concepts formulated by Umberto Eco. The discussion of three kinetic installations from the 1960s by ZERO artists Heinz Mack, Otto Piene, and Günther Uecker focuses on reconstructions as a preservation strategy and concludes that while we cannot be sure if an interpretation of a work is correct, we can recognize if it is wrong.

Interpretation and Overinterpretation

All professionals engaged with the conservation and restoration of kinetic objects are familiar with this tool: the screwdriver. This paper is about the use of a screwdriver; however, it does not explain how to use it to open a case and repair a motor. Rather, it employs it as a metaphor to explore the boundaries between interpretation and overinterpretation.

In 1962, Italian semiotician Umberto Eco published his *Opera aperta* (*The Open Work*) in which he theorizes about the category of "open works." According to Eco, these works offer a constellation of elements that the interpreter can freely combine, so that different relationships and configurations are possible. He also identifies "inside the category of 'open' works a further, more restricted classification of works which can be defined as 'works in movement'" (Eco 1989:12). Referring to works by Alexander Calder, he writes: "Here there is no suggestion of movement: the movement is real and the work of art is a field of open possibilities" (Eco 1989:86).

Eco's considerations about the open work were contemporary to the development of kinetic art. Significantly, in the same year as *The Open Work*, Eco also wrote a text for the catalogue of the exhibition *Arte programmata: Arte cinetica, opere moltiplicate, opera aperta*, which opened in 1962 in Milan, elaborating on some of the concepts from his book. He wrote that the "work in movement" didn't have a fixed form; it was mutable even if it followed "determined lines of orientation" (Eco 1962).

But if a kinetic work is a "field of open possibilities," if we can perceive and interpret it in different ways, what should we conserve or restore? How can we keep the different options open and at the same time be sure that we stay in the field of possibilities given by the work without overstepping its boundaries? In other words: how can the limits of permissible scope for interpretation be defined?

In the Tanner Lectures on Human Values at the Cambridge University in 1990, Eco looked back on *The Open Work* and commented:

> When those pages were written, my readers mainly focused on the 'open' side of the whole business, underestimating the fact that the open-ended reading I was supporting was an activity elicited by (and aiming at interpreting) a work.... I have the impression that, in the course of the last decades,

> the rights of the interpreters have been overstressed (Eco 1990:143).

Eco drew a distinction between interpretation and "overinterpretation." According to him, it is the task of the interpreter to formulate a "conjecture" about the "intention of the work." An overinterpretation is an interpretation that does not consider what the work suggests independently of the author's intention and the interpreter's pragmatic purposes. An overinterpretation assigns to the work meanings that are not supported by a consistent analysis based on "economical" criteria (Eco 1990:162–82).

In relation to texts, Eco spoke of a "hermeneutic circle": "the text is an object that the interpretation builds up in the course of the circular effort of validating itself on the basis of what it makes up as its result" (Eco 1990:180). Although Eco was referring to texts, his assertion applies to any form of art. That is: We make up the work with our interpretation and check our interpretation on the basis of the work we made up. It is a circular process indeed. In the case of art installations, our interpretation is always based on the results of the previous interpretations and presentations of the same installation (Caianiello 2013:217–18).

Eco's lectures provoked a heated discussion. The American philosopher Richard Rorty denied that a work can impart its intention and introduced the example of a screwdriver. He claimed that the use made of a screwdriver to tighten screws was not imposed by the object itself (Rorty 1992:103). We would have the right to interpret a screwdriver as something useful to open a package or to scratch our ears.[1] Eco replied:

> A screwdriver can be inserted into a cavity and be turned inside, and in this sense could also be used to scratch one's ear. But it is also too sharp and too long to be manoeuvred with millimetric care, and for this reason I usually refrain from introducing it into my ear. … I cannot use a screwdriver as an ashtray. I can use a paper glass as an ashtray but not as a screwdriver (Eco 1992:145–46).

Eco intends to demonstrate that "it is not true that everything goes":

> During my lecture … I have stressed that it is difficult to say whether an interpretation is a good one, or not. I have however decided that it is possible to establish some limits beyond which it is possible to say that a given interpretation is a bad and far-fetched one (Eco 1992:144).

In this context, Eco considered the "consensus of the community" as a reliable parameter for judging if an interpretation was far-fetched. People from the same culture attribute a certain meaning to particular forms and materials. Besides, according to Eco, objects can suggest how to interact with them, since their characteristics are associated with particular uses (Eco 1992:144–45). You can use an object in different ways. In the case of the screwdriver, you can also use it to open a box or a bottle with crown cork, or to crush ice and so on. You cannot say that one of these uses is better than another. As long as it works, each use is acceptable. However, there are uses that are simply impossible: a screwdriver doesn't have any cavities, so you cannot drink out of it and you cannot use it as an ashtray (fig. 2.1).

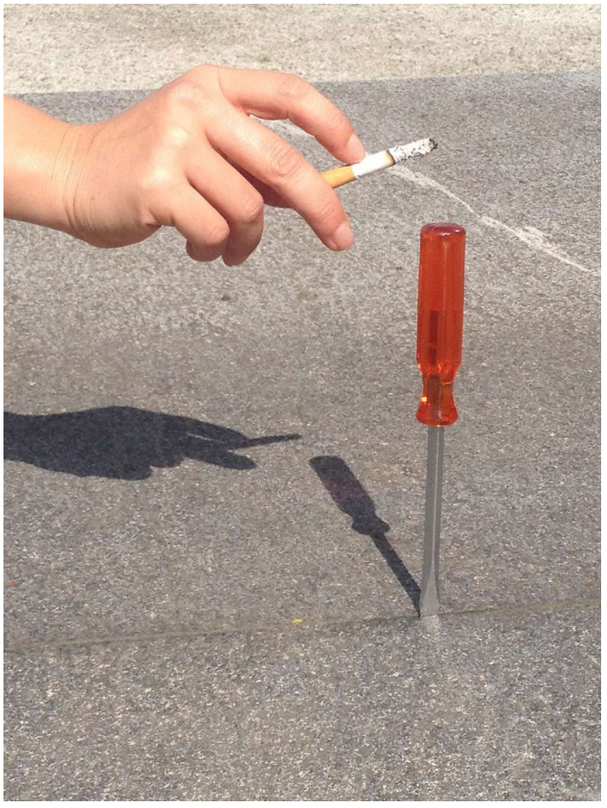

Figure 2.1. A screwdriver cannot be used as an ashtray.

Acquiring, Reconstructing, and Staging Kinetic Art Installations

Kinetic installations cannot be experienced if they have not been installed: in order to have access to them, they must be fully assembled, with the kinetic components working. However, in some cases, museums and other institutions acquire kinetic installations that are dismantled and need

to be reconstructed. Such reconstructions can be challenging.

The way we interpret and present a kinetic installation depends to some degree on our current state of knowledge about the artwork and its history. In turn, our interpretation of the work influences the form in which it will be staged in the future. Many questions arise when we acquire, reconstruct, or stage a kinetic installation, including:

- What exactly did our museum or institution acquire?
- Do we know which parts belong to the installation?
- Do we know how the work was installed in past presentations?
- Have we already seen the work installed, or do we know it only through documentation?

The following case studies illustrate the relevance of these questions.

Lichtraum (Hommage à Fontana) by Heinz Mack, Otto Piene, and Günther Uecker

The artists Heinz Mack (b. 1931), Otto Piene (1928–2014), and Günther Uecker (b. 1930) often used the same kinetic light objects for different installations,[2] adapting the selection and arrangement of pieces to the spatial circumstances in which they were displayed. Because each single object also has an artistic value, the objects can be sold either as individual pieces or as part of an installation. Consequently, if a museum intends to buy a particular installation, it could discover that not all the objects in the original installation are still available, as some may have been purchased separately.

This happened in 1991, when the Kunstmuseum Düsseldorf (today called Museum Kunstpalast) acquired *Lichtraum (Hommage à Fontana)* (Light room [Homage to Fontana]), realized by Mack, Piene, and Uecker in 1964 for documenta 3 in Kassel.[3] Two of the installation's seven kinetic light objects had to be replicated: Mack's *Weißer Dynamo* (White dynamo), which had been acquired by the Sprengel Museum Hannover in 1964; and Uecker's *Lichtscheibe* (Light disk), which had been acquired by the Kröller-Müller Museum in Otterlo (Netherlands) in 1965 and is discussed below.

Figure 2.2. Heinz Mack, Otto Piene, Günther Uecker's *Lichtraum (Hommage à Fontana)*, 1964. Museum Kunstpalast, Düsseldorf, 2005.

Figure 2.3. Günther Uecker's *Lichtscheibe* on view in the Fridericianum, documenta 3, Kassel, 1964.

Uecker, who made a replica of *Lichtscheibe* in 1993, had realized different "light disks" since the beginning of the 1960s. These were disks covered with nails that were rotated by an electric motor, so that the nails threw constantly changing shadows on the disk's white surface. When the Kunstmuseum Düsseldorf acquired *Lichtraum (Hommage à Fontana)*, the *Lichtscheibe* in the Kröller-Müller Museum could not serve as a reference for the display of the replica because it no longer had a motor and was presented on the wall. The replica was finally displayed horizontally on the floor (fig. 2.2).[4] However, while researching my doctoral dissertation at the documenta-Archive, I discovered a photograph (fig. 2.3) showing *Lichtscheibe* in a vertical position (Caianiello 2005:63, 86). A video was later found of documenta 3 that clearly shows Uecker's work positioned vertically and rotating on a

tripod.[5] Archival research can have a determinant role in the reconstruction and presentation of installations; however, it is difficult to say if the replica would have been made differently in the 1990s if the photograph or video had been known at that time. Regardless, it would have been helpful to know that *Lichtscheibe* had been displayed in a vertical position at documenta 3. I wouldn't say, however, that *Lichtraum (Hommage à Fontana)* was overinterpreted merely because the *Lichtscheibe* replica differed from the version displayed at documenta 3. The replica was validated by other installations in which Uecker had presented another light disk horizontally on the floor. In fact, the work might have been displayed vertically at documenta 3 because the space under the Fridericianum ceiling was narrow. There, the artists decided to collocate all the objects on one side of the room, leaving the other side free for visitors. There was no such constriction in the larger space of Museum Kunstpalast, so the *Lichtscheibe* could be positioned horizontally on the floor without hindering the visitors who explored the installation.

Heinz Mack's *Zwischen Himmel und Erde*

Another example is the kinetic installation *Zwischen Himmel und Erde* (Between heaven and earth) that Mack realized in 1966 for the exhibition *Zero in Bonn* at the Städtische Kunstsammlungen Bonn. The work had not survived, and Mack replicated it in 2005 for the exhibition *Light Art from Artificial Light* at the ZKM in Karlsruhe (Weibel and Jansen 2006:122). On that occasion, he changed the presentation form of the work and probably gave it its title. A photograph of the replica shows narrow nets (aluminum honeycombed structures) hanging from a black ceiling, which conceals the motors that rotate the nets at different speeds and in opposite directions. Metal sticks are inserted through the nets. Mirroring stainless-steel panels cover a platform at the bottom of the installation (fig. 2.4).

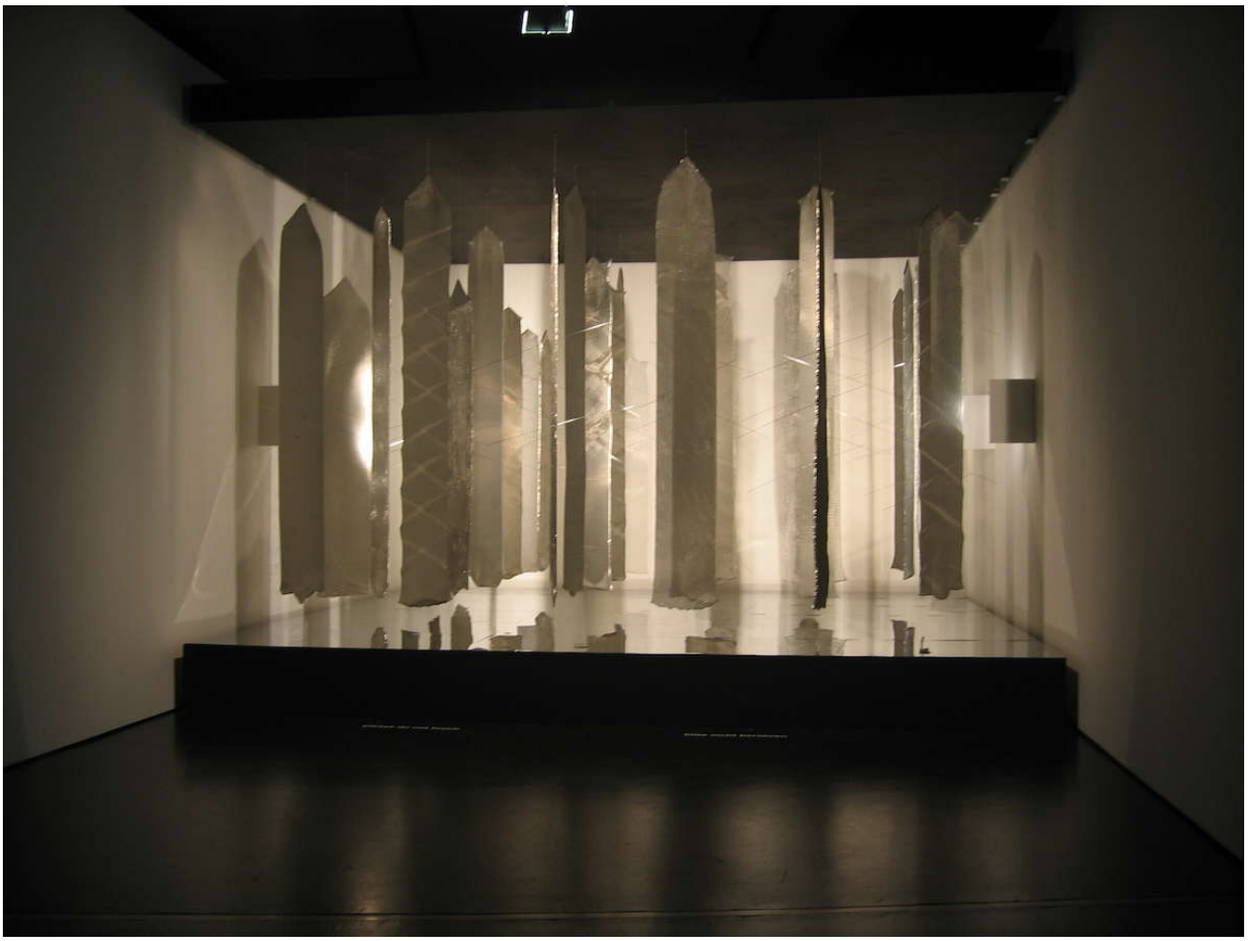

Figure 2.4. Heinz Mack's *Zwischen Himmel und Erde*, 1966/2005, in *Light Art from Artificial Light*, ZKM, Karlsruhe, 2005.

In 2008, Mack donated his replica, which was actually a new version of the work, to the ZERO Foundation, which presented it twice in the same form as 2005.[6] However, for the 2016 exhibition *Zero ist gut für Dich: Mack, Piene, Uecker in Bonn, 1966/2016* in the LVR-LandesMuseum Bonn,[7] the foundation displayed *Zwischen Himmel und Erde* as it had been presented in Bonn in 1966. Thekla Zell, research associate at the ZERO Foundation, conducted in-depth archival research on *Zero in Bonn* and found many records about Mack's original installation (Zell 2015:408-12) (fig. 2.5), which had occupied an entire room at the exhibition. The floor was not covered with mirroring panels but with white glass wool that resembled clouds. There were no metal sticks inserted through the aluminum structures. Under the ceiling, white fabric concealed a metal construction with the motors. And visitors couldn't enter the space: they could look at the installation only through two acrylic glass panels that closed the entrances.

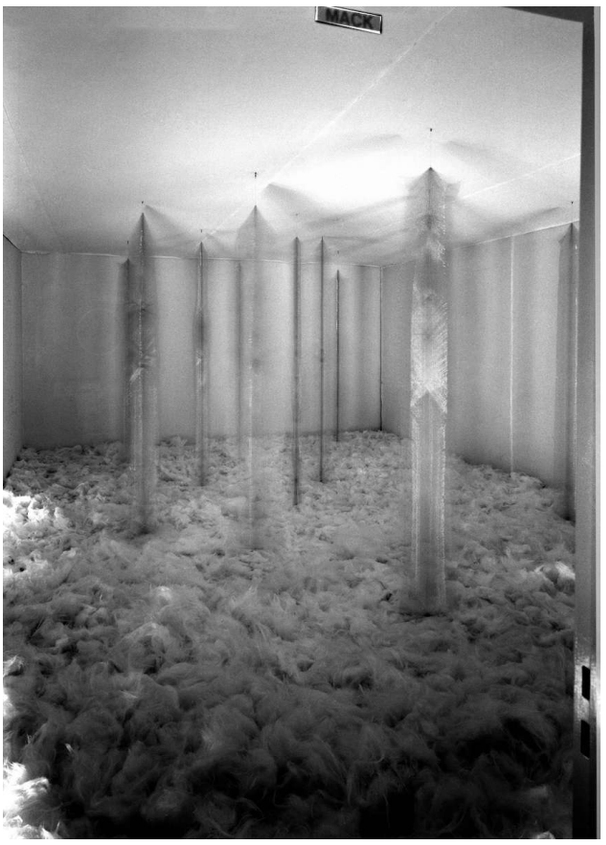

Figure 2.5. Heinz Mack's *Zwischen Himmel und Erde*, 1966, in *Zero in Bonn*, Städtische Kunstsammlungen Bonn, 1966.

Zero ist gut für Dich was intended to give viewers an idea of the installations that Mack, Piene, and Uecker had presented fifty years before, and our intention was to stage *Zwischen Himmel und Erde* as similarly as possible to its first presentation form. Mack approved this plan and was very pleased with the result. The installation of 2016, which made use of the nets and motors from 2005, was a kind of hybrid between the first and second versions of the work, and it inspired the following theoretical questions:

Did we overinterpret the work, giving priority to our intention rather than preserving the intention of the work that was transmitted to us?

In many cases, the first staging of an art installation does not correspond to its definitive presentation form, because the artist often experiments with different possibilities. The presentation form of a work usually becomes determined after a few attempts (Laurenson 2005:5). Is it legitimate to go back to the first presentation form (or, more generally, to an earlier version) of a work? Or should we always preserve the latest state?

Is the presentation of the work in its first version comparable to the exposure of an older layer in the restoration of traditional works? Did we remove—so to speak—a pentimento of the artist presenting the work with glass wool instead of mirroring panels on the bottom?

Unlike the exposure of an older layer in a painting, our intervention with *Zwischen Himmel und Erde* is reversible. It doesn't preclude us for showing the 2005 version in the future. However, our presentation will leave traces in the history of the work and will influence its future reception.

Otto Piene's *Lichtballett "Hommage à New York"*

The exhibition *Zero in Bonn* also included Piene's *Lichtballett "Hommage à New York"* (Light ballet "Homage to New York") (fig. 2.6), a programmed multimedia installation, with light filaments and slides projected on colored screens, walls, and ceiling, fully immersing the viewer in an environment of color. Images of New York City are projected by two carousel slide projectors. Organic forms handpainted by the artist on glass slides are shown on the third projector. The projections are accompanied by sound consisting of noises recorded by Piene in the New York City streets.

Figure 2.6. Otto Piene's *Lichtballett "Hommage à New York,"* 1966, in *Zero in Bonn*, Städtische Kunstsammlungen Bonn, 1966.

The work had not been displayed since 1966 and was not mentioned in the literature. During her research on *Zero in Bonn*, Zell rediscovered the installation through black-and-white photographs and other archival records (Zell 2015:414-15) and asked the artist if the whole work or parts of it still existed. Piene found five projection screens—fabric pieces dyed with spectral colors, sewn, and stretched on wooden frames—in his studio and donated them to the ZERO Foundation. After the artist's death in 2014, we found color photographic documentation of the work. Piene's chief assistant, Günter Thorn, then could identify numerous installation components and Piene's original sketches in his studio (fig. 2.7), and we decided to reconstruct the installation for the exhibition *Zero ist gut für Dich*. In this case, basic information about the installation, which normally should be gathered during the preacquisition phase,[8] could only be documented after we had staged the work for the first time.

Figure 2.7. Sketches by Otto Piene for *Lichtballett "Hommage à New York,"* 1966.

Although we had found many components and much documentation of the installation, there was still room for interpretation in its reconstruction. As with *Lichtraum (Hommage à Fontana)*, some parts of the installation were no longer available because they had been acquired by other collections: four kinetic light machines—two *Scheibenprojektoren* (disk projectors) and two *Lichttrommeln* (light drums)[9]—had to be reproduced by Piene's chief assistant. Moreover, we needed to reconstruct the synchronization of the machines, spotlights, and slide projectors. The synchronization was based on a score from 1962 that Piene had used to program the timer for his light ballets. The score was composed with seven time intervals, which had to be attributed to the installation's devices.

Another point that left great leeway in decision making was which slides to duplicate for the installation. Piene's assistant found 514 photographic slides (in color and black and white) in Piene's studio after his death, and these likely included slides used by the artist for *Lichtballett "Hommage à New York."* However, they were in boxes that had been vaguely labeled by Piene to indicate the slide subjects rather than the artworks he had used them for. We needed 160 slides for two projectors; that is, eighty for each slide magazine. Newspaper articles from 1966 that describe Piene's installation always refer to color slides, so we first removed all the black-and-white images (even those with subjects related to New York City). Among the color images were fifty-four souvenir slides, of the type mass-produced for tourists, from different series that showed tourist attractions in New York. Because we could identify one of them, an image of the Empire State Building, on a photograph of the installation (fig. 2.8), we decided to use duplicates of all the souvenir slides. There was also a series of color slides that Piene had made of people on the streets of New York. We could identify a detail of one of them in a photograph of the installation, so we selected this series as well. A further clue was provided by a letter Piene wrote to the art critic Jasia Reichardt, in which he mentioned that he had used slides of "Broadway and 42nd Street" for the installation in Bonn.[10] This prompted us to select the slides in a box labeled "Broadway." Our slide selection seemed to be inherently consistent with the homage to New York, although it was impossible to reconstruct Piene's exact slide sequence from 1966.

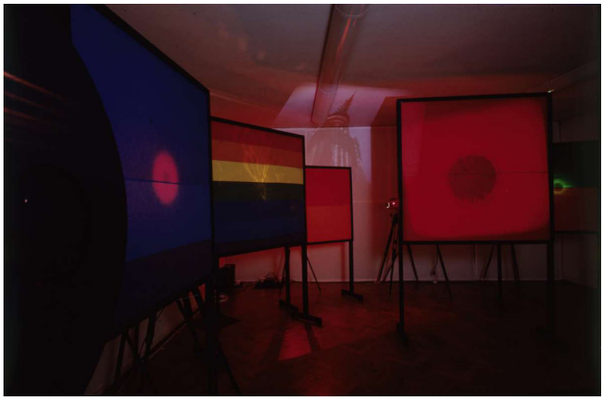

Figure 2.8. Otto Piene's *Lichtballett "Hommage à New York,"* 1966, in *Zero in Bonn*, Städtische Kunstsammlungen Bonn, 1966.

Choosing among Piene's handpainted glass slides was more arbitrary. Piene's assistant had found nearly 1,000 painted slides in the artist's studio, and we didn't have any reference point by which to select the eighty slides necessary for the installation.

Every reconstruction implies an interpretation. A certain range for decision making cannot be avoided even in the case of reconstructions based on the most comprehensive documentation (Caianiello 2013:212). The label for *Lichtballett "Hommage à New York"* in the exhibition *Zero ist gut für Dich* indicated both the year of creation (1966) and the year of reconstruction (2016) to make clear that the presentation reflected today's interpretation of the original work. In the reconstruction process, a relevant question was: which role did the different light machines and the single slides play in the overall effect of the installation? We interpreted the work as an immersive environment with simultaneous light and slide projections that didn't allow a linear reading of the projected images. Consequently, we did not consider the single slides and light machines to be as important as the whole effect of the installation. This interpretation justifies the use of light machines that are not original and a certain freedom in selecting and ordering the slides. Setting up the installation with Piene's chief assistant and discussing the reconstruction with other professionals[11] gave us the sense that our interpretation worked in the main, but is it definitely valid?

Conclusions

Although reconstructions leave considerable room for interpretation, they also present clear advantages: they bring forgotten works back to the collective memory and are an occasion to conduct in-depth research on the works

and to exchange ideas with colleagues. They also ensure the conservation of original components.

A reconstruction or a new staging reflects an interpretation of the work. We will never be able to draw a clear demarcation line between a right and a wrong interpretation; therefore, we can never be sure if a reconstruction or a staging is correct, although the consensus of the scientific community can give us an orientation. An interpretation can always be invalidated by new archival findings, new methodological approaches, and by interpretations that are more economical and consistent. So we will never know if our conjecture is definitely valid. But we can know if it is definitely wrong, if "it is not the case" (Eco 2012). If we try to use a screwdriver as an ashtray, we will notice that it doesn't work.

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Notes

1. In the printed version of his paper, Rorty deleted the allusion to ear scratching, while it remained in the reply by Eco.
2. Mack, Piene, and Uecker didn't use the term *installation* in the 1960s. They used the word *Lichträume* (light rooms) to refer to their arrangements of kinetic light works in the gallery space. At that time, English-language art magazines used the word *installation* to describe the arrangement of works in an exhibition.
3. See also "The Hype about ZERO and Its Influence on the Conservation and Presentation of Early Kinetic Works" by Gunnar Heydenreich and Julia Giebeler in this publication.
4. At the first presentation of the *Lichtraum (Hommage à Fontana)* after documenta 3 (exhibition *Upheavals–Manifestos, Manifestations: Conceptions in the Arts at the Beginning of the Sixties; Berlin, Düsseldorf, Munich*, Kunsthalle Düsseldorf, 1984), Uecker displayed a new version of the *Lichtscheibe* (called *Light Mill*), with a disk set vertically on a large tripod. However, Piene didn't like this version of the work particularly because of the tripod. Otto Piene, interview by Tiziana Caianiello, Gunnar Heydenreich, Günter Thorn, and Cornelia Weyer (August 7, 1999) in Caianiello 2005:185.
5. Through this archival material, it became evident that the position of the disk in the version presented at Kunsthalle Düsseldorf in 1984 was nearer to the original mounting than the position of the disk in the replica from 1993. However, the tripod from 1984 was more prominent than the original used for documenta 3.
6. Once at the exhibition *Heinz Mack: Kinetic*, Museum Abteiberg, Mönchengladbach, April 3– September 25, 2011, and once at the exhibition *ZERO: Zwischen Himmel und Erde*, Zeppelin Museum Friedrichshafen, May 16–July 20, 2014.
7. *Zero ist gut für Dich: Mack, Piene, Uecker in Bonn, 1966/2016*, LVR-LandesMuseum Bonn, November 26, 2016–March 26, 2017.
8. See "Acquiring Media Art" in the collaborative project *Matters in Media Art*. Accessed March 8, 2017. http://mattersinmediaart.org/acquiring-time-based-media-art.html.
9. A *Scheibenprojektor* is a perforated, motorized, rotating vertical disk, positioned on a stand, that projects a light ballet. A *Lichttrommel* is a drum with a perforated, motorized, and rotating horizontal disk on the top that projects a light ballet.
10. Otto Piene, undated [beginning 1967] draft letter, to Jasia Reichardt, assistant director, Institute of Contemporary Arts, London. Otto Piene records, 2.I.2214, ZERO Foundation, Düsseldorf.
11. The ZERO Foundation organized a meeting of professionals (*Light On/Off: Reconstruction and Presentation of Light Installations*, LVR-LandesMuseum Bonn, December 8, 2016) to discuss the reconstruction of Piene's *Lichtballett "Hommage à New York"* and the staging of Mack's *Zwischen Himmel und Erde* and Uecker's *Lichtplantage* for the exhibition *Zero ist gut für Dich*.

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Part 2. Case Studies

3.

Fast and Furious: Operation, Maintenance, and Repair of Chris Burden's *Metropolis II* at LACMA

Mark Gilberg
Alison Walker
Richard Sandomeno

Chris Burden's *Metropolis II* is an elaborate kinetic sculpture modeled after a frenetic modern city. Steel tubing forms a grid interwoven with an elaborate system of roadways and train tracks with miniature cars speeding through the sculpture's dense network of buildings. This paper discusses the maintenance and operation of the sculpture and highlights many of the problems inherent in the acquisition of kinetic works of art.

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Figure 3.1. Chris Burden's *Metropolis II* (2010) in action. Watch the video at https://youtu.be/7vQkoFfU9gA.

Introduction

Artist Chris Burden (1946–2015) designed and fabricated *Metropolis II* (2011), an intense kinetic sculpture modeled after a frenetic modern city (fig. 3.1). Steel tubing (Unistrut®) forms a structural grid interwoven with an elaborate system of eighteen roadways, including a six-lane freeway, and HO-scale[1] train tracks. Miniature cars speed through the city at 240 scale miles per hour; every hour, the equivalent of approximately 100,000 cars circulates through the sculpture's dense network of buildings. According to Burden, "The noise, the continuous flow of the trains, and the speeding toy cars produce in the viewer the stress of living in a dynamic, active and bustling 21st century city" (Schader 2012). Burden described its fabrication as a "string and felt tip pen operation"; that is, no computer renderings or plans were used (Schader 2012). The sculpture took five years to build, and the development of the architecture was very organic, with Burden in the studio every day making aesthetic decisions. Purchased by the Nicholas Berggruen Foundation, *Metropolis II* is on loan through 2022 to the Los Angeles County Museum of Art (LACMA), and it has been on display and in continuous operation since January 2012. It took almost three months to disassemble the sculpture and four and a half months to install at LACMA.

We discuss the exhibition of this contemporary sculpture, focusing on specific maintenance and repair issues—foreseen and unforeseen—that illustrate many of the problems inherent to the acquisition and operation of kinetic works of art. We examine LACMA's overall philosophy and approach to the operation and maintenance of *Metropolis II*, including the repair and replacement of damaged parts, in the context of both the artist's and the owner's expectations as well as the

demands of the museum's exhibition program. We also focus on the costs associated with the sculpture's long-term operation and how best to assess the artwork's condition and predict or anticipate mechanical failure.

Metropolis II

When installed, the sculpture is approximately 6.4m wide by 9.1m long (fig. 3.2); it is approximately 3m tall at its highest point. The main structure of the sculpture breaks apart into nine separate sections, or modules, which connect via telescoping steel tubing (Unistrut®). Each module is designed to fit into a shipping container for ease of transport. The core module houses the three conveyor systems, including their motors, conveyor belts, conveyor ramps, and associated control devices that operate the sculpture. Each module has leveling feet (eighty-six total) that are used to calibrate the sculpture and align the tracks on adjacent modules. All car and train tracks bridging adjoining modules, which number more than 100 pieces, must be removed for the deinstallation/installation process.

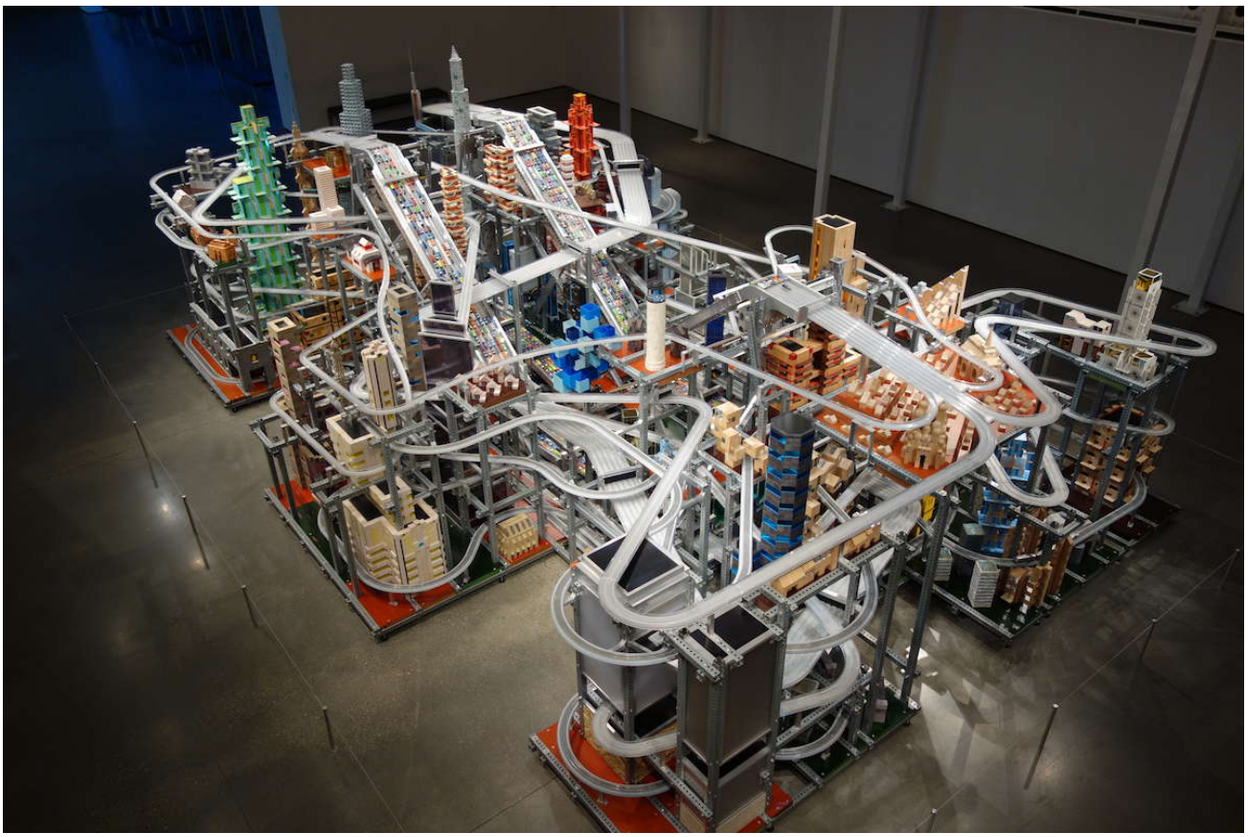

Figure 3.2. Chris Burden's *Metropolis II* installed at the Los Angeles County Museum of Art.

Figure 3.3. One of *Metropolis II*'s conveyor belts.

At any given time, there are 1,200 cars in operation on the sculpture. The ninety-six custom car types—four body types, each type in four colors, and six combinations of detailing within each color scheme—were mass-produced in China after extensive prototyping at Burden's studio. Each car is die-cast aluminum with a rare-earth magnet embedded in its chassis, and each has front and back rubber bumpers to dampen the impact as the cars run into one another at the bottom of the conveyor ramps. Each of the three conveyor ramps is a six-lane highway, and each has a corresponding conveyor belt with magnets embedded in it (fig. 3.3). When the conveyor motor is on and the conveyor belt is moving, the attraction between the belt and car magnets draws the car to the top of the ramp. Once the car is at the top, the conveyor belt loops away and gravity causes the car to fall down the track until it hits the cars that have stopped at the base of the ramp. It is this push from behind that engages the conveyor belt and draws the car back to the top again.

The speed of the cars is controlled by a series of adjustable brushes installed over the car track. Located at various strategic points along the roadways, particularly near curves, these brushes can be lowered or raised to alter the amount of friction on the car as it passes underneath them.

There are also thirteen electric trains on *Metropolis II*, eight loops with train sets and five end-to-end trolleys (fig. 3.4). The store-bought trains and trolleys are HO scale (approximately 1:87), and they were specifically chosen by the artist for their aesthetic qualities. Each train track has its own controller, allowing the operator to individually adjust the speed of the trains as specified by the artist. Each trolley track has an optical sensor (a tiny, light-sensitive photocell) at each end. When the moving trolley gets close to the optical sensor, blocking the light, a signal is sent for the trolley to stop and reverse direction.

Figure 3.4. *Metropolis II*'s train sets and trolleys.

The cars, trains, and trolleys weave through a maze of buildings of varying shapes and sizes. More than 200 buildings made of HABA blocks, Lego blocks, Lincoln Logs, glass tile, stone, and acrylic densely cover the landscape.[2] About 80 percent of the buildings are fixed in place, and the remaining 20 percent are partially or completely removable for disassembly/assembly of the sculpture. In general, the smaller buildings are secured with adhesive while the larger structures are bolted in place. All building components that are taller than the conveyor belt are also removable, to allow the sculpture to be packed in a cargo container. While a number of buildings are reminiscent of famous architecture, such as the Eiffel Tower, the Taj Mahal (fig. 3.5), and the Empire State Building, it was never the artist's intent to present replicas of these structures (Schader 2012).

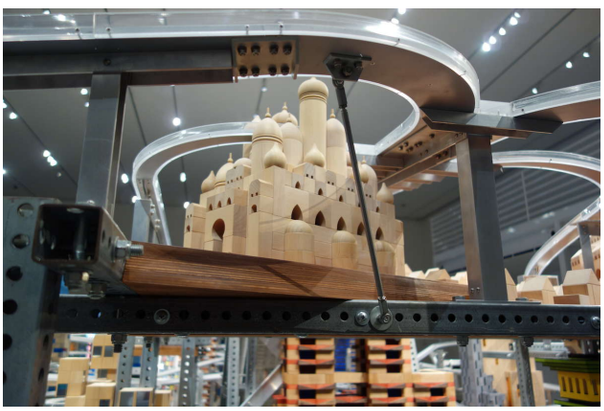

Figure 3.5. Examples of *Metropolis II*'s architecture.

It should be noted that the 21st Century Museum of Contemporary Art in Kanazawa, Japan, owns an earlier version of this kinetic sculpture, *Metropolis I* (2004). It is one-third the size of *Metropolis II*, with four trains and eighty cars (modified Hot Wheels™). Unlike *Metropolis II*, this version requires two operators and is currently not on view.

Operation

LACMA is the first and, thus far, only venue that has exhibited *Metropolis II*, and the museum had essentially no data or information to assist us in determining the work's longevity, the key component of which is its operation. To maximize viewership while minimizing wear and tear on the sculpture, the museum ultimately decided to operate *Metropolis II* on Fridays, Saturdays, and Sundays (the busiest days), as well as for holidays and special events. On the regularly scheduled days, the sculpture is operated four times: starting thirty minutes after the museum opens, the sculpture is run every other hour, for an hour. This allows the operator to rest (it is extremely cramped and noisy inside the sculpture), retrieve any cars that jumped the track, answer patrons' questions, and make notes on the sculpture's performance. Operating *Metropolis II* on a schedule was also in keeping with the artist's desire not to run the sculpture continuously: Burden liked the juxtaposition of chaos and quiet, which mimicked the stop-and-go of life in a major city. Also, the frenetic pace of the cars can be exhausting to the viewer, for even a short time. For this reason, the artist designed a balcony in the gallery for viewers so they could step back from the noise and excitement and observe the sculpture as a whole from a distance.

Figure 3.6. Operation of *Metropolis II*.

The operators monitor the movement of the trains and make sure the cars do not jam at any brush over the roadway or at the bottom of the conveyor ramps. Operators share notes on successive days to communicate potential problems with tracks or conveyor belts that require monitoring or repair (fig. 3.6).

The sculpture has a number of built-in safety features, including overload switches (circuit breakers) for each conveyor motor, one photo-eye sensor for each conveyor belt, and one photo-eye sensor for each lower conveyor sprocket. There is also an emergency button that shuts down the entire system.

Care and Maintenance

Proper maintenance of *Metropolis II* proved critical to its overall operation and function. The entire sculpture is vacuumed once a week to remove dust and debris that has accumulated from the gallery. The sculpture is also inspected frequently to assess wear and identify any issues that may cause a problem in the future.

In addition to vacuuming, the plastic car tracks are fastidiously dusted by hand with a super-soft microfiber polishing cloth. As they speed around the track, the cars degrade the plastic, creating grooves in the track and generating a considerable amount of fine white powder. This wear is most pronounced along bends in the track where the cars tend to scrape against and scratch the vertical plastic retaining wall (fig. 3.7). The wear is readily apparent, yet it does not yet seem to have affected the cars' performance so far. As a preventive measure we have explored how best to undertake the replacement of portions of the track showing the most wear. We have carefully measured and traced individual pieces of track, creating highly detailed templates and computer renderings. We now have the ability to cut sheet material using CNC (computerized numerical control) to the exact size and shape of any specific curve for future replacement.

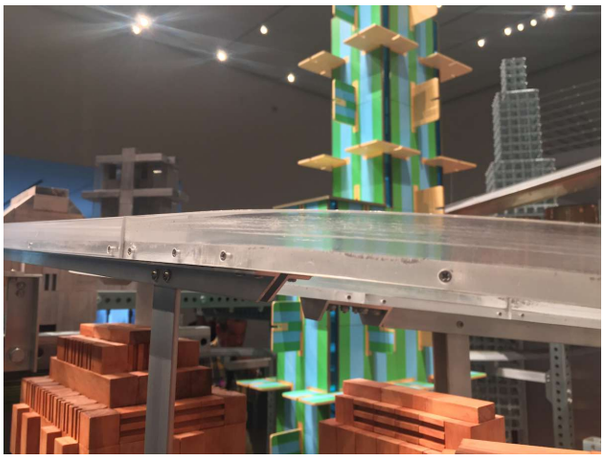

Figure 3.7. Track wear in *Metropolis II*.

Though the cars were designed to be robust, they take quite a beating racing down the 19.8m of roadway over and over, approximately 650 hours a year. The cars' plastic wheels, which are press-fit onto a metal axle, fail most frequently (fig. 3.8). The hole in the wheel eventually bores out from the repetitive rotation, and the wheel itself slides off. There are no spare parts for these custom cars, so damaged parts are replaced by exchanging good parts from other used cars. When repair is no longer possible, the cars are retired to storage and a new car is used. Anticipating that the cars would wear out, the artist gave the collector 12,000 spare cars. Based on the current rate of wear and tear, we estimate that there are just enough spare cars to keep the sculpture operational throughout the loan period.

Figure 3.8. Car failure in *Metropolis II*.

Like the tracks and cars, the trains require constant cleaning and repair. As dust collects on their wheels, the transfer of electricity from the track to their motor is compromised and causes them to sputter, stall, and/or derail. All dust and debris must be meticulously removed from the train wheel assemblies and gears every week. In addition, each train track must be carefully degreased and cleaned by hand. The motor components wear out with almost constant use. Most commonly, their plastic drive shafts are worn smooth, preventing the train from running at all. Unfortunately, the train sets are not easily replaced, given the artist's preference for some older models that are no longer commercially available. Over the years, we have resorted to rebuilding the trains and making our own replacement parts. We are experimenting with more durable materials, such as replacing the plastic drive shafts with brass, which greatly increases the operating life of the trains. Even though they have been repaired multiple times, some of the trains have logged more than 2,000 hours of operation—well beyond the average lifetime of a model train.

The trolleys presented a unique problem, which could be traced back to the original fabrication of the sculpture. The sculpture had never been operated for more than 100 hours prior to its installation at LACMA, and it was impossible to predict how the different components of the trolley system would hold up to constant use. We discovered that the trolley circuit boards are not compatible for long-term use with the original controllers/transformer. With permission from the artist's studio, we replaced some of the controllers with a more robust version.

Typically, the architecture requires little maintenance other than minor repair of loose or fallen building elements, which occurs periodically in response to vibration from the cars. The detachment of individual building blocks is largely due to adhesive failure. On one occasion, a patron fell into the sculpture and broke an acrylic building rooftop. Surprisingly, the damage was isolated to one piece of the roof component, and the patron was not injured. The Nicholas Berggruen Foundation approved immediate repair/replacement, and we were able to complete the work without having to close the sculpture to the public. Using the broken piece as a template, we purchased identical acrylic sheet material from the same vendor that the artist had used, cut into shape, and reassembled with the original detail elements and trimming.

The base layer of the sculpture is composed of colored resin-coated plywood (phenolic). These plywood pieces, anchored within the metal Unistrut® grid, fill in about 85 percent of the surface area of the artwork parallel to the gallery floor. As cars fly off the track, they sometimes hit this plywood or a building, leaving a visible dent. In an effort to reduce the number of dents to the base of the sculpture, we installed a GoPro camera[3] to film the cars in areas where they frequently jump the track (fig. 3.9). This footage enabled the operator to identify the exact location where cars were coming off the track and which of the four car types fell off most frequently. With this information, we were able to make strategic brush adjustments to slow the cars, keep them on the track, and reduce damage to the plywood and/or buildings.

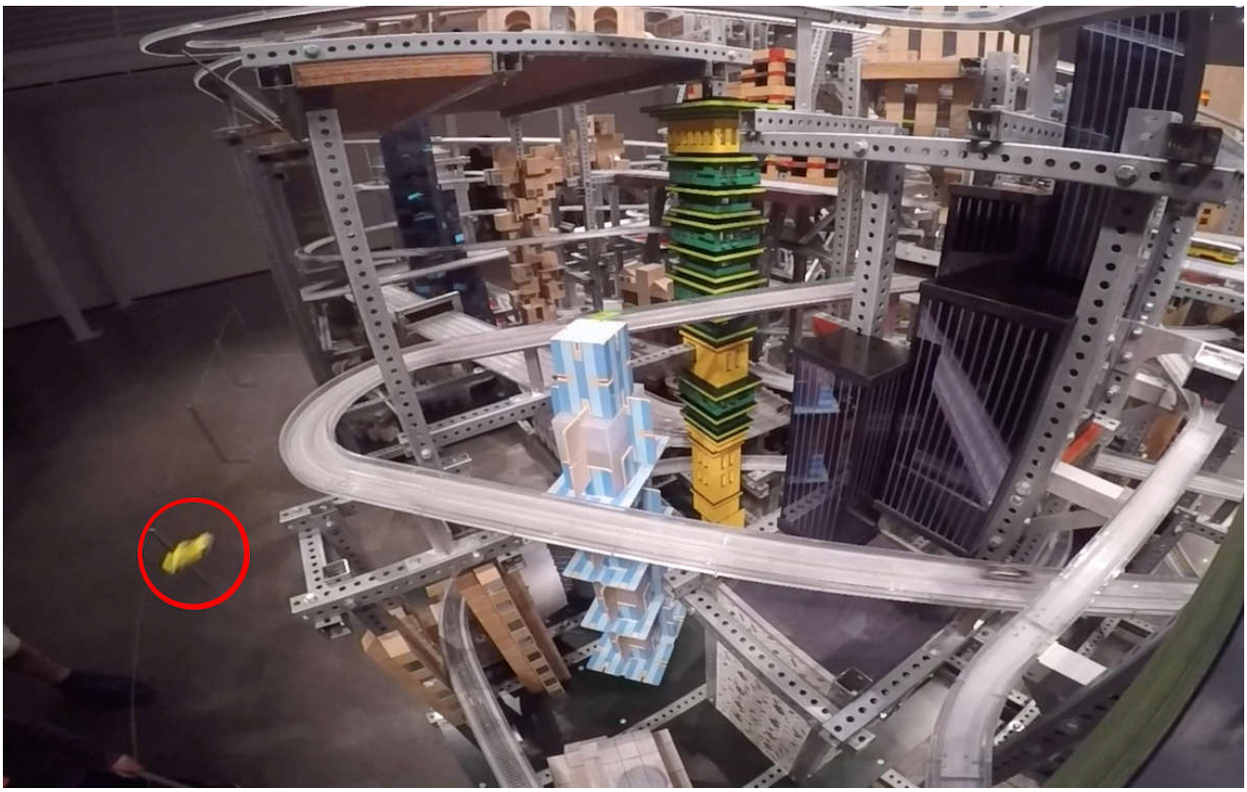

Figure 3.9. A car in *Metropolis II* falling off the track, captured by the GoPro.

The motors that drive the conveyor system also require periodic maintenance. Intentionally installed upside down for aesthetic reasons, the oil seals are destined to fail. Because the seals were not designed to handle upside-down pressure, oil has leaked out of the gearboxes and contaminated the rest of the motor. As a precautionary measure, we are gradually replacing the original motors with oil-less motors of the same kind. In addition, as problems arose, we replaced various sensors and overload switches (motor circuit breakers) with more robust industrial versions to improve performance.

Documentation

Because *Metropolis II* is on loan to LACMA, it is necessary to document the condition of the sculpture over time and account for damaged cars, trains, and trolleys; however, this has also proved critical to assessing the long-term operation and maintenance costs of the artwork. *Metropolis II* operates almost 650 hours per year, with an average of 554 run hours before a car is retired. Each car is individually numbered, and the oldest car to date has run for more than 1,234 hours. LACMA has retired a total of 5,143 cars since the sculpture was installed in January 2012: 1,758 (in 2012), 1,090 (in 2013), 961 (in 2014), and 1,334 (in 2015). Remarkably, not a single scheduled run of *Metropolis II* has been missed, although the sculpture has at times been operated without several trains or trolleys. The artist approved operation of the sculpture under these conditions as long as all the cars were functional.

Conclusions

Kinetic sculptures present a range of issues and challenges, some of which are unique to the artwork. Their installation and exhibition is both costly and timeconsuming, and many museums, ill prepared to meet these challenges, frequently underestimate the resources that must be devoted to ensure their proper function and operation. Preventive maintenance is key, though it is important to have a clear understanding of how the sculpture functions, the artist's intent, and what changes the artist will allow and support as technology changes. The exhibition of *Metropolis II* has proven successful primarily because LACMA was willing to take a more multidisciplinary approach to its care and preservation, embraced the assistance of the artist's studio and staff, and allowed professional fabricators and artists to play a

large role, under the guidance and direction of the museum's conservation staff.

✦ ✦ ✦

Notes

1. HO refers to the scale system commonly used in North America for model railroads.
2. HABA™ blocks are a construction toy consisting of small wooden building blocks. Legos™ are construction toy consisting of small plastic bricks. Lincoln Logs™ are a construction toy consisting of notched, miniature wooden logs.
3. GoPro is an HD-quality video recording camera.

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4.

Conserving Thomas Wilfred's *Lumia Suite, Opus 158*

Carol Snow
Lynda Zycherman

Kinetic light artist Thomas Wilfred (1889–1968) created *Lumia Suite, Opus 158* as a complex construction of polished and painted metal, projectors, electric motors, fans, mirrors, and a rear projection screen. Meant to be seen in a dedicated, darkened room, it was commissioned in 1963 by New York's Museum of Modern Art and on view nearly continuously until it was deinstalled in 1981. It was in storage for the past thirty-five years. In preparation for the Yale University Art Gallery's 2017 exhibition *Lumia: Thomas Wilfred and the Art of Light*, the installation was unpacked, assessed, conserved, repaired, and reconstructed to bring it to working, exhibitable condition.

Thomas Wilfred: The Unrecognized Pioneer

Thomas Wilfred (1889–1968) was born Richard Edgar Løvstrøm in Naestved on the island of Zealand, Denmark. In Copenhagen, as a precocious sixteen-year old, he began experimenting with light as an artistic medium, using a cigar box, incandescent light, and colored glass to create colored projections. Later, when he studied painting at the Sorbonne, he expanded his setup to several cardboard boxes, lenses, and a bedsheet screen. His painting instructor discouraged him from pursuing his experimentation with light, directing him toward traditional painting instead; yet Wilfred persevered with his passion undaunted. During his early, experimental years as a light artist, Wilfred supplemented his income by performing medieval music on the archaic, twelve-string archlute; he performed to international acclaim until 1914, when he was called to duty in World War I. After his service, he immigrated to the United States in 1916 to continue his experiments with light art and work out its presentation to the public. By 1919 he abandoned his career as a musician to devote himself to the art of light.

Artists and musicians from the sixteenth through the early nineteenth centuries had dreamed of seamlessly marrying color and sound in a single instrument,[1] usually called a "color organ" or, more elaborately, a kaleidoscope, *clavier à lumières*, Chromola, Optophonic Piano, Sarabet, and Chromopiano, each of which joined music with light projections. Most often, a single performer played the music and coordinated the light, but there are orchestral scores combining light projections and music.[2] Like all of the other precursors and presentations by contemporaneous artists who worked with projected light, this presentation relied on at least one performer.[3] However, Wilfred's unique contribution was to present kinetic colored light performances without the music: a silent, purely visual experience.[4]

By 1919, after years of experimentation, Wilfred invented his own color organ, calling it the clavilux, from the Latin *clavi* (key) and *lux* (light), thus "light played by key." To the traditional seven arts—architecture, sculpture, painting, music, poetry, dance, and theater—Wilfred added an eighth, lumia, his term for signifying light as its own expressive art form. The light was not *in* the art; the light *was* the art.

To Wilfred, lumia, in addition to being a general term for an art form, were compositions played on claviluxes. Wilfred's clavilux was different from other color organs of the time because it created shapes of colored light by means of reflectors, diaphragms, and stained-glass disks, and the shapes moved silently across the screen.

Wilfred had perfected his first clavilux by 1921, and the next year had his first ticketed public performance, at the

Neighborhood Playhouse in New York City, which was followed by worldwide tours from 1922 to 1925, to generally favorable reviews (fig. 4.1). Theater and film producer Kenneth Macgowan wrote, "This is an art for itself, an art of pure color; it holds its audience in the rarest moments of silence that I have known in a playhouse" (Wilfred 1947:250–51). His setup at every venue was similar: a large screen placed at center stage, the artist seated downstage at a clavilux console with his back to the audience. Because this was a new art form, the audience members had no preconceived ideas about what they were going to experience, and sitting in silence for an hour, watching something large on a screen, would probably not have been uncomfortable. In 1927—the same year that talking films were first produced—Wilfred positioned himself to the side of the stage behind a curtained enclosure, to allow the audience to concentrate on the visual without the distraction of the clavilux operator.

Figure 4.1. A clavilux recital by Thomas Wilfred in Seattle, 1924. Photo: Yale University Library Manuscripts and Archives.

In the first part of the twentieth century, it would have been unusual to have someone perform in galleries devoted to paintings. And how would such works have entered private collections? Wilfred addressed these thorny issues by developing a clavilux that no longer required an operator for performances. By 1928 Wilfred created his first internally programmed clavilux, a projector that could play lumia compositions by itself. Two years later he founded the Art Institute of Light in New York City as a nonprofit entity for research on lumia. Soon after, an article in the *New York Times* reported on his invention of a new kind of painting with light as a medium that could be displayed at home like a painting. Wilfred said about the quality and permanence of lumia: "These pictures are built up in three dimensions as a sculptor shapes a statue. They have a depth impossible to attain with oils or watercolors, and furthermore they are imperishable, since the colors are fused in glass."[5] In 1933 Wilfred opened a theater with surrounding studios and laboratories in Grand Central Palace, a performance hall above New York's Grand Central train station (Wilfred 1947:251).

Wilfred's Exhibitions

From the 1930s until his death in 1968, Wilfred continued to create and advocate for his lumia as the eighth art form, always feeling unappreciated because museums did not buy his work (with the exception of MoMA's 1942 purchase), and private collectors, however enthusiastic, were a small group. A 1959 commission for the Clairol headquarters in New York seems to have been his first and last relationship with a corporate collection. In 1967 he showed with Nam June Paik at the Howard Wise Gallery in New York; by this time a new era of time-based media art had begun, but Wilfred, a prime innovator, was neither featured nor given credit for his farsighted inventions.

In 1971, three years after Wilfred's death, the Corcoran Gallery of Art in Washington, D.C., organized a retrospective exhibition of eleven internally programmed lumia compositions that were completely self-operating in addition to twenty-eight drawings, dating to 1928, that represented technical ideas, individual works, and visionary projects and designs for theatrical projected light settings. A smaller version of the exhibition traveled to the Museum of Modern Art (MoMA), New York.

Nearly forty years after Wilfred's death, his lumia were shown in the 2005 exhibition *Visual Music: 1905–2005* at the Museum of Contemporary Art, Los Angeles, and the Hirshhorn Museum and Sculpture Garden, Smithsonian Institution, Washington, D.C. Wilfred's final composition, *Lucatta, Opus 162*, was exhibited alongside works by Lynda Benglis, Robert Indiana, and Jimi Hendrix, to name a few, at the 2005–7 exhibition *Summer of Love: Art of the Psychedelic*

Era.[6] In 2011 director Terrence Malick used Wilfred's 1965 composition, *Opus 161*, in his film *The Tree of Life*.

At present, there are lumia compositions in collections across the United States, from New Haven to Honolulu, yet only Wilfred's final work, *Lucatta, Opus 162*, remains on view as a loan to the Los Angeles County Museum of Art; all other extant works have been allocated to museum storage, are in private collections, or have been lost. We express gratitude to passionate lumia collectors and mechanical experts Eugene Epstein and A. J. Epstein, who have saved, preserved, and restored numerous works by Wilfred and made nearly every recent exhibition of Wilfred's oeuvre possible.

Wilfred and the Museum of Modern Art, New York

Figure 4.2. Thomas Wilfred with *Lumia Suite, Opus 158*.
Photo: Yale University Library Manuscripts and Archives.

Wilfred's long-awaited major breakthrough in the museum world came in 1942, when MoMA purchased his *Vertical Sequence II, Opus 137* (1941),[7] his first lumia composition to enter a museum collection. A decade later, MoMA further advanced Wilfred's career by including him in the exhibition *15 Americans* (1952) alongside fourteen other artists: William Baziotes, Edward Corbett, Edwin Dickinson, Herbert Ferber, Joseph Glasco, Herbert Katzman, Frederick Kiesler, Irving Kriesberg, Richard Lippold, Jackson Pollock, Herman Rose, Mark Rothko, Clyfford Still, and Bradley Walker Tomlin. An outlier in the exhibition of eleven painters and three sculptors, Wilfred was nonetheless appreciated by some as the only truly original artist in the exhibition (Turrell 2013). In 1961 MoMA acquired a second Wilfred, *Aspiration*.[8] Both are domestically sized, internally programmed lumia compositions shown in wooden cabinets, with small screens (approximately 38 × 38 cm), a far cry from the giant, projected images of the concert stage.

In 1963 MoMA again supported Wilfred by commissioning a new installation for its thirty-fifth anniversary and 1964 reopening of renovated and expanded galleries designed by Philip Johnson. In a return to the lumia as large works suitable for public spectacle, Wilfred created his magnum opus, *Lumia Suite, Opus 158* (fig. 4.2).[9] In a custom-designed, 3.6 × 4.8 m room painted dark gray, viewers sat on custom benches centered before a 2.4 × 1.8 m screen with a rear-projected moving-light spectacle. The installation was a favorite of the public, and it ran nearly continuously for seventeen years.

When MoMA closed its galleries for the 1981–84 expansion of its campus, *Lumia Suite* was dismantled and carefully stored. (fig. 4.3). It remained in storage until December 2014, when the Yale University Art Gallery requested *Lumia Suite* for its 2017 exhibition *Lumia: Thomas Wilfred and the Art of Light*, in which fifteen kinetic light works dating from 1928 to 1968 would be on view. Having *Lumia Suite* in working order was essential; without it, there would be no exhibition.

Figure 4.3. Thomas Wilfred's *Lumia Suite, Opus 158* in storage at the Museum of Modern Art, 2013.
Photo: Yale University Art Gallery.

Resurrecting Wilfred's *Lumia Suite, Opus 158*

After unpacking the numerous crates and boxes sent by MoMA to Yale in early 2015, eighty-five items, ranging from Wilfred's tools to spare sheets of mica, were catalogued into the database and tracked with barcodes. It took days to sort the main components for *Lumia Suite* from the spare parts and hardware, but it led to a better appreciation of Wilfred's foresight in guaranteeing that his

lumia would last into the future. In correspondence to MoMA, Wilfred stated: "It will probably be a long time before any of the spare items will be needed, and by that time the manufacturers may have changed their models and replacements may take a long time."[10] The Rosetta stone among all of the items was Wilfred's technical manual, written for the museum conservator at MoMA and staff of the Art Institute of Light, without which the resurrection of *Lumia Suite* would not have been possible (Wilfred 1964).

A thorough condition assessment of the main components was performed: vertical projector, horizontal projector, reflector tower, elliptical convertor, two ultramarine flood lamps, lamp control unit, and the actuator. An important part of this assessment was checking the condition of the 1960s electrical wiring and testing the electrical components. A multimeter, an instrument that measures electric current, voltage, and resistance, was used to check all switching devices, motors, and fans. The electrical components of *Lumia Suite* looked good, including the hazardous asbestos wiring and mercury switches. Minor physical damage was discovered—the color wheel on the vertical projector was bent out of plane and the adhesion of some electrical tape had failed—but otherwise *Lumia Suite* was in robust condition.

The next phase of the project was the design and construction of a portable system to replace MoMA's original projection room, which had been built with lumber, drywall, and a firewall. Again, Wilfred's meticulous descriptions, along with his scale drawings (¼ in.:1 ft. and 1 in.:1 ft.), allowed for accurate reconstruction and reassembly (fig. 4.4). A T-slotted, anodized matte-black (to prevent light reflections), extruded aluminum track system was chosen to provide two lightweight, adjustable, and mobile framework systems to replace the opposing walls in the projection room. While the 80/20® aluminum frames were being fabricated, treatment of the components proceeded.

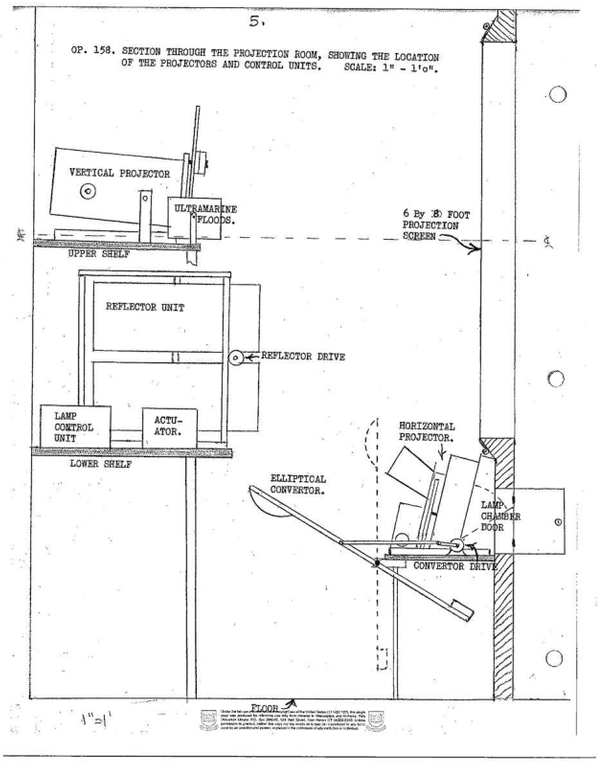

Figure 4.4. A section drawing of Thomas Wilfred's *Lumia Suite, Opus 158* in a projection room, from Wilfred's technical manual. Museum of Modern Art, New York, Department of Painting and Sculpture, Museum Collection Files.

All main components were cleaned, as per Wilfred's instructions: glass was cleaned with alcohol (ethanol), and the aluminum reflectors were cleaned with a soft brush. The metal, glass, and theater-gel color wheel for the vertical projector was carefully put back in plane through gentle clamping. As it turned out, very little treatment was required, and our intent was to keep all original parts as long as they were safe to reuse.

With the aluminum frameworks ready to receive the components, and the components ready to be installed, reassembly could proceed (fig. 4.5). The components were placed in their precise locations relative to one another, and their electrical connections were made following Wilfred's wiring diagrams and explanations. At this stage, there was still no way of knowing if the contacts and communications among all parts would still work as a unified whole. The wiring within the walls at MoMA had included a main electrical panel, but to simplify the exhibition's installation at the Yale University Art Gallery and its subsequent appearance at the Smithsonian American Art Museum (October 2017–January 2018), heavy-duty extension cords were used for the initial setup. Because this work was being done in the conservation

laboratory of the new Institute for the Preservation of Cultural Heritage at Yale, the most up-to-date electrical codes had been used, following the National Electrical Code (NEC) as part of the National Fire Protection Association (NFPA), as well as elevated requirements from the Yale Environmental Health and Safety Department. Problems were unlikely because the alternating current (AC), 120V power supply of the 1960s had been upgraded to a much higher level of safety in the 1970s. Regardless, the nearby circuit panels were monitored and a fire extinguisher was kept next to *Lumia Suite* while the main components were plugged in.

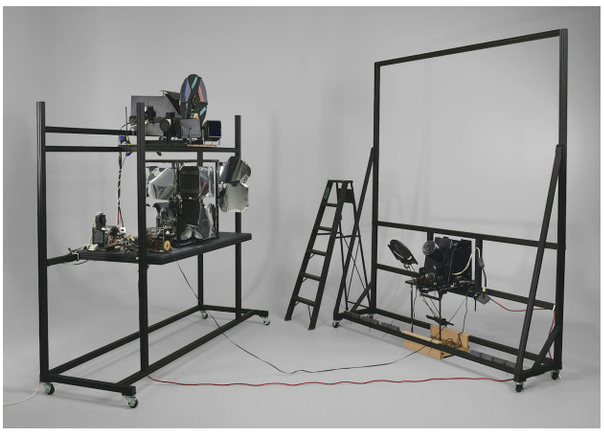

Figure 4.5. Thomas Wilfred's *Lumia Suite* reassembled on the aluminum framework.
Photo: Yale University Art Gallery.

The technical manual described the importance of the timing and synchronization of all components, so although brief tests were conducted on individual components, the installation was not plugged in for any length of time until all components were wired together as per Wilfred's instructions. Once completely connected, *Lumia Suite* was plugged in simultaneously using one extension cord for the light bulbs and lamps and one extension cord for all motors and fans. That way all components were synchronized and followed precisely the twelve-minute cycle comprising the three movements: horizontal, vertical, and elliptical. The only components that needed to be replaced during the electrical setup were one small potentiometer that controlled the motion of the elliptical convertor and one 5 amp fuse in the lamp control unit, both still readily available. A thermal check with a FLIR ONE™ camera attachment for smartphones confirmed that the source of the greatest heat was the 1,000W beacon bulb in the horizontal projector (fig. 4.6).

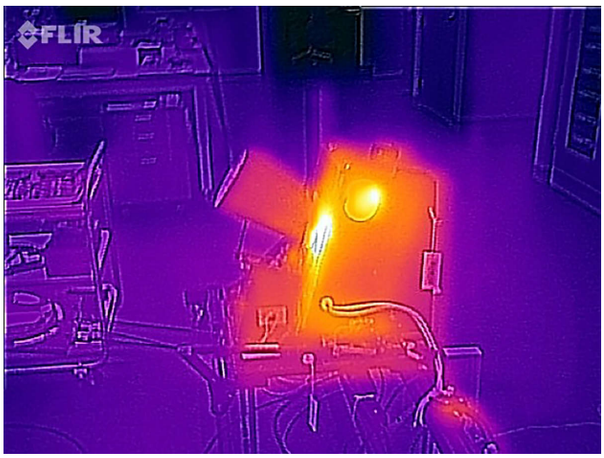

Figure 4.6. FLIR ONE™ thermal image of the horizontal projector.
Photo: Yale University Art Gallery.

In the technical manual, Wilfred describes the precise type of 1,000W beacon bulb (now obsolete) that must be used, and the alignment of its tungsten filament. The loan agreement with MoMA stipulated that the few remaining original light bulbs, including the extras they have from 1964, *not* be used during the exhibition. After searching for available alternatives and testing new technologies such as LED and halogen 1,000W bulb equivalents, it was decided that a more exact replica could only be obtained by hand manufacturing. Dylan Kehde Roelofs, an incandescent light artist who trained as a chemical glass blower, was invited to Yale to consult on this issue. Roelofs first produced a much smaller wattage bulb in the Yale chemical glassblowing laboratory and believed, after some research and development, that he could produce a suitable 1,000W bulb matching as closely as possible the filament of the original General Electric 1M/T 20 P/AB bulb (fig. 4.7). He created two prototypes bulbs within a few months. The first prototype was kept burning for more than 500 hours, and was then put on a timer that turned it on and off every thirty minutes, as it is the on/off cycle that causes the most wear on tungsten filaments. After an additional 300 hours of burning, the clamp device holding the bulb failed and the bulb fell and broke on the concrete floor. Microscopic examination of the filament, however, revealed it was still burning when it broke: blue tungsten oxide ($W_{18}O_{49}$) crystals, which form around 700˚C, were evident. The tests far exceeded all expectations of the handmade bulb's performance, and twenty more light bulbs were ordered at a cost of $250 per bulb.

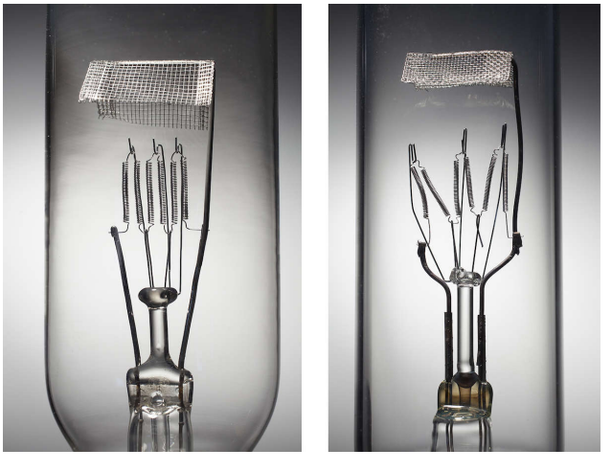

Figure 4.7. Manufactured and handmade 1,000W tungsten filaments.
Photo: Yale University Art Gallery.

Because the original Colorwall 30 rear projection screen provided by the Trans-Lux Corporation was deteriorated, yellowed, and brittle, a replacement screen had to be made. It is possible that the original was made from natural latex. Trans-Lux has agreed to search its archives and try to find a suitable replacement. New materials are available that increase the sharpness of the image and angle of focus, qualities that may be necessary in museum-gallery lighting conditions, where some ambient light is required for visitor safety. Research into rear projection screens continued as this paper went to press, but during treatment a sheet of high-density polyethylene was used for a temporary screen (fig. 4.8).

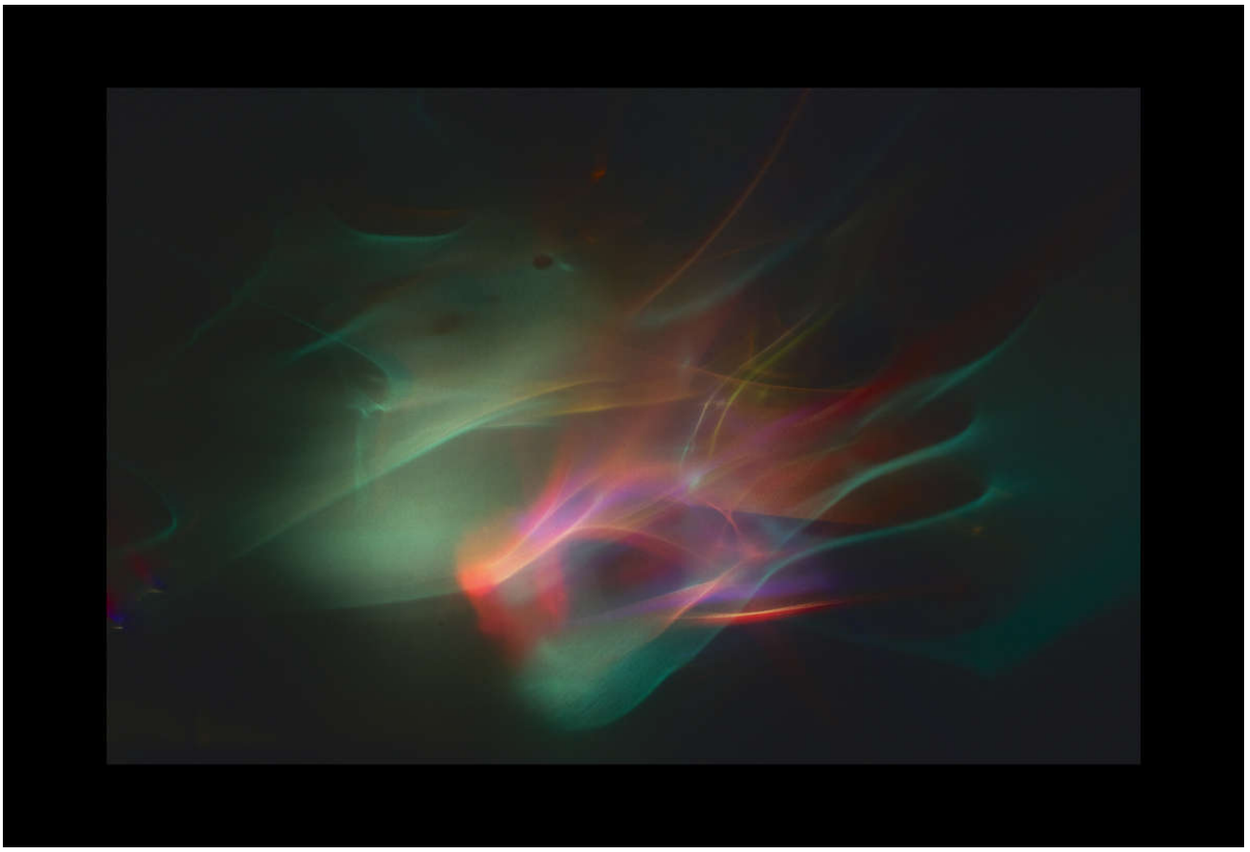

Figure 4.8. Thomas Wilfred's *Lumia Suite, Opus 158* during treatment.
Photo: Yale University Art Gallery.

A critical part of any treatment of kinetic art is documentation that includes high-resolution video. The Yale University Art Gallery is planning to do additional still-image and video documentation once an acceptable new screen is chosen. Simultaneous with the high-resolution video, several twelve-minute cycles of the work will be captured using multiple video cameras. Behind the screen, video cameras will film the mechanics of the various moving parts that create the projected image. Though Wilfred may not have approved of our revealing the

interior kinetic components that produced his lumia, this may be the only opportunity to document *Lumia Suite, Opus 158* from the inside out (fig. 4.9).

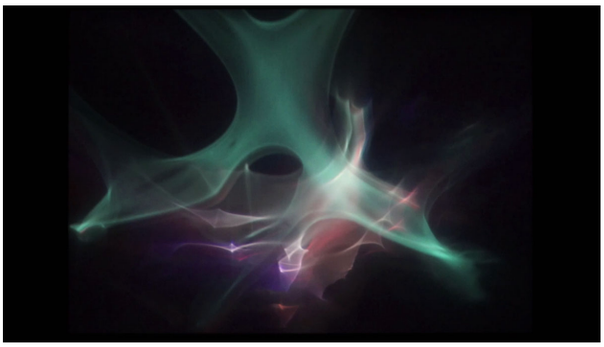

Figure 4.9. Yale University Art Gallery's video documentation of Wilfred's *Lumia Suite, Opus 158*. Museum of Modern Art, New York, Department of Painting and Sculpture, Museum Collection Files. Watch the video at https://youtu.be/h4PxDv_CFS4.
Video: Courtesy Yale University Art Gallery.

Wilfred's groundbreaking contribution to kinetic art and time-based media is finally being reevaluated through a long-awaited retrospective in 2017 and the scholarly consideration that accompanies such an endeavor. The exhibition would be impoverished without the inclusion of Wilfred's magnum opus, *Lumia Suite, Opus 158*. Our conservation and restoration of the physical and electrical components of this masterwork allow it to be safely exhibited for the first time in more than three decades, and the small upgrades ensure that the installation can be enjoyed long into the future.

✦ ✦ ✦

Materials and Suppliers

Extruded aluminum: manufactured by 80/20® Inc., https://www.8020.net; distributed by AIR, Inc., http://airinc.net/8020-extrusion.

Handmade tungsten-filament incandescent light bulbs: Dylan Kehde Roelofs, http://www.incandescentsculpture.com.

Coiled tungsten filaments: R. D. Mathis, Long Beach, CA, http://www.rdmathis.com.

Infrared camera for smartphone: FLIR ONE™, http://www.flir.com.

Notes

1. For a chronology of the idea and its various incarnations, see "Color organ," *Wikipedia*, accessed November 2016, https://en.wikipedia.org/wiki/Color_organ.
2. Most notable among these is Russian composer Alexander Scriabin's synesthetic symphony *Prometheus: The Poem of Fire* (1915), re-created in February 2010 by Anna Gawboy, a doctoral candidate at the Yale School of Music and scholar of Scriabin. See Yale Broadcast & Media, "Scriabin's *Prometheus: Poem of Fire*," 2010, accessed November 2016, https://www.youtube.com/watch?v=V3B7uQ5K0IU.
3. Film is excluded because it is not a direct projection of colored light.
4. Alice Armstrong, "Explorations in Light: Affinities of Color and Music," *American Arts Quarterly* 26, no. 1 (Winter 2009), available online at Newington-Cropsey Cultural Studies Center, accessed November 2016, http://www.nccsc.net/legacy/explorations-in-light. Wilfred was vehemently opposed to using music in his lumia: "Mr. Wilfred's clavilux has no connection with electronic instruments designed to transcribe sound or musical chords into color. 'The musical analogy is a lost cause,' he says. 'Sound and color are simply not equivalents.'" See Grace Glueck, "New Art Display 'Plays' On and On," *New York Times*, July 11, 1964, 22, in which Glueck interviews Wilfred and reviews his *Lumia Suite, Opus 158*, commissioned for the Museum of Modern Art.
5. "New Kind of Painting Uses Light as Medium," *New York Times*, December 8, 1931, 34.
6. Organized and presented by the Tate Liverpool, the exhibition traveled to the Kunsthalle Schirn Frankfurt, Kunsthalle Wien, and the Whitney Museum of American Art, New York.
7. MoMA accession number 166.1942.
8. MoMA accession number 133.1961.
9. MoMA accession number 582.1964.
10. Thomas Wilfred, letter to MoMA curator Dorothy Miller, January 6, 1965. Museum Collection Files, Thomas Wilfred, *Lumia Suite, Opus 158*. Department of Painting and Sculpture, Museum of Modern Art, New York.

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Wilfred 1964
Wilfred, Thomas. 1964. "*Lumia Suite, Op. 158* by Thomas Wilfred 1964. Lumia Composition in 3 Movements: A technical manual on the projection instrument rendering the composition, as installed at the Museum of Modern Art in New York City during June and July, 1964." Museum Collection Files, Thomas Wilfred, *Lumia Suite, Opus 158*. Department of Painting and Sculpture, Museum of Modern Art, New York.

5.

Cybernetic *Umbrella*: A Case Study in Collaboration

Carla Flack
Louise Lawson
Jack McConchie
Ming-Yi Tsai

Tate has a long history of displaying and treating kinetic works of art, each of which generates its own unique and challenging technical and ethical questions. *Umbrella* by Wen-Ying Tsai (1928–2013) highlights the many philosophical and ethical questions raised by the conservation treatment of kinetic artworks. In this paper we consider both the sculptural and technical aspects of the artwork as well as the need to determine the significant characteristics and properties, physical as well as behavioral, to be conserved. We also examine the philosophical and ethical challenges presented by the preservation of kinetic artworks when reviewed against the need for longevity and functionality.

These are complex questions, and we decided that a collaborative approach would lead to a successful decision-making process and informed outcomes. We discuss the collaboration between the institution and the artist's foundation, and its role in maintaining the difficult balance between artistic intention and technical functionality. We also explore the various skill sets (of conservators, technicians, engineers, and manufacturers) that were brought together to complete this complex project successfully.

The Context of Kinetic Art Conservation at Tate

Tate acquired its first kinetic work in 1951 (Lynn Chadwick's *Dragonfly*, 1951), and there are now approximately sixty kinetic sculptures in the collection, including mobiles, interactive works, and motorized works. Each artwork has its own complexities relating to display; therefore, conservation needs are reviewed on an individual basis and require a variety of implementation approaches. The following three sculptures highlight some, but not all, of the different approaches that could be applied to Weng-Ying Tsai's *Umbrella* (1971),[1] based on previous work within Tate conservation.

When Jean Tinguely's *Metamechanical Sculpture with Tripod* (1954)[2] was displayed in the 1990s, it needed daily repairs after short periods of movement.[3] The available options to strengthen the twenty-four loose joints, consolidate the flaking painted cardboard sections, and possibly perform certain reconstructions would mean that a large part of the original material would be lost. Furthermore, the "unpredictable" and "constantly changing" nature of the work, which is inherent to its interpretation, would be compromised. Therefore, the Tate decided to show the work as nonoperational when it was displayed at Tate Liverpool in 2009, allowing the original material to be retained. In this instance, the materiality of the sculpture, rather than its functionality, was viewed as the significant characteristic of the artwork.

The issue of the "auto-destruction" of kinetic works is a recurring problem; the very mechanisms used to bring the works to life cause their mechanical fatigue and trigger constant failures. In the case of Rebecca Horn's *Concert for Anarchy* (1990),[4] the successful longevity of the piece requires a stringent and regular maintenance plan. When the work was acquired, Tate was made aware of the various mechanical wear issues that would occur; for example, the pipes that pull out of the keyboard will

degrade and start to break if they are not regularly greased.[5] Conservators worked with the artist and, crucially, the manufacturers to assess what maintenance and servicing was required to ensure both the longevity of the work and the artist's intention.

Another example of Tate's approach to kinetic works is partial or full replication. Naum Gabo's *Kinetic Construction (Standing Wave)* (1919–20)[6] consists of a strip of metal made to oscillate, creating a standing wave, and this movement in real time creates the illusion of volumetric space. Gabo, known for having an interest in the life span of the materials he used, specifically chose those that he believed would last a long time. Also, and specifically for this discussion, he had an interest in the problems of mechanical fatigue with recurring display: "I, being interested in the preservation of that work, advised the Tate Gallery that it might suffer should it be lent to exhibitions" (Gabo 1969a).

Gabo used primitive techniques and reclaimed materials in the manufacture of *Kinetic Construction (Standing Wave)*, and it often failed during display. Despite many conservation attempts, it was decided in 1974 that a replica of the work should be made. During a discussion with his assistant, Charles Wilson, Gabo implied that "it was only the sculptural idea or image that was important … he personally did not attach any great significance to the notion of the original work of art" (Lodder 2007). Working in close collaboration with the artist, Tate produced a replica with the goal of re-creating the effect of the original without getting too far away from the original appearance.[7] The resolution of this work is important not only because of the collaboration with the artist himself but also because Gabo and *Standing Wave* strongly influenced Wen-Ying Tsai's artworks.

Wen-Ying Tsai's *Umbrella*

Wen-Ying Tsai (1928–2013) began to make cybernetic sculpture in 1966. Each sculpture consists of a number of stainless-steel rods set on a platform, vibrating at a constant rate of 20Hz to 30Hz (cycles per second). These vibrating rods are lit by high-frequency strobes that capture their movement, allowing the viewer to see them as slowly undulating standing waves. The standing waves appear to immediately respond to a loud noise—the clap of a hand or a loud voice—by quickening their motion (Alley 1981:730-31).

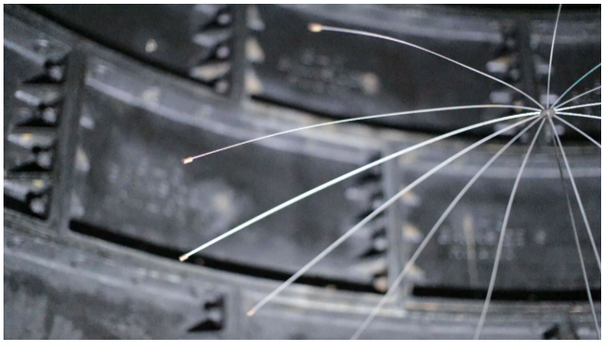

Figure 5.1. The central crown of *Umbrella*, 1971, by Wen-Ying Tsai, in action at Tate Modern's Tank Gallery, June 16, 2016–February 5, 2017. Watch the video at https://youtu.be/gj42ZITk7EM.
Courtesy Tsai Art and Science Foundation. Photo: © Tate, London 2016.

Figure 5.2. The central crown of *Umbrella*, 1971, by Wen-Ying Tsai.
Courtesy Tsai Art and Science Foundation. Photo: © Tate, London 2016.

Tsai's *Umbrella* (1971) (fig. 5.1) is composed of a round concrete base with a small, centrally mounted 230V Bodine motor. Attached to the mounting brackets, at the top of the motor, is a disk of phenolic resin that supports a vertical stainless-steel rod (fig. 5.2). At the top of this main rod is a smaller phenolic-resin disk, the central "crown," from which thirteen thinner stainless-steel rods emanate, reflecting the armature of an umbrella. The ends of each of these rods have an additional "weight" of phenolic resin, which makes the rods bow slightly downward when motionless but balances them to move harmonically when operating. The motor (fig. 5.3) has an eccentric, off-axis weight that, when spinning, causes harmonic standing vibrations to pass through the vertical stainless-steel rod to the weighted phenolic-resin tips at a frequency of 1,465 rpm (revolutions per minute). The continuous pulse rate of the strobe light is slightly slower, and the stroboscopic effect causes the vibration of the steel rods to appear to oscillate at a frequency of approximately 1Hz. A

microphone provides feedback to the strobe unit, and noise such as speech or a hand clap can alter the pulse rate from its rest state of twenty-four pulses per second to around eighty-five, making the sculpture appear to speed up.

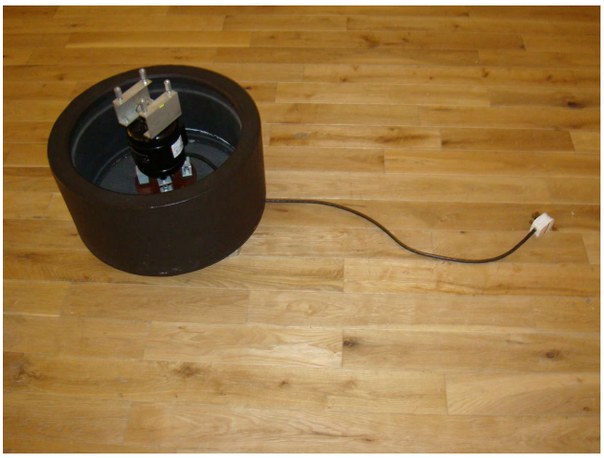

Figure 5.3. The motor of *Umbrella*, 1971, by Wen-Ying Tsai. Courtesy Tsai Art and Science Foundation. Photo: © Tate, London 2016.

When Tate acquired *Umbrella* in 1972, the conservation department gathered information to find ways to ensure the longevity of its display. In particular, the artist mentioned that the bulb for the strobe light unit had a life expectancy of 300 hours, so Tate acquired addresses of suppliers. The work was briefly on view in 1972 and 1979, but it was removed from display on both occasions due to a mechanical fault and the breaking of a rod that forms part of the central crown.[8] In 1979, the artist provided additional operating instructions. There was intermittent communication between Tate and the artist throughout the 1990s, which culminated in the first stage of treatment in 2003, the replication of the central crown.

The central crown's broken rods meant that the work could not be displayed, and the 2003 treatment focused on replicating this component. A collaboration with the artist, the curator, and Jonathan Benthall, an art historian and longtime friend of the artist, resulted in the following treatment guideline: "That the piece be looked on as a unity. Interventions are secondary and should not be obvious. Construction is much more important than the object's authenticity." This closely echoes Gabo's philosophy for his *Standing Wave*.[9] With this in mind, the Tate conservation team decided to make a replica crown from original materials (as much as possible) and closely followed the size, weight, and characteristics of the original central crown.

Subsequently, the work was put into storage until 2014, when it was reviewed with the hope that it could be placed on view in the new Tate Modern. The challenges of displaying the sculpture were revisited, and the review considered a range of options for the artwork's components: the central crown, the strobe unit, and the audio control unit. Some parts had failed previously, and others are now considered obsolete, irreplaceable technology. To ensure that the public could fully enjoy *Umbrella* at the Tate Modern, we focused on operability, reliability, and longevity, with each component considered in detail and in relation to these criteria. The viewpoint of the artist's foundation is central to Tate's decision-making process, and the process of ensuring that a kinetic sculpture is functional is complex and challenging. The role of the conservator is to understand where these challenges arise and engage in conversations to ensure a successful outcome (Lawson and Cane 2016).

Collaboration

Collaborating with the artist's foundation and our various conservation teams (and considering our various working practices) was central to the delivery of *Umbrella* to the Tate Modern. Work with the Tsai Art and Science Foundation began in early 2016 with Ming-Yi Tsai, the artist's son and a foundation board member, and later included other members of the foundation (fig. 5.4). This was the first time Tate and the foundation had worked together, and it was important to establish a relationship based on trust and clear communication, with an understanding of Tate's commitment to the care of the sculpture. The initial meeting included viewing the sculpture and discussing both the foundation's and Tate conservation's concerns. The emphasis was on ensuring the sculpture's longevity and functionality balanced against the artist's intent and conservation philosophy.

Figure 5.4. Tate conservation manager Louise Lawson and Ming-Yi Tsai, the artist's son, at Tate during the initial meeting in January 2016.
Courtesy Tsai Art and Science Foundation. Photo: © Tate, London 2016.

The members of the conservation team had skills that addressed the sculpture's material and technical aspects. Outside experts in programming and lighting were brought in to ensure that all the perceivable requirements for conservation work on *Umbrella* were addressed.

The collaboration focused on the central crown, strobe unit, and audio control unit. The central crown, as mentioned previously, was replicated in 2003. The lamps for the strobe unit are no longer manufactured, and contemporary substitutes do not fit into the lamp's housing or strobe enclosure. Furthermore, both the strobe unit and the audio control unit are of aging technology, and need to be conserved as a reference. This led to the following proposal:

> A "backup" central crown would be made in case of failure while on display.
>
> A strobe light unit would be manufactured to replicate the light and pulse rate. This could be housed in a unit similar to the original, thereby retaining its aesthetic.
>
> A new audio control unit would be manufactured. It was agreed that the foundation would undertake this work as a prototype that could later be used for other Tsai sculptures.
>
> A display/installation specification would be formulated that addressed the artist's intention as well as current health and safety regulations.
>
> Communication with the foundation would be maintained at all times, to ground all treatment with the artist's intent.

The conservation team and the foundation agreed that one backup would be made for the previously replicated central crown. Although the original central crown and its stainless-steel rods are beyond repair, they are available as a reference, along with the replicated central crown. Ming-Yi Tsai commented that "his father used a structured, 'intuitive' process to make each element"[10] and highlighted the uniqueness of each rod. Research confirmed that the rods are likely stainless-steel welding rods, and each rod was weighed and measured so an accurate copy could be made. The central disk and each phenolic-resin weight were handmade to mimic the original manufacture.

There is an ethical debate about having a series of backup components for the central crown. A backup is viewed as an element that can be decommissioned, and the backup crown was called such from the outset, as it is not possible to quantify its life expectancy. Rather than have multiple broken central crowns, the team decided to give the reserve component temporary status. The concept will be reassessed once further data is obtained from having *Umbrella* on display.

As already stated, lamps for the original strobe unit were no longer available. Rather than make significant modifications to the original strobe unit to accommodate modern lamps, the team decided to keep it in perpetuity as a reference and comparison and re-create the component. As part of the original strobe's preservation, all of its significant technical and aesthetic characteristics were documented for future reference and use.[11] These characteristics played a vital role in the creation of a new unit, which was undertaken with the collaboration of a strobe specialist. The new strobe unit is visually identical to the original, but it functions with LED lights that closely match the original color. The original strobe unit can be used for side-by-side comparisons with any re-created item, but it has fewer than 300 lamp hours remaining.

The Tsai Foundation re-created the audio unit, since there are many different types of audio control units for

Tsai's sculptures. Each needs to operate at a base frequency and respond to the microphone's audio inputs to generate various higher frequencies, which are outputted to the strobe. The exact characteristics of the original control box are currently being mapped and replicated into a modern control unit using an Arduino microcontroller. This unit is reprogrammable and can be adapted to many of Tsai's works.

The treatment of each component enabled the sculpture to be displayed at the new Tate Modern when it opened on June 17, 2016. The work was initially installed according to the artist's specific written instructions; however, now set against a black background, it seemed visually very different compared to its previous installation against a white background. The visual effect for the viewer was more muted, as the original high positioning of the strobe light limited its reflection off the moving rods. Against the white wall, the darker silhouettes of the rods had been easy to discern. When foundation members viewed *Umbrella* with the conservation team, they were fully able to assess the effect of the artwork. As a result, the strobe unit was placed in a lower position to more effectively illuminate the central crown and capture its undulating movement. This alteration was captured within the conservation documentation.

Conclusion

At the outset, the collaboration aimed to ensure the longevity and functionality in both the display and long-term preservation of *Umbrella*. This was achieved through the analysis of previous treatments of kinetic works at Tate, which helped inform the conservation strategies for Tsai's artwork. Through the realization of the project and the conservation treatment, *Umbrella* is now functional and displayable. The work's longevity has been achieved through the creation of a new strobe unit and a new audio control unit, both of which were constructed using durable and replaceable digital and solid-state technologies. This was also an opportunity to further document the work and define and capture its significant characteristics, which can be used to re-create any of *Umbrella*'s three major components.

The project was successful primarily due to the ongoing collaboration of all parties involved, both external and internal to Tate, including the artist's foundation, Tate curatorial, and Tate conservation (both sculpture and time-based media). The artist's family and foundation provided advice and guidance and considered every recommendation. It was important to have continuous and transparent dialogue but also to meet in person and establish trust as we progressed with the work's treatment. Tate curators guided the overall preservation process and the realization of the display into the new Tate Modern, and they were essential to informing the conversations about the artwork. Finally, Tate conservators provided a range of conservation strategies to consider and actively guided and carried out the treatments. The collaborative approach, and the engagement of each person involved, was essential to *Umbrella*'s installation at the new Tate Modern, forty-four years after its acquisition.

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Acknowledgments

We thank the Tsai family and the Tsai Art and Science Foundation for their ongoing support and insight. They made this a truly remarkable project to be a part of, and we are very proud of what we achieved collectively.

Notes

1. Tate, T01521.
2. Tate, T03823.
3. F. Herzog, personal communication, Tate, London, 2009.
4. Tate, T07517.
5. T07517 artwork file, Tate, London, 2000.
6. Tate, T00827.
7. Tate Conservation, "*Naum Gabo, Kinetic Construction (Standing Wave)*, 1919–20, replicas 1968, 1975, 1983, 1990," Tate, London, 2010.
8. D. Pullen, internal memorandum, Wen-Ying Tsai T01521 artwork file, Tate, London, 1993.
9. S. Joyce, conservation notes, Wen-Ying Tsai T01521 artwork file, Tate, London, 2001.
10. Ming-Yi Tsai, personal communication, Tate, London, 2016.
11. Tate Conservation, "Internal Report: Significant Characteristic Report, Strobe Unit," Tate, London, 2016.

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6.

Moving with the Times: The Refurbishment and Restoration of a Choreographed Robotic Arm

Sherry Phillips
Marcel Verner

As Yet Untitled (1992–95), a robotic arm and photograph installation by Toronto-based artist Max Dean (b. 1949), was a critical success from its first exhibition, but it is also a temperamental and unreliable machine. The refurbishment project for this kinetic work at the Art Gallery of Ontario (AGO) was initiated by a loan request from a Montreal gallery for a 2013 exhibition. Like most variable-media works of art, *As Yet Untitled* challenged the traditional framework for the conservation of art. To successfully restore it to working order, a volunteer mechatronics engineer and the artist provided crucial support for conservation staff.

Introduction

Without loan requests, some of the most fascinating and challenging conservation projects would end up languishing on to-do lists. Complex projects tend to be event-driven rather than the result of strategic long-term planning (Smithsonian Institution 2010). The restoration of *As Yet Untitled* began in 2013 with a loan request from VOX, Centre de l'Image Contemporaine, a leading public gallery in Montreal. To loan the work, the Art Gallery of Ontario (AGO) had to ensure that it would operate reliably and without constant repairs. A review of the artwork's file revealed that *As Yet Untitled* had been popular, engaging, and a critical success but was also considered a temperamental and seemingly incomprehensible machine.

The robotic arm and photograph installation *As Yet Untitled* (1992–95) was created by Toronto-based artist Max Dean (b. 1949). It was first exhibited at the AGO in 1996 and eventually acquired as part of the permanent collection in 2007, with full knowledge of its history and the challenges it presented. Before coming into the collection, the piece had toured internationally with Dean and his technical assistants.[1] As with most kinetic art, maintenance is essential to the operation and appreciation of the piece. *As Yet Untitled* was developed and constructed in the artist's studio with a team of mechanical and computer specialists, whom Dean describes as "tinkerers."[2]

Overview of the Installation

In *As Yet Untitled* (fig. 6.1), found photographs are presented to the viewer by a robotic arm. The motion is relentless; the robot operates whether or not someone is present. The arm is programmed to pick up a photograph from the feeder on the right, present it to the viewers, and then wait a few seconds for a response before proceeding. Viewers can intervene by covering one or both of the hand silhouettes in front of them, and the robot will place the photo in an archive box on the left. Should viewers choose not to act (or if no one is present), the robot will place the photo in a shredder, and the shredded photo will be conveyed to a pile. The robot runs continuously when the gallery is open to the public.

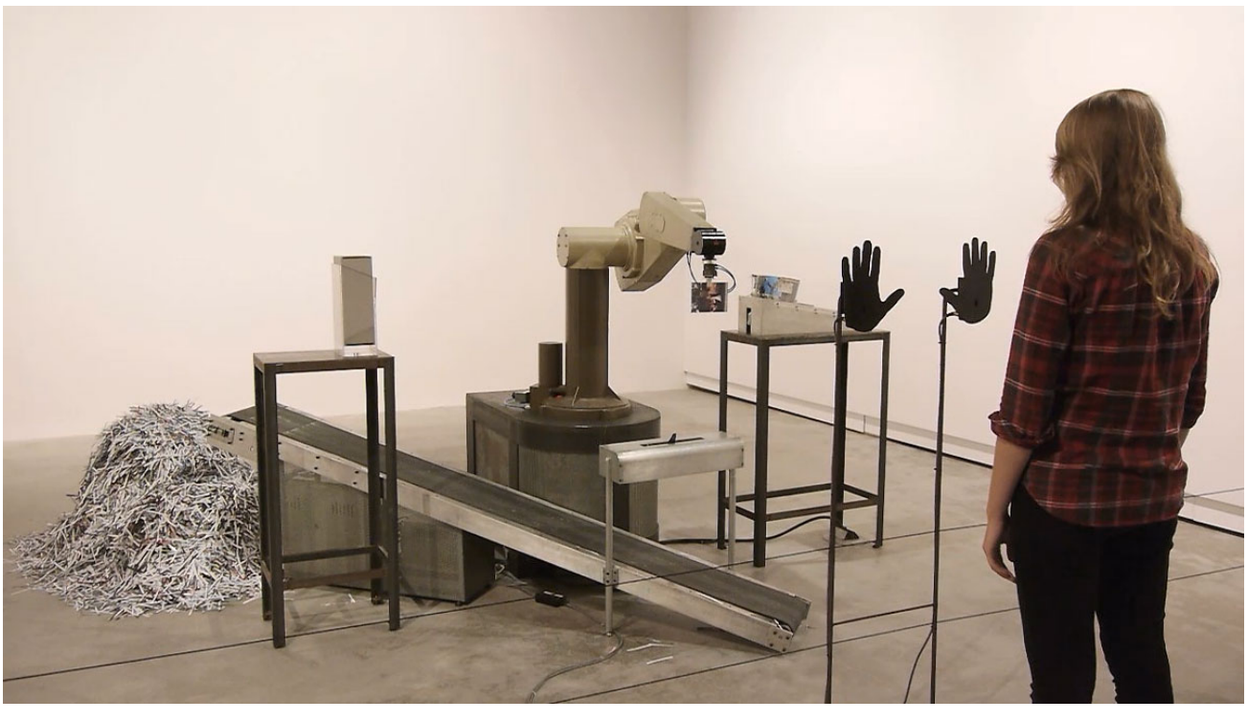

Figure 6.1. Max Dean's *As Yet Untitled*, 1992–95, on view in *Drone: The Automated Image* at VOX, Centre de l'Image Contemporaine, Montreal, September 7–October 19, 2013, during *Le Mois de la Photo à Montréal 2013*. Installation from the collection of the Art Gallery of Ontario. Watch the video at https://youtu.be/h5mMCqOLACo.

What do strangers—the viewers observing the robot's presentation—choose to do with someone else's memory embodied in the photograph: save it or shred it? *As Yet Untitled* explores technology and obsolescence, trust, power, connection, and the relationship of the viewer to the machine.

The installation is reminiscent of a choreographed performance, and the actions in the performance should be precisely replicated each cycle. The robot's joint positions are like gestures, and the sequence of motion is like a dance; all are controlled by the program, which is composed of lines of code, a numerical quantification of movement. The code specifies points in space, geometric coordinates that define the dance composition, which can be captured like a performance score with the state machine diagram, a flowchart of actions describing the behavior of a system governing the operation of the artwork known as *As Yet Untitled*.

As Yet Untitled had not been installed for several years and had the reputation of being unreliable. Fortunately, the artist is based in Toronto and was keen to participate in the project. He is remarkably well connected to a diverse community of professionals and was able to reach out to Marcel Verner, a systems engineer with a strong commitment to volunteerism. Sherry Phillips readily acknowledges that the restoration project would not have been possible without Verner's generous participation and Dean's patience with the minutiae of restoration. Verner in turn knew of Richard Voyles, whose company, Mark V Automation Corp, specializes in retrofitting PUMA (Programmable Universal Machine for Assembly) technology originally developed by Victor Scheinman, but later manufactured and distributed by Unimation, the world's first robot company. In addition to this happy confluence, VOX, the gallery in Montreal that requested the loan, was willing to share in the cost of the restoration.

Stage One: Opening the Crates

As we began to work more deeply with the components, we realized that there would be two stages to the restoration process: pre- and post-exhibition at VOX. Stage one focused on bringing *As Yet Untitled* to a minimum level of viability for the loan. Various components of the installation still worked, but the robot controller was nonfunctional, and the original operational program was obsolete. We repaired or replaced some mechanical aspects of the installation, specifically the air compressor and conveyor motor, and installed upgraded software and safety protocols, but the artwork would still require

considerable support through the entire exhibition. All studio-built furniture components such as stands or supports were in excellent condition with no need for intervention.

Stage two would begin when *As Yet Untitled* was returned to the AGO; that is, completing the programming and, ultimately, amending the robot's unfortunate reputation.

Preparing the robot and installation components for loan was a logistical challenge. We were awash in unassembled and scattered components, too many for the conservation studio. We used empty gallery spaces, but we were displaced four times before our work was complete (fig. 6.2).

Figure 6.2. The nomadic conservation studio working in one of four free gallery spaces.
Photo: © 2017 Sherry Phillips.

Photographs

Originally the supply of found photographs was sourced through unclaimed stock at photographic developing shops or through donations. Newly sourced photos for the loan to VOX, however, produced an unexpected complication: contemporary photo paper has a different texture than the photo paper commonly used in 1996, and the photo separator tabs on the front edge of the feeder could no longer reliably separate the photos. The shredder can manage up to three photographs without jamming but, ideally, only one photo at a time should be presented to the visitor. A colleague with experience working in mail rooms recalled that envelope sorters use brushes to separate mail. Using a band saw, we cut a new bristle brush into single rows and attached them to the delivery end of the photo feeder. This worked well. This solution was intended to be temporary, but Dean felt the change was in the spirit of the piece so the brushes remain in place.

Photo Feeder

Pneumatic technology is used to pick up the photos in the mechanical feeder as well as to supply air to the robot gripper. The air compressor is located under the conveyor belt. Ideally, a single photograph is brought forward by the pneumatic suction cup and picked up by the robot gripper.

Dean supplied two air compressors but neither one worked; we acquired a new compressor of the same brand. Our reasoning for replacement was simple: for some components, it's much less expensive to replace than to repair. The new model doesn't quite fit into the available space under the conveyor, but it is much quieter than the original. Dean's original choice of compressor was based on the quietest unit then available so viewers can better focus on the robot. We decided not to adapt the conveyor stand to hide the larger compressor; the slight extra length of the new compressor is not visible from the viewer's main vantage point and an intervention would have involved a substantial rebuild.

Hands

Photoelectric cells are embedded in the silhouettes of the hands. The sensors register a visitor's intervention (the action of covering one or both hands) to signal the robot to archive a photo. If the hands are not covered, the robot shreds the photo.

Archival Box

Photos selected for archive acknowledge the visitor's conscious decisions to save specific images, and these are stored post-exhibition as archival material.

Shredder and Conveyor

The conveyor belt and motor are commercially sourced but custom sized for the installation. The original conveyor motor was refurbished by an outside company. The seals had decayed, and oil had leaked while the artwork was in storage. Changing our storage approach to establish a maintenance protocol—that is, rotating the unit to redistribute the oil and preserve the seals—will improve the preservation of mechanical elements.

The average shredding capacity of the robot is eighty photos (4 × 6 in.) an hour. There are two paper shredder

units, and both are currently in working order. They could be replaced with new models provided they fit into the studio-made shredder housing and create long strips of photographs. Shredded photos are discarded discreetly at the end of the exhibition period.

Robot, Controller, and Software

Dean chose a Unimation Puma 550 industrial robot arm with a gripper attachment mounted on a studio-built metal stand. These robots—relatively simple to program, operate, and repair—can still be found in robotics classrooms as teaching tools. Dean originally thought he would build his own robotic arm but chose the Puma 550 after a visit to Antenen Robotics in West Chester, Ohio.

The robotic arm appeared to be sound mechanically and only required general maintenance, including re-greasing the joints. Grease in robot joints can leak, and some residue on the exterior of the arm case seems to be inevitable. These joints should be moved and greased regularly.

A chassis unit containing the controller, computer and monitor, and I/O (input/output) module slides under the robot stand and is accessed by the operator from behind the robot. The I/O module and circuits (fig. 6.3) are connected to the controller, receiving or generating signals to the feeder, shredder, and robot arm. The computer manages the software program that contains the commands controlling the action of the robot.

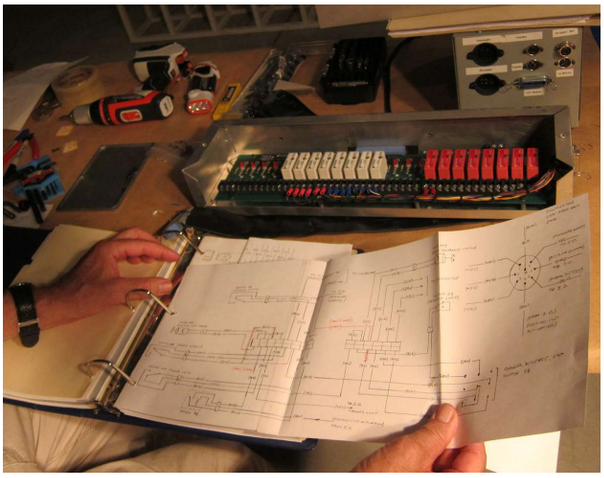

Figure 6.3. Assessing *As Yet Untitled*'s I/O board.
Photo: © 2017 Sherry Phillips.

The 1980s-era Unimation Puma 550 robot was initially controlled by a closed, dedicated, terminal-based architecture similar in structure to a mainframe computer system. Its sequencing was programmed in Variable Assembly Language (VAL), a novel language in its time but now obsolete. Dean and his tinkerers had scripted the original operational program—that is, the choreography for *As Yet Untitled*—in VAL. The controller houses the computer unit, power supplies, and servo amplifiers needed to power the robot's joint motors. Over the years, while touring with Dean, the unit experienced several hardware failures, necessitating upgrades that removed the mainframe hardware and replaced it with laptop-based emulators, while still allowing the VAL script to be preserved.

Ultimately, a hardware failure in the original controller meant that it was no longer suitable for use and needed to be replaced. The options were to replace the Unimation controller or to change the architecture to something more contemporary. While it was technically possible to get a refurbished or used replacement, it would not have been cost effective, and the age of the hardware meant that there was significant risk that it would not be successful. Switching the controller architecture to a commercial off-the-shelf (COTS) design would be more cost-effective and increase the unit's reliability and sustainability.

The new controller from Mark V Automation was hardwired to the existing robot interface, and it replaced the motor-power amplifiers with commercially available amplifiers based on open standards. All signals to and from the robot pass through the controller and perform real-time calculations that control the arm's movements and positions. The operational program on the computer is transmitted to the robot through the controller.

The controller's software platform was based on Mark V Automation's recommendation for use with their hardware. The computer runs MS-DOS, an extremely efficient operating system that allows for simplified, low-level device control. Even though MS-DOS is technically obsolete, its very lightweight system overhead still makes it favorable for embedded systems control. The Puma control software is written in the C programming language, using open standards and reusable device drivers and components. This selection in programming techniques ensures that the source code will be part of the piece and archived. If there is future need to revise the software, it should pose no challenges.

The purchase of the new controller, a cost-effective means of updating and refurbishing the artwork, is within Dean's COTS concept. There should be no artist's quirks in the build or program. Reentering the code in contemporary programming language with new components also aligns with the artist's design/build strategy; the operational part of *As Yet Untitled* is off-the-shelf, not a custom build with personalized circuit boards

and mechanical components that need to be preserved.

The original scripting of the commercial software in the 1990s had not been migrated, nor had the sequencing been extracted in a format readable by humans; the software resided on two laptops of questionable operational status (fig. 6.4) and a set of floppy disks. The artist's belief in multiple redundancies paid off: it was possible to retrieve the sequencing choreography and software flow of the installation from one of the laptops. This information was converted to a state machine or flowchart of actions (fig. 6.5), software-speak for a flowchart describing the behavior of a system that governs the operation of the exhibit that the viewer experiences as *As Yet Untitled*. The sequencing experienced as *As Yet Untitled* was re-sequenced using the new robot control software.

Documentation

We created two manuals: one for a programmer and another for a relatively nontechnical installer. The programmer manual will assist in the identification of communication links and faults between components and controller. The installer's manual is image heavy, with a lot of repetition to the instructions.

Figure 6.4. The value of multiple redundancy: one of the two original laptops was still in working order, which enabled successful program recovery.
Photo: © 2017 Emily Nichols.

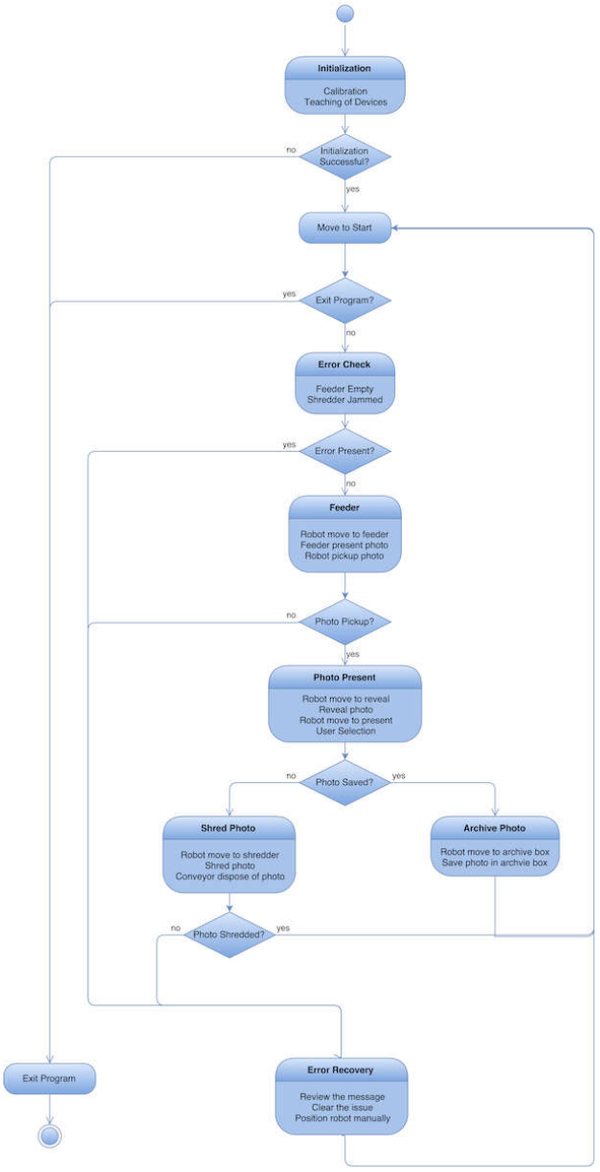

Figure 6.5. The state machine or flowchart of *As Yet Untitled*.
Photo: © 2017 Marcel Verner.

Stage Two: Post VOX

As Yet Untitled operated reliably in Montreal—daily for more than seven weeks—and was monitored by an in-house installation technician (with telephone and e-mail access to the project engineer for advice), but the program and refurbishment was not complete.

Robot

After the robot returned to AGO, coding and subsequent testing of commands in the script eventually revealed that index pulses were not working properly. Marcel Verner

found the root cause in failing encoder signals in arm-joint motor number 3. An encoder is an electrical device used to measure position in space, and index pulses, also called reference pulses or points, are signals generated by the encoder. We could either replace the malfunctioning joint motor or try to write the code around it and maintain a temperamental machine; we opted for replacement.

We also realized that a significant reason for the machine's unfortunate reputation was that its position never returned to "zero" after each session. The Puma 550 does not know or remember where it is in space upon start-up; it must be programmed to perform a calibration routine to ensure the program can be precisely replicated for each operational session. Failure to have the machine recalibrate over several installations had created a domino effect of missteps and deviations in its operation, with subsequent repairs or resets. Appropriate maintenance routines and installation protocols are only possible with a thorough understanding of the machine.

The original laptops and controller are in storage. They are now part of *As Yet Untitled*'s history. The new controller produced by Mark V Automation and the newly written software may undergo the same fate someday.

Sequencing of Motion

As Yet Untitled's original 1996 performance at the AGO and its subsequent installations were not fully documented. Dean's participation in preparation for the loan to VOX, however, meant that we were able to build upon the program extracted from the old laptop.

It was necessary to change the original motion routines to better align with the actual limits of the machine and the program. A new start-up process for alignment of components has been added, as well as a few subtle changes from the original choreography, because the original performance was not coded in accordance with the robot's functional limits. Dean fully supports the variation and believes that an enriched understanding of the machine through a specialist engineer's participation has led to overall improvement in its operation and function and, consequently, performance. We adjusted, for example, velocities and joints. The arm's original motion—a single sweep, with a large wrist flip from feeder to presentation to the viewer—resulted in slow speed, a droop in the arm, and a jerky motion at the waist joint. The motion was changed so that the wrist flip occurred at the conclusion of the arm sweep, resulting in a smoother, slightly faster arm sweep and concluding with a smaller wrist gesture before the final extension and presentation to the viewer.

Safety

Some changes to the installation were necessary for health and safety. Working to provincial electrical safety standards is AGO policy, and we also reviewed industrial safety standards for robotic installation. Two emergency stops have been added, one on the controller, another on an auxiliary box; the latter is meant to be moved to an accessible location during operation of the piece. At least two people must be involved in the installation, and there must be an attendant close to the robot at all times.

Stanchions and cord to indicate a perimeter barrier are original to the piece. These will be maintained, but we are now in conversation about options for adding an industrial-type perimeter safety feature, such as a light curtain and intrusion-detection technology. It is important to remember that the robot cannot sense that someone is in the way; it could do serious harm. Insurance, risk tolerance, and inspection by external safety authorities are real considerations.

We maintained programmed responses to unexpected variables, like a jammed shredder or no photo pickup. This seems like improvisation and contributes to the tendency of visitors to anthropomorphize the robot, to believe the robot is thinking and responding. Now, however, error prompts are coupled with instructions for the operator in accessible language on the monitor at the back of the work and supported by instructions in the operational manual (fig. 6.6). The robot also has its own Gmail and Dropbox accounts so that software updates and troubleshooting can be performed remotely if required.

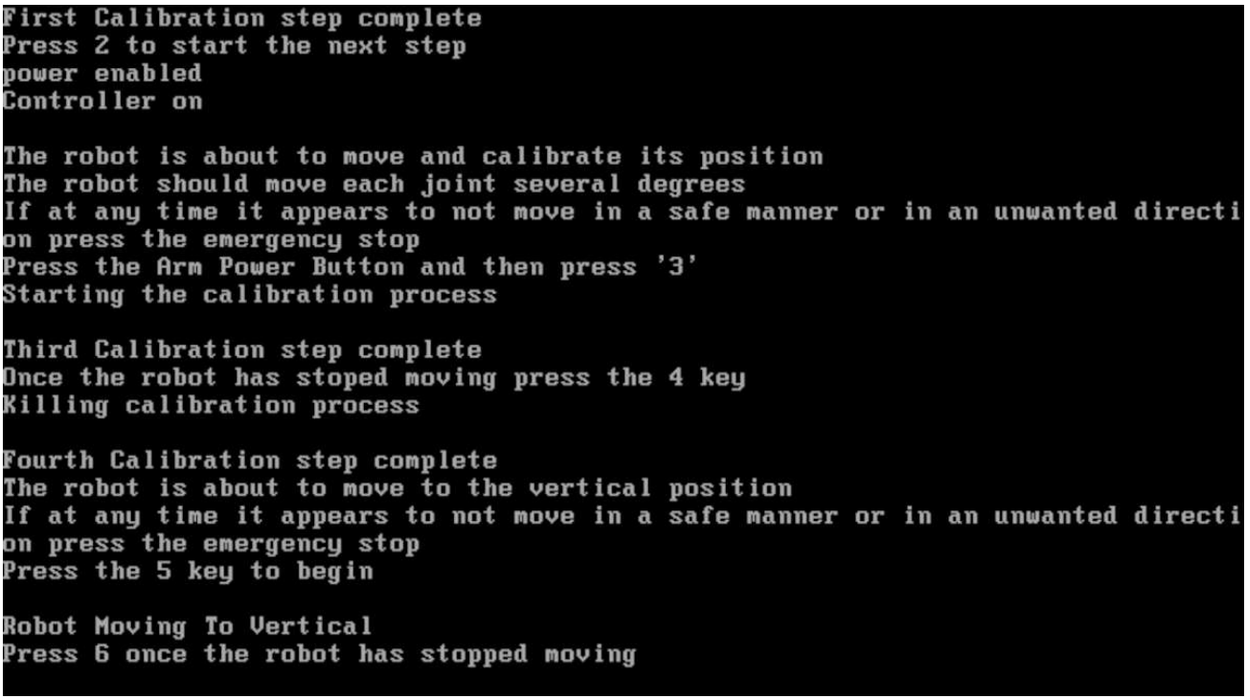

Figure 6.6. A screenshot of the updated language between the installer/operator and the robot.
Photo: © 2017 Marcel Verner.

Future

There is no current need to replace the robot or other major components of the installation, but the artist has said it is an acceptable option. Working closely with the artist means we can record his tolerances for future preservation strategies.

The industrial look of the arm, its choreography of movement, and the potential for viewers to anthropomorphize the robot are essential, but the styling of the Puma arm and its control unit is considered secondary. Dean originally chose or designed the various components of the installation because they are COTS; they are meant to be repairable or replaceable—that is, "future-proof."

Artists and their studio assistants may develop a project with incomplete knowledge of the technology. Dean acknowledges this was true for *As Yet Untitled*, and we addressed this deficit under his guidance while maintaining the installation's original appearance. An evolution of the piece is inevitable, as the technology and components needed to support the kinetic installation change over time. Robotics and the associated mechanics or electronics are simply a means of solving a problem for Max Dean, not an end in themselves.[3]

If there is a major shift in computers/robotics, equipment, and software, then all processors, the I/O board, and written software may have to be replaced. Any program or computing language compatible with robots in general should work as long as the programmer follows the state diagram and documented lines of code. We have been able to largely preserve the original integrity of the installation; our future colleagues may be faced with very different decisions, but they will be guided by documentation of Dean's intention. There is a range of options for future decisions on behalf of *As Yet Untitled*, options that ultimately are to keep the work kinetic.

Conclusion

According to Max Dean, this restoration project took *As Yet Untitled* to a state that he would have wanted in the original but which his early team of tinkerers was incapable of realizing.[4] Our project has resulted in an iteration of the original computer program. It is a version of the old, based on a clearer understanding of the machine and with new and necessary safety features. The artist's collaboration on the project, together with a conservator's tendency toward restraint and an engineer's ingenuity, meant that the result is not an interpretation or relic of the original, but rather a reliable and robust performance by the original mechanical components. Working collaboratively with specialists and the artist was

necessary and complicated but also professionally and personally enriching.

If the restoration of *As Yet Untitled* had not been completed after the Montreal loan, it would have been difficult for others to pick up where we left off, and appropriate restoration may have been impossible. Like any kinetic object, it will remain susceptible to mechanical wear and tear. As the original components age, and as replacement parts become obsolete, the robot may even regain its temperamental attitude. Building on our work, however, a new team should be able to face the challenge with confidence.

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Notes

1. Art Gallery of Ontario, Canada, 1996; *d'APERTutto*, Venice Biennale, Italy, 1999; *The Fifth Element*, Städtische Kunsthalle Düsseldorf, Germany, 2000; *Voici: 100 ans d'art contemporain/ Look: 100 Years of Contemporary Art*, Palais des Beaux-Arts, Brussels, Belgium, 2000; *Quality Control*, Site Gallery, Sheffield, England, 2001; *Iconoclash*, ZKM, Karlsruhe, Germany, 2002; *The Bigger Picture*, Ottawa Art Gallery, Ottawa, Canada, 2003; *Damage Done: Materializing the Photographic Image*, Prefix, Toronto, Canada, 2005; *Drone: The Automated Image*, VOX, Centre de l'Image Contemporaine, during Le Mois de la Photo à Montréal, Canada, 2013.
2. Sherry Phillips, in conversation with Max Dean, AGO, 2015.
3. Langill 2006, Question 4.
4. Sherry Phillips, in conversation with Max Dean, April 8, 2016.

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Part 3. Collections/Artists' Oeuvres

7.

Takis and the Fourth Dimension

Erin Stephenson
Kari Dodson

In 2012 Greek artist Takis (b. 1925) became the focus of a collaborative project between the curatorial and conservation departments of the Menil Collection. Takis uses magnets and electrical components to create static and kinetic three-dimensional art that explores the energies of an invisible fourth dimension. The project addressed the challenges and complexities that often arise when working with a living artist, including balancing the artist's preferences with the ethics and standards of traditional conservation practice. The ability to achieve that balance resulted in the first survey exhibition of the artist's work in the United States.

Introduction

Takis is known for his investigations into the relationship between art and science. His earliest works include bronze forms focused on concepts of force and volume. Later he began his ongoing Signaux series with the development of wind-activated antenna-like structures inspired by radio and radar apparatuses. In the late 1950s he began including magnetism in his paintings and sculptures, employing electromagnets to fix objects in space, generate motion, and elicit sound. A common thread in Takis's work is an element of aesthetic disinterest in prioritization of concept. This is evident in his experimental use of found objects, unconventional materials, and aggregate technologies and mechanics.

A curatorial research project prompted the Menil conservation department to take a closer look at Takis's works in the collection. This interdepartmental collaboration in turn led to an interview with the artist and treatment of several of his works in preparation for the exhibition *Takis: The Fourth Dimension* (2015). Takis's frequent experimentation, combined with the inherent imperfections and inevitable obsolescence of his materials, necessitated ongoing conversations with the artist regarding the relationship between his artistic vision and the practical requirements of exhibiting such works.

Takis

On the afternoon of January 3, 1969, Takis and a group of his peers walked into the Museum of Modern Art (MoMA) in New York, collected one of his works on display, and carried it into the museum garden, where they staged a sit-in.[1] This event was to protest the piece being included in the exhibition *The Machine as Seen at the End of the Mechanical Age*. John and Dominique de Menil had donated the work to MoMA, and the museum, as owner, had the right to exhibit the work at its discretion. However, Takis felt the piece did not represent his current aesthetic and believed he should have control over its display, regardless of who owned it. The purpose of his demonstration was to prompt open dialogue between "museum directors, artists, and the public" regarding museum policy and artists' rights. Ultimately, MoMA agreed to remove the piece from the exhibition, and the event served as a catalyst for the formation of the Art Workers' Coalition—a group of creatives, critics, and museum staff that campaigned for museum reform, particularly in regards to artists' rights (Lippard 1970).

Takis left New York a few months later, but the ripple effect his actions had on the arts community was profound. This story is an effective example of his character and illustrates the strength of his conviction regarding the treatment and display of his artwork.

Takis was born Panagiotis Vassilakis in Athens in 1925, during a time of political strife in Greece. His family was poor and was forced to endure an oppressive dictatorship, the Axis occupation during World War II, and a catastrophic civil war. Takis was intelligent and motivated from an early age, but lacked the means for a formal education. He taught himself by reading about subjects such as science, mythology, philosophy, religion, poetry, and the arts. Seeing the work of artists such as Giacometti and Picasso led him to the decision to become an artist—a choice that resulted in a long and prolific career of inspired manifestations of the subjects he studied (Takis, Jouffroy, and Hoctin 1964).

Now more than ninety years old, Takis is still expanding the depth and breadth of his oeuvre. Once he adopts a new idea or technique he will adapt and incorporate it into his work as he reconsiders the forces around him. As a result, the transitions throughout his career are complicated to define and even harder to see.

General points of differentiation can be applied to Takis's work to provide some sense of structure to his development (Galerie Alexandre Iolas and Clay 1966). His earliest pieces were experimentations in plaster reminiscent of Giacometti's elongated forms. In 1954 he moved to Paris, where he came into contact with artists, including Yves Klein, Jean Tinguely, and Alexander Calder. He began forging, welding, and casting in metal on a much smaller scale in comparison to his previous plaster works, and he enjoyed the way the harder materials resisted manipulation (Takis, Calas, and Calas 1984). His iron works were angular, with influences of Egyptian forms, religion, and mythology. His bronze Fleurs and Espace Intérieurs series represented the ideas of metamorphosis, fetishes, and idols.

The study and application of scientific principles are key elements in the development of Takis's work. He created his first Signaux—commonly referred to by the English translation of Signals—in response to the visible and invisible forces of train signals, radar, and other navigation and communication systems (Takis, Calas, and Calas 1984). The reedlike structures topped with fine wires and small objects were meant to sway and touch, giving sight and sound to the invisible energies of wind and other unseen forces. Sometimes he performed happenings by exploding the elements on top of his Signals in public spaces to create a dynamic and cathartic display and release of energy. Over time his Signals increased in size and complexity to include more intricate mechanics and electrical elements.

The year 1958 was pivotal for Takis because he began incorporating magnets in his work—devices he utilized consistently in his career from that point forward. Magnetics are the ideal representation of the invisible forces of the unseen fourth dimension. In 1968 and 1969 he continued working with magnets as an artist-in-residence at the Massachusetts Institute of Technology's Center for Advanced Visual Studies.[2] The program encouraged artists to merge science and art for creative expression and technological advancement. Takis used electromagnetic forces to hold liquids in suspension and invented a work called *Oscillation of the Sea* (1968) that was able to translate the motion of bodies of water into kinetic energy.

Takis also uses magnets to incorporate sound into his artworks. In 1963 he collaborated with composer Earle Brown to create *Sound of Void* (Takis, Calas, and Calas 1984), a musical piece that used electromagnetic waves to activate mechanics that produced repetitive sound. *Sound of Void* was the earliest iteration of Takis's musical works and eventually led to his ongoing Sculptures Musicales, which also employ electromagnets as the driving force behind the production of sound.

Takis's use of magnets is one of the most complex and diverse aspects of his artwork. Alain Jouffroy called two of Takis's most developed and prevalent magnetic series Télé-Peintures and Télé-Sculptures, also known as Murs Magnetiques and Ballet Magnetiques. Works in the Murs Magnetiques series are frequently described as Magnetic Tableaux and consist of two distinct features. The first component is a painted canvas with varying types and numbers of magnets fixed to the wooden strainer. The second component consists of elements connected to a string or wire and attached to a fixed point across from the painting. The elements are positioned over the magnets so they float just off the surface of the canvas; they are held in stationary suspension by their attraction to the magnets. The resulting space between the elements and the canvas contains and illustrates the energy that is the primary focus of the work. The canvases are often painted in a single color from the restricted palette of black, white, red, and yellow because Takis feels the colors are associated with power and have the ability to convey energy. The Ballets Magnetiques series encompasses a diverse set of works, but their general construction consists of an electromagnet base with elements suspended above that are forced into motion by attraction or repulsion to the magnet. It was a work from this series that had been donated to MoMA and subsequently pulled from exhibition by Takis in 1969.

Takis is well known in much of Europe, having lived and worked most of his life in France and Greece, but his work is less known in the United States. The Menil Collection has the largest institutional body of Takis's work outside Europe. In 2012 that work became the focus of a collaborative project between the Menil Collection's conservation and curatorial departments.

Takis at the Menil Collection

In 2012 Melissa Warak, a curatorial fellow at the Menil Collection, included Takis in her research on the relationship between art and music. Her study prompted the conservation department to take a closer look at Menil's holdings of Takis's work, most of which, unfortunately, had not been exhibited since the museum opened in 1985. The initial assessment resulted in two conclusions. First, an updated survey was recommended to pinpoint any serious condition issues and prepare for the possibility of treating the work. Second, it became clear that more information was required regarding the proper installation and function of several of the pieces. Two works became the focus of the project: *Magnetic Tableau No. 7*, from the Magnetic Tableaux series, and *Ballet Magnetique*, from the eponymous series.

Figure 7.1. Installation view of the exhibition *Defining Space* at the Menil Collection, Houston, May 24–September 24, 1995. Takis's *Magnetic Tableau* No. 7, 1962, is on the left, and *Eléments animaux (Insectes)* is on the right. The Menil Collection, Houston.

Magnetic Tableau No. 7 was last displayed at the Menil Collection in a 1995 exhibition entitled *Defining Space* (fig. 7.1). The photograph shows the work installed near one of his Signals. The suspended elements are held at a sharp, upward angle by tethers that were most likely attached to tracks in the high hallway ceiling. A faint copy of an installation diagram, which appeared to be the basis for the 1995 installation, was found in the exhibition files. Unfortunately, there was no way to determine if it was interpreted correctly, and the source of the diagram was unknown. It is labeled, but the numbers and signature are unclear. Research into past exhibitions of similar works in the Magnetic Tableaux series installed at other institutions provided few additional details. The most informative images showed the wires attached to a scaffolding structure across from the painting, which was in direct contrast to the single image from the Menil files.

Even less was known about the installation of *Ballet Magnetique* because no previous installation or exhibition information was on file. Menil archivists were able to find a single press image of *Ballet Magnetique* installed in an exhibition entitled *For Children* at Houston's Rice University Art Gallery in 1971 (fig. 7.2). To date it is the only known image of the one time the work was shown.

Figure 7.2. Press image of Takis's *Ballet Magnetique*, 1961, in the exhibition *For Children* at Rice University Art Gallery, Houston, 1971. The Menil Collection, Houston.

The two works also had condition issues. *Magnetic Tableau No. 7* had metallic debris, abrasions, and discolored overpaint around the magnet that drew focus away from the space between the magnet and suspended elements. In addition, the magnet had shifted from a parallel line to a slightly diagonal position. There were abrasions and metallic transfer on the back of the canvas where the magnet used to sit, and an image on file from 1962 showed the magnet in a parallel orientation (fig. 7.3). *Ballet Magnetique*'s surfaces were abraded and spotted with superficial corrosion, the wires were frayed, and the plug was missing from the power supply cord (fig. 7.4). Temporary replacement of the plug and testing of the work produced sparks and smoke and overheated the selenium

rectifier. The work could not be operated long enough to determine if the electromagnet itself still worked.

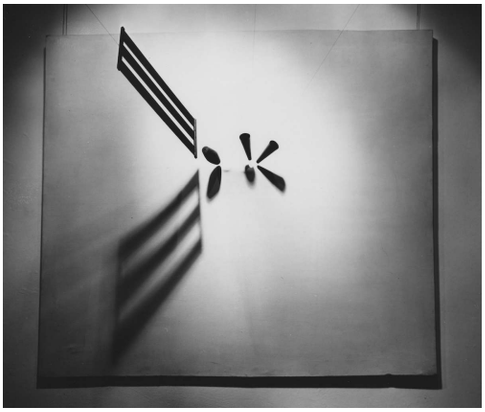

Figure 7.3. Takis, *Magnetic Tableau No. 7*, 1962, oil on canvas, magnets, silk ribbon, metal, and cork, 145.4 × 125.4 cm. The Menil Collection, Houston, 78-169 E.

Figure 7.4. Detail of Takis's *Ballet Magnetique*, 1961, electromagnet, Plexiglas, cork, and iron, 31.8 × 41.9 × 41.9 cm. The Menil Collection, Houston, X 482.

Artist Interview

At that point a chance encounter took the project in an interesting direction. Maria Kokkori, science fellow from the Art Institute of Chicago, visited the conservation labs and heard about the project. She had been acquainted with Takis since childhood, when her father and the artist ran in the same political and social circles in Greece. This presented a potential opportunity to begin a dialogue with a living artist. Kokkori offered to assist the conservation department by contacting Takis to request an interview. At his advanced age, the artist rarely travels outside Greece, and it was not feasible to conduct an interview remotely. Eventually Takis consented to a meeting in Greece, and Kokkori graciously agreed to assist as an interpreter.

Figure 7.5. Takis, *Musical-M.013*, 2000, painted wood, electrical circuit, nail, and needle, 257 × 100 cm. The Menil Collection, Houston, gift of the artist, 2014.11.2.

A list of questions from curatorial and conservation points of view was prepared for the interview and Kokkori translated them into Greek. The questions were sent in advance of the interview to Takis and Giorgos Nakoudis, the director of the artist's research center and the primary liaison between the Menil and Takis. Three of the questions pertaining to conservation and exhibition of the works were most relevant to this project. The first asked about his thought processes and methodology behind his materials, fabrication techniques, and installation methods. The second asked for installation details such as spatial relationships between suspended elements and the placement and angles in relation to the viewer. The third asked about aesthetics in his work and his feelings regarding those visual qualities.

The interview took place at Takis's direction in July 2013 on the Greek island of Paros, where he was spending part of his summer away from his Athens studio. As many people who work with living artists can attest, the process can be as much of a challenge as it is a privilege. The interview with Takis was no exception. There were several complicating factors, including language barriers and the artist's apparent disinterest in conservation. Fortunately, the conversation still yielded answers to the three questions mentioned above.

According to Takis, the materials he uses for his suspended and attached elements are found objects that he finds interesting, but they do not carry any special significance. The most important aspect of the work lies in what is unseen. He also feels strongly that exhibitions of his work should always include his musical pieces. The spatial relationships are not extremely important—five, maybe ten centimeters—as long as the suspended elements are close to the magnets. And the elements in his Magnetic Tableaux should be nearly perpendicular to the plane of the painting, rather than at the sharp angle seen in the Menil exhibition photograph (see fig. 7.1). Finally, he did not place particular importance on aesthetic qualities as long as the focus of the work was respected and maintained.

Shortly after the initial interview with Takis, the project began to generate serious curatorial interest. Menil curator Toby Kamps decided to organize an exhibition of the Menil holdings of Takis's work, and he arranged a follow-up interview with Takis that resulted in the gift of two new artworks to the collection. One was a Sculpture Musicale (figs. 7.5, 7.6), which was the first of its kind to enter the Menil Collection and which fulfilled Takis's requirement that one of his musical pieces always be included in an exhibition of his work.

With an exhibition imminent, conservation treatment and installation details moved forward, with the majority of the project focused on *Magnetic Tableau No. 7* and *Ballet Magnetique*.

Figure 7.6. Detail of the operation of Takis's *Musical-M.013* producing sound, 2000. The Menil Collection, Houston, gift of the artist. Watch the video at https://youtu.be/OdKBY-9Xeos.

Conservation

The treatment of *Magnetic Tableau No. 7* was conservative, to return focus to the space between the magnet and hanging elements without undermining Takis's opinion regarding aesthetics. First, the magnet was returned to its original parallel position through incremental movements that were followed by localized humidifying action and drying to allow the canvas to adapt to each shift. Layers of foam, blotter, and cotton provided support to the area, and strategically placed twill tape exerted gentle and even pressure. When the magnet was in the correct orientation, two basswood blocks were secured to the cross brace under each side of the magnet to prevent future movement (fig. 7.7).

The rest of the treatment minimized the distracting issues on the front of the canvas. Metallic debris was removed from the surface with the aid of a microscope. Removal of the overpaint risked causing further damage to the original materials, so the discolorations were retouched with ground pastels mixed into dilute methylcellulose, additional dry pastels, and colored pencil.

The kinetic nature of *Ballet Magnetique* required a more complex and invasive treatment to return the mechanical components to working order. The information Takis supplied during the interviews was taken into consideration for each decision.

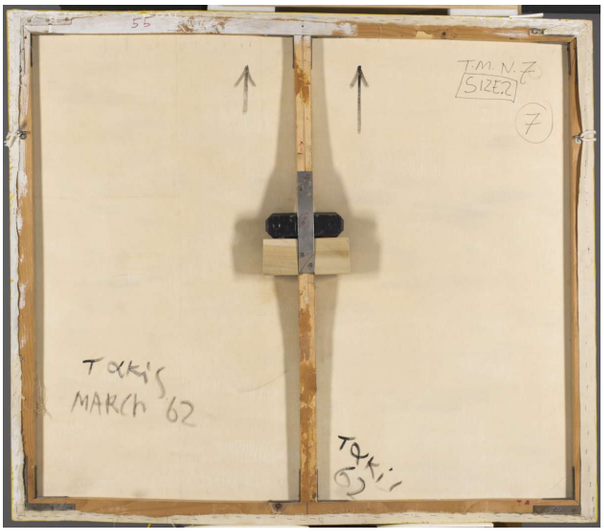

Figure 7.7. The verso of Takis's *Magnetic Tableau No. 7*, 1962. The Menil Collection, Houston, 78-169 E.

Treatment of the work focused on restoring its function, and the abrasions and superficial spots of corrosion were left untreated to respect Takis's aesthetic detachment. A new circuit-board-format bridge rectifier and heat sink were wired into position and connected to the long pins with crimp connectors. The new configuration was secured with a short screw, using an existing hole in the underside of the base. The original selenium rectifier was retained, although it was removed for the duration of the exhibition. All wire connections were reestablished with twist-on connectors to avoid soldering. Several frayed wires were replaced for safety reasons, but the originals were retained. At that point the electromagnet was turned on for testing, and the springs and bend of the relay coupon were adjusted to get maximum contact when closed and maximum spread when open. Finally, the power cord was replaced by splicing the lead inside the wooden box and adding an electrical-tape stop just inside the inner wall. A thumbwheel actuator was added for ease of operation during exhibition, but once again the original cord was retained (fig. 7.8).

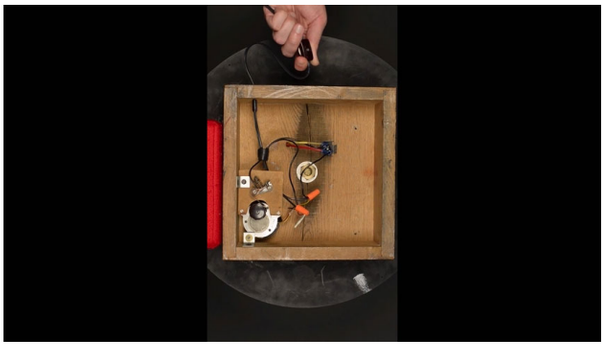

Figure 7.8. Detail of posttreatment mechanics on Takis's *Ballet Magnetique*, 1961. The Menil Collection, Houston. Watch the video at https://youtu.be/lBixeFhcJm8.

Exhibition Planning for *Takis: The Fourth Dimension*

Takis sent a diagram with detailed instructions for the installation of *Ballet Magnetique*. Unfortunately, testing of the installation setup revealed two complications: the tethers often became tangled and significantly impaired the movement of the suspended elements; and the elements collided frequently and with enough force to cause concern about their long-term preservation.

Figure 7.9. Exhibition copies of elements for Takis's *Ballet Magnetique*, 1961. The copies are on the left and the originals are on the right. The Menil Collection, Houston.

Takis was consulted for assistance in troubleshooting the problems. A compromise was reached to improve the movement of the elements by adding an additional inch between them and the magnet. In addition, the conservation department received permission to create exhibition copies of the two elements.

The original elements appeared to be painted fishing bobbins made from now-solid cork with cylindrical magnets inserted into the center. A copy of the round form was made by facing the cork core of a softball with thin cork sheeting until it reached the correct diameter, and

then it was spray-painted matte black. A copy of the biconical form was made from two corks adhered on-end and painted with white acrylic. Both pieces were given hanging hardware and a magnet of appropriate strength, and weighted with lead shot to be the same weight as their respective originals. The copies (left) can be compared to the originals (right) (fig. 7.9). The final exhibition copy of *Ballet Magnetique* stayed true to the artist's intention without compromising the most fragile original materials (fig. 7.10).

Figure 7.10. Operation of Takis's *Ballet Magnetique*, 1961, after conservation treatment. The Menil Collection, Houston. Watch the video at https://youtu.be/j86w750dsNU.

For the installation of *Magnetic Tableau No. 7*, Takis sent several images that included a copy of the same installation diagram the Menil had on file, confirming that the original information came from the artist. However, he also sent images of scaffolding that was similar to the scaffolding seen in images uncovered during the research phase of the project. The time, funds, and space required for scaffolding were not practical for the Menil so an alternative was presented to Takis. At some point during the project, a friend of Melissa Warak had visited Paris and photographed a Magnetic Tableau installed at the Centre Pompidou. There appeared to be a partial wall hanging from the ceiling opposite the painting from which the elements could be suspended. Takis granted the Menil permission to create a simplified version of that design using thin metal rods. This allowed successful viewing of the piece while maintaining the correct angles in the work and respecting its focus (fig. 7.11).

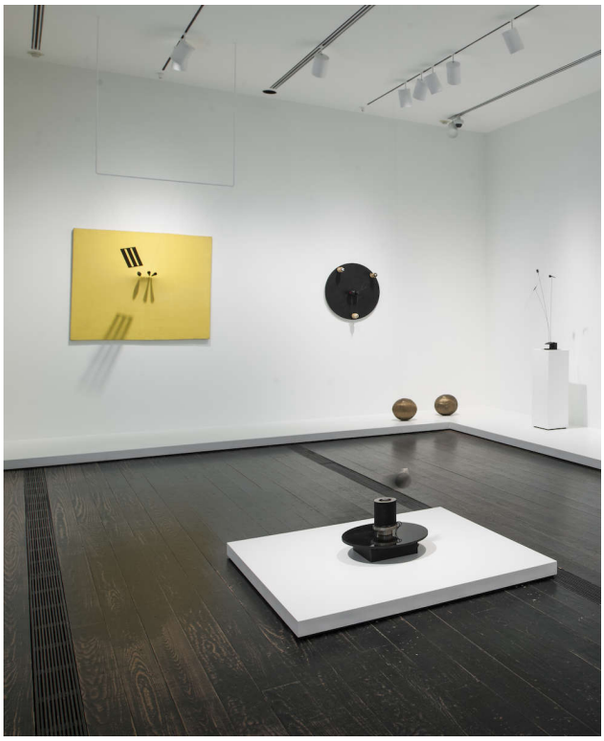

Figure 7.11. Installation view of Takis's *Magnetic Tableau No. 7*, 1962, and *Ballet Magnetique*, 1961, in the exhibition *Takis: The Fourth Dimension*, The Menil Collection, Houston, January 24–July 26, 2015.

Conclusion

This project was a study in collaboration, diplomacy, creativity, and compromise that produced a very successful exhibition for the Menil Collection. Everyone involved had the full experience of working with a living artist. All aspects of the project required a thoughtful review of conservation ethics and standards.

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Acknowledgments

Sincere thanks to Takis and the Menil Foundation and Menil Collection staff, with special recognition of Bradford Epley, Toby Kamps, Tom Walsh, Adam Baker, Tobin Becker, Tony Rubio, Melissa Warak, Lisa Barkley, and Consuelo Gutierrez; Maria Kokkori of the Art Institute of Chicago; J. D. Wise and Don Johnson of Rice University's George R. Brown School of Engineering; Florin Dragan, Jeff Lieberman, and Laura Knott; and Giorgos Nakoudis, director of Takis K.E.T.E. Research Center for the Arts and Sciences.

Notes

1. "Sculptor Takes Work out of Modern Museum Show," *New York Times*, January 4, 1969, 24.

2. Robert Reinhold, “M.I.T. Center Seeks to Wed Esthetics and Technology: M.I.T. Seeks to Wed Art and Science,” *New York Times*, December 26, 1969, 31; Grace Glueck, “Art: Whirring and Quivering Aplenty: Electronic Sculpture of Takis at Wise Gallery,” *New York Times*, February 8, 1969, 25.

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8.

Preserving Performativity: Conserving the Elusive in Aleksandar Srnec's Artwork

Mirta Pavić
Vesna Meštrić

Aleksandar Srnec was a renowned member of the international New Tendencies movement (1961–73), and he created the first light-in-movement object in Croatian art (1967). Srnec's luminokinetic objects, Luminoplastics, are a highlight of the Museum of Contemporary Art (MSU) in Zagreb, Croatia. Luminoplastics are activated by electric motors from sewing machines, and the combination of materials and "amateur" construction achieve a dynamic of movement and color. The first Luminoplastic features, along with sound and movement, a slide projection, which raises additional conservation issues. This paper presents the conservation strategy adopted for *Luminoplastic 1*, which included interdisciplinary research and individual decisions regarding the various components and materials that compose this exceptional work of art.

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Srnec and His Luminoplastics

Aleksandar Srnec (Zagreb, 1924–2010) was a prominent Croatian artist whose work developed between 1950 and 1970, a vital period for the arts as well as for international culture, politics, and economics. Srnec was a member of the EXAT 51 group, active in the early 1950s, which sought to introduce experimentation into art and based its activities on the theories and traditions of Russian Constructivism, Bauhaus, and Neoplasticism. EXAT 51 was followed in the 1960s by the New Tendencies movement, which highlighted the need for the socialization and democratization of art and played a crucial role in the development of both the Croatian art scene (then Yugoslavia) and the international art scene. New Tendencies attracted artists who were experimenting with optical, kinetic, and luminokinetic art, in addition to influential scholars of Neo-Constructivist and kinetic art and information theory such as Giulio Carlo Argan, Abraham Moles, Matko Meštrović, and Alberto Biasi.[1] Srnec's creative drive found its basis in research and experimentation and, in 1953, led him to a key achievement of the EXAT 51 period, *Space Modulator* (fig. 8.1), the artist's first object to give three dimensions to lines, that is, turning a drawing into a space. *Space Modulator* holds a special place in Srnec's oeuvre because it was the first of a series of kinetic and luminokinetic settings, which he constructed and exhibited at New Tendencies shows during the 1960s. There is an obvious link with one of László Moholy-Nagy's most important luminokinetic objects, *Light Space Modulator* (1930), but only at the formal level. Moholy-Nagy experimented with light and movement to create ambience, while Srnec, using light and movement, transformed the two-dimensional line motif into a three-dimensional medium.

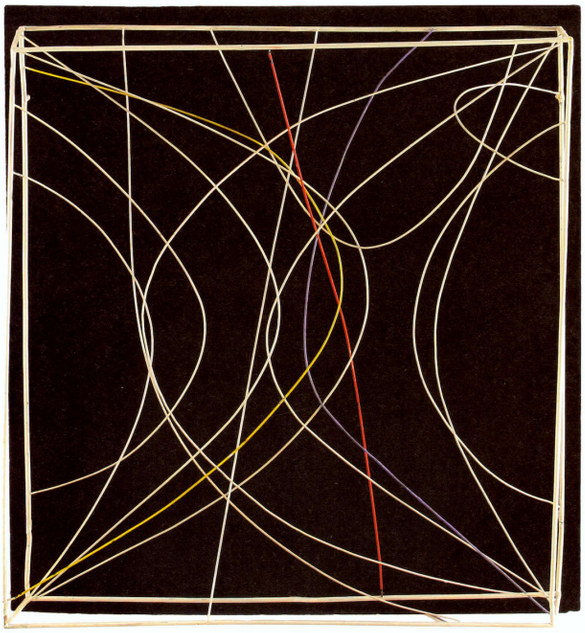


Figure 8.1. Aleksandar Srnec, *Space Modulator*, 1953, colored wires, wood, 49.5 × 53.6 × 18 cm. Modern Gallery, Zagreb.
Photo: © Goran Vranic.

The connection between two- and three-dimensional media was to become a distinctive feature of the artist's work. Srnec called his luminokinetic works Luminoplastics (fig. 8.2), and through them he joined a large group of artists who experimented with space, from pioneers of kinetic art (such as Alexander Rodchenko, Naum Gabo, Vladimir Tatlin, Moholy-Nagy, and Alexander Calder) to his contemporaries (including Nicolas Schöffer, Otto Piene, Bruno Munari, Jesús Rafael Soto, Jean Tinguely, Julio Le Parc, and Alberto Biasi, among others) (Denegri 2004:270).

Figure 8.2. Aleksandar Srnec adjusting his luminokinetic artwork at his exhibition in 1969. Museum of Contemporary Art, Zagreb.
Watch the video at https://youtu.be/j5rhSkSZc3w.
Video: V. Petek.

Srnec's luminokinetic objects in the Museum of Contemporary Art (MSU) in Zagreb consist of combinations of various traditional artistic media and everyday materials. In his optical-kinetic research, Srnec used anything that might contribute to the marvelous play of light and movement, and very often this meant ordinary objects, such as electric motors from sewing machines, metal rods, wires, and projectors. However, *Luminoplastic 1* (fig. 8.3), Srnec's first luminokinetic object, has one element that is quite different from the artist's other luminokinetic works: a projection of eighty slides (fig. 8.4). The slides were made using various techniques and materials, and a detailed analysis of each slide has shown that these are actually eighty miniature works of art.

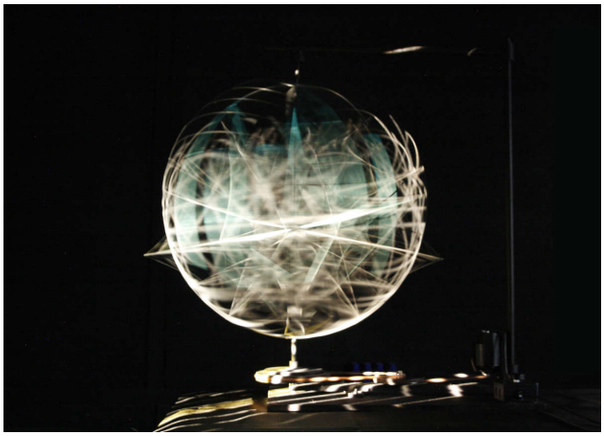


Figure 8.3. Aleksandar Srnec's *Luminoplastic 1*, 1965–67, in operation. Museum of Contemporary Art, Zagreb.
Photo: © Kreso Vlahek.

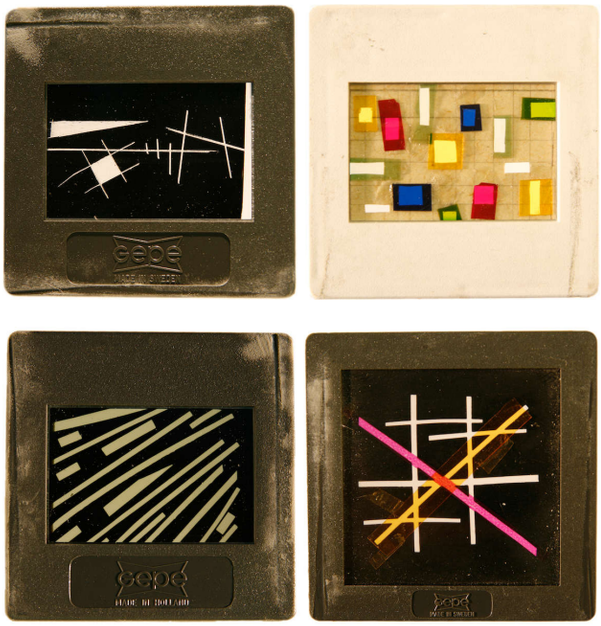


Figure 8.4. Examples of slides from Aleksandar Srnec's *Luminoplastic 1*, 1965–67.

Srnec constructed *Luminoplastic 1* between 1965 and 1967, and it is an extremely important work in the development of postwar Croatian art. The idea of *Luminoplastic 1* is based on the dimensionality of line, movement, and light, and it represents a visual experience of light that is created in a darkened room. When not in operation, in daylight, it looks completely different (fig. 8.5). Srnec has described assembling the various elements and materials to construct the Luminoplastics as a process of "explaining something to himself."[2] He built the metal construction from wires joined along a rim on a wooden panel; an electric sewing machine motor rotates two plates joined by leather belts (also from a sewing machine), causing the construction to move. Slides are projected onto the rotating metal construction at set intervals. The image projected onto the moving object produces an optical illusion, and it is difficult for the viewer to discern how the work of art actually functions. Therefore, performativity is a key element of *Luminoplastic 1*, without which the different components have no purpose (Muñoz Viñas 2010:11). The projection of slides onto a revolving construction dematerializes both the object and its form, so that only the moving images remain: in *Luminoplastic 1*, only the space and light are important, as they create a dynamic, changing ambience (fig. 8.6).

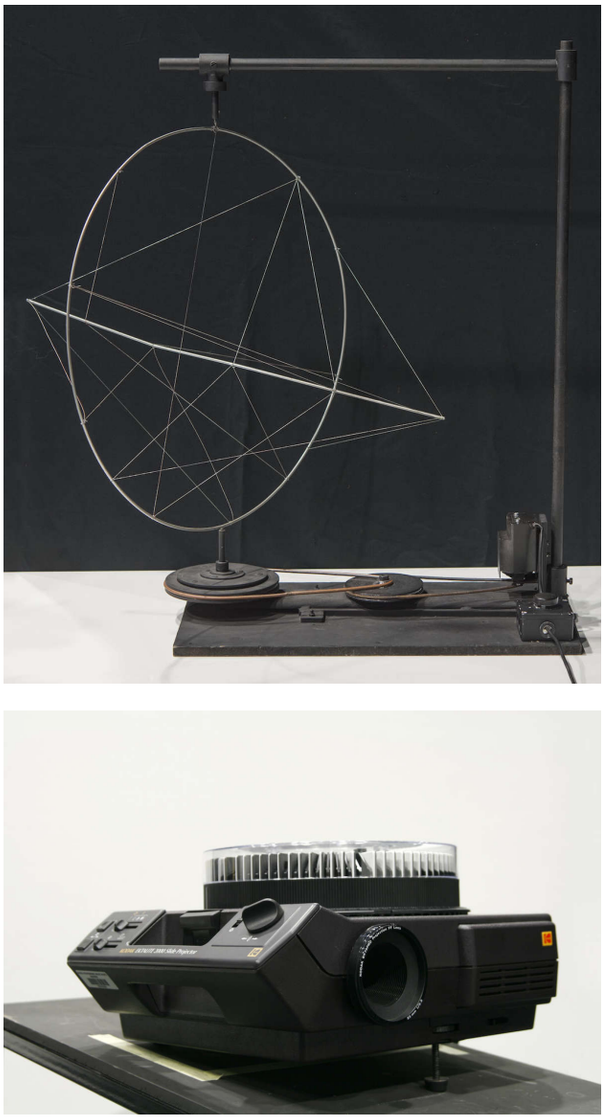


Figure 8.5. Aleksandar Srnec, *Luminoplastic 1*, 1965–67, metal construction with electric motor (top), eighty slides, and slide projector (bottom). Museum of Contemporary Art, Zagreb.

This work was on display during the opening of the new MSU building in 2009, in the museum's first permanent collection exhibition since its establishment in 1954.[3] The constant use to which *Luminoplastic 1* was subjected, eight hours per day, caused several failures in the electric motor and slide projector. The exacting requirements for exhibiting *Luminoplastic 1* prompted the museum professionals to analyze the materials in detail and consider strategies for maintenance and display. This required a systematic and interdisciplinary approach as these elements, when becoming part of an art object, change their habitus, their original intent, and are used for a purpose for which they had not originally been intended.

Thus, the curators and conservators faced a number of challenges relating to the maintenance and protection of the work, as well as the optimal way of exhibiting it. To approach the conservation decision-making process systematically, it was necessary to understand the object's history and artistic-historical position as well as its mechanics and materials (metals, rubber, plastic, and photographic media). It was obvious that we would need the assistance of experts in various fields.

Figure 8.6. Analogue projection of Aleksandar Srnec's *Luminoplastic 1*, 1965–67. Watch the video at https://youtu.be/bXS4nfmu5Tw. Museum of Contemporary Art, Zagreb.

The Electric Motor

The first problem was the electric motor that activates *Luminoplastic 1*, which had originally not been intended to run constantly. In an attempt to prevent further failures, we placed sensors that would activate the motor only when visitors approached the object. However, after a certain period, the motor stopped working. Conservators of modern art are well acquainted with the problem of obsolete technology and, with the goal of preserving the object's function, it was decided not to adopt a "fetishist" approach (Muñoz Viñas 2005:90) to certain parts, because it was inevitable that they would have to be replaced. Srnec had used electric motors produced by the Bagat Company, which was very successful in the former Yugoslavia in the 1960s. Srnec mostly used two types of electric motor: Ruža and Danica. (Interestingly, the company had given women's names to its various sewing machine models, most of which today sound old-fashioned.) A few years ago, when the electric motor of the second *Luminoplastic* object developed an irreparable failure, the former head of the conservation department, Zlatko Bielen, succeeded in finding one of these two motor types in a small shop. However, when the motor on *Luminoplastic 1* stopped working in 2015, the original Ruža and Danica models were no longer available. An electrical engineer helped with the repair (the coil had burnt out), and it was thought that the motor would have a few years' life left. Should an alternative to the existing motor be necessary, a replacement with a brushless motor and speed regulator was proposed, although the mechanics would need to be adapted. Also, one of the two leather belts within the construction needed to be replaced, as the material had split and lost elasticity over time, putting extra stress on the motor. We ordered a belt of the same diameter from a sewing machine supply shop, along with a replacement electric motor (for future use, if necessary) that had been made along the same principles as Ruža and Danica but produced in Taiwan.

Slide Projector and Slides: A Time-Based Media Issue

Further analysis of the construction elements showed that the artwork's slide projector was not the original from 1967, as that one had burnt out during Srnec's lifetime. On the advice of Srnec's colleagues, the MSU acquired (around 2006) a new Kodak Ektalite 2000 analogue carousel slide projector, which is still in use today.

The eighty slides were examined with the assistance of a professional cinematographer,[4] which led to several important pieces of information. The slides could be divided into two groups: those produced entirely by photographic means, and those on which the artist had intervened. Technically, they fell into four categories: collages, black-and-white graphic films, black-and-white graphic films with engraved drawings, and standard slides.

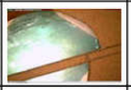
No.	Description of the slide	Type of photographic material	Type of emulsion	Damage	Photo on the emulsion side	Photo under the microscope	Comment
no. 13	Made mechanically on b/w graphic film. Atypical dimensions. Graphic film cut down from a larger format to 37 x 39 mm with irregular corners.	B/w graphic film. Atypical dimen	B/w graphic film, unknown emulsion by an unknown manufacturer.	On the glossy side there are traces of drying - matte stains.			
no. 14	Collage. Dimensions 35x38. Cardboard with silver foil on one side; not photographic processing. Three cut-out half moons within the cardboard. Yellow and turquoise transparent foil glued over them.	Not a photographic technique. Collage.					
no. 15	Made by photographic processing and mechanically finalized (lines carved in). Shot in a larger photographic format that has subsequently been cut down to the size of leica format slide.	B/w graphic film. Atypical dimensions of 37 x 39 mm. Irregular shape.	B/w graphic film, unknown emulsion by an unknown manufacturer.				Unstandard positioning of frames - one horizontally, the other vertically, so instead of the usual 24 x 36 mm, the 24 x 24 dimension was applied to this slide. The way it was placed inside is visible from the traces of projector on the outside edge of the frame (scratches).
no. 16	B/w graphic film with atypical dimensions of approx. 35 x 39 mm. Made mechanically by carving in curved lines into the film.	B/w graphic film with atypical dimensions of approx. 35 x 39 mm.	B/w graphic film, unknown emulsion by an unknown manufacturer.	Two matte stains on the matte side (the emulsion side) in the upper right hand corner, as if it came into contact with a liquid that has left this trace behind. A small hole in the film underneath this. Several stains on the glossy side as well.			
no. 17	B/w graphic film made by photographic processing. Atypical dimensions in a frame of atypical dimensions (frame different from others). The dimension of the frame opening in the slide is 38 x 38 mm, unlike the others that are in leica format.	B/w graphic film of atypical dimension approx. 35 x 39 mm.	B/w graphic film, unknown emulsion by an unknown manufacturer.	Dust on the frame produced by mechanical scraping in the slots of the slide projector. The frame of lesser quality than others. The slide preserved excellently, no damage.			Graphic film is more sensitive than a negative in terms of immeculate photochemical processing, especially in the final stage of cleaning and rinsing because limescale stains and other impurities are much more visible on it. The reason for this is a thin and even and thus a more sensitive emulsion.

Figure 8.7. The Excel spreadsheet with detailed descriptions of Aleksandar Srnec's slides for *Luminoplastic 1*, 1965–67. Museum of Contemporary Art, Zagreb.

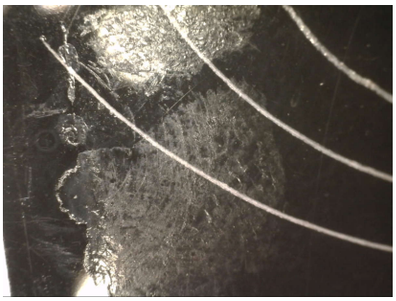
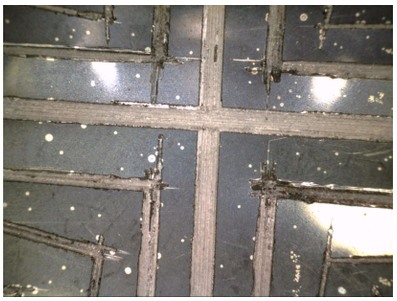
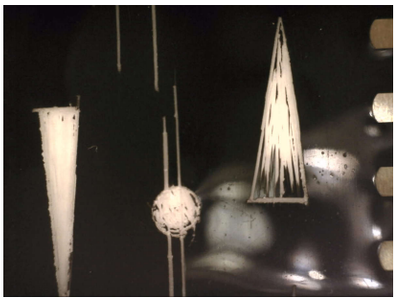




Figure 8.8. Various types of damage on the slide emulsions are visible under the microscope. Museum of Contemporary Art, Zagreb. Photos: © Maja Vurusic.

For documentary purposes, we used digital cameras to photograph each slide with its emulsion side face-up, and then examined them, emulsion side up, under a Dino-Lite microscope. The observations were described in detail in an Excel spreadsheet (fig. 8.7), including the condition as found, changes that had already occurred, and the technique and type of photographic material and emulsion used. The most obvious changes were irreversible spots on the emulsion, damage that had occurred because of the high temperatures of the projector's lamp heat (fig. 8.8). The conservator, curator, and cinematographer decided that it was necessary to make exhibition copies of the slides. Although this decision launched ethical and technical discussions about the right way to proceed, there was immediate agreement that it was necessary to ensure a clear distinction between the originals and the exhibition copies. It is interesting to note that the need to protect the original slides had been acknowledged many years before and, at that time, a suggestion was put forth to make copies. Even setting aside the ethical aspect of this suggestion, it would have been difficult to achieve such a goal due to the imperfections of the originals and the tiny details that should be conserved. At the time, there was a good reason for the proposal.

So we decided to digitize the original slides guided by the premise of the acknowledged necessity of distinguishing between the original and replacement materials. The aim was to protect the originals by using digital files but also to respect the ethical principle of authenticity, "which forms the backbone of traditional conservation theory and practice" (Van Saaze 2013:36), as well as the performativity of this unique work of art. The correct preservation of digital files can markedly prolong the lifespan of an artwork.

Although Srnec did not originally use digital technology, creating analog exhibition copies of the slide-collages would cause a significant problem due to the difficulty of faithfully transferring the collages' contents and all their details onto reversal film without altering their appearance.

Digitizing the slides led us to the understanding that each one represented a separate work of art, which, had they belonged to another era, might have been called "miniatures." They are abstract compositions in which one of the main motifs is lines that were created, using an engraving technique—scratching the surface of the film—which can clearly be related to Srnec's early works from the early 1950s.

This series of compositions, on the border between geometric and lyrical abstraction, is interspersed by slides formed from geometric motifs—circles, triangles, cubes/squares—using a collage technique. These slides, which consist of transparent color film and silver candy wrappers, were difficult to scan due to their fragility, and due to the reflecting silver foil, which appeared black in the digital version. Additional Photoshop intervention was required to regain the appearance of silver foil (which in fact turns black during projection).

Luminoplastic 1 is a luminokinetic object that includes a time-based media element: the slide projection transforms it from a sculpture into a work with a performative aspect and ambience. Allographic art is an art form that is performed in some way, and this is a crucial dimension of *Luminoplastic 1* (Goodman 1976:113). The artist's hand is present in the slides, particularly those produced using a collage technique, and it is a very important feature of these works, giving them an autographic[5] character. However, the secondary use of the slides, as projections in a new context, gives them an allographic character. Each slide is an individual work of art, but the projection has a certain duration, is variable, and gives a new dimension to the luminokinetic object.

Authenticity and change may be interpreted differently for autographic or allographic works of art, so the distinction between the two types of works is important when making conservation decisions (Laurenson 2006:8).

Scanning the slides on a flatbed scanner produced unsatisfactory results: it did not record all the details and imperfections, thus altering the slides' original appearance. A rotary scanner was then used. Since the original slides had not been photographed or developed by a professional, they had a number of technical deficiencies that made them unique and reflected Srnec's hand. This was particularly true where he engraved the film using a sharp object and for the collages made with candy wrappers and fixed with school glue, which had partially lost its adhesive properties. The slides were treated and conserved before the scanning process,[6] which produced excellent results.[7] While treating the slides, the issue of their order arose, but due to a lack of documentation, they were left in the order in which they were found.

By comparing an analogue projection of the original slides (produced photochemically) and a digital projection of the scanned material, we discovered two differences that revealed two key problems. The first related to the range of colors. The analogue projection had warmer tones as a result of the Kodak projector bulb's (halogen, tungsten filament) light temperature of 3,200 kelvin, in contrast to the cold, bluish light of the Osram Unishape lamp with Dynamic Dimming (approximately 6,500 kelvin) produced by the Texas Instruments projector, known commercially as DLP (Digital Light Processing) (fig. 8.9). During testing, a relatively acceptable result was achieved using a Kodak Wratten (KW) orange 85B filter. Any filter allows light to pass through it selectively, and this resulted in the visible reduction of some parts of the color spectrum. The KW 85B filter was only successful in the case of the black-and-white slides; for the chromatic slides (the collages), the desired result was not obtained.

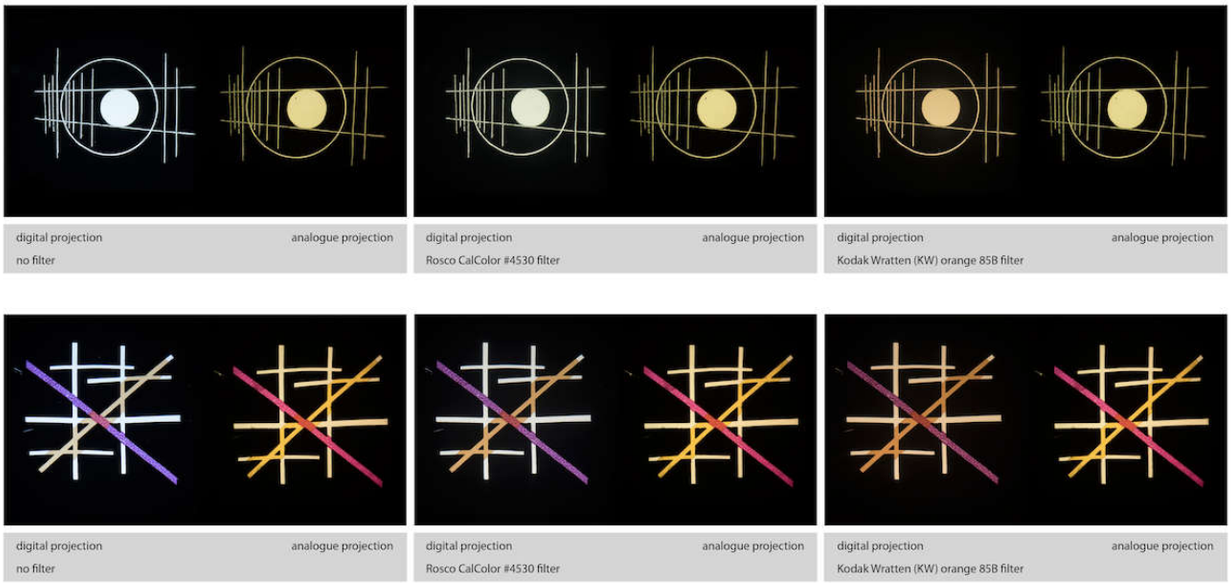


Figure 8.9. Comparison of the analogue and digital projections of two slides, a black and white (top) and a collage (bottom). Different filters were tested to reduce the color variance between the analogue and digital projection.

The second problem was related to (timed) interruptions in the slide projection, which is a feature of any DPL projector. This technology creates projections in repeated sequences; first the red content of the image, then green, and then blue. When images are projected onto a moving object, the human eye perceives only the order of the red, green, and blue excerpts. This effect is sometimes perceptible even on fixed objects viewed on an ordinary projection screen as a series of separate colors, and the disturbance is known as the rainbow effect (fig. 8.10). When affected by movement, the image is also quite different from that projected by an analogue projector, and therefore needs improvement (fig. 8.11). In contrast to Texas Instruments' DLP technology, the JVC company has developed LCoS (Liquid Crystal on Silicon) projection technology, which is not affected to the same degree by problems linked to the rainbow effect. This type of projector would achieve the desired result; however, it is expensive, and the MSU is still waiting for funds to purchase it.

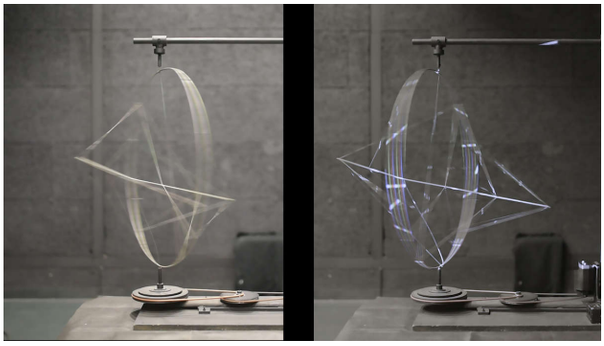


Figure 8.10. Comparison of the original analogue projection (left) and the digital projection with its visible rainbow effect (right). Museum of Contemporary Art, Zagreb.
Photo: © Jovan Kliska.

Another option would have been to transfer the scanned slides onto film. In this case, the experts at the professional studio where the slides were scanned[8] were willing to guarantee success in transferring black-and-white films and classic slides onto film, but could not offer a similar guarantee for the collages, as there was no standard procedure for obtaining absolutely faithful copies.

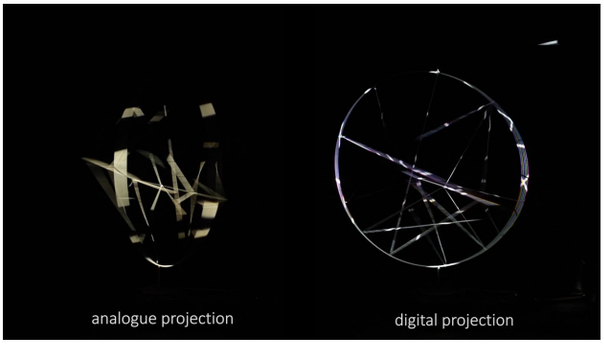


Figure 8.11. Comparison of the analogue and digital projections. Watch the video at https://youtu.be/EY3foRIJIFE.
Museum of Contemporary Art, Zagreb.

An additional complication in producing copies of the slides was the fact that the originals were probably not photographed, developed, and archived with an awareness of all the technical norms required to guarantee unquestionable slide quality. The noticeable departure from neutral, achromatic colors (white, gray) in the originals was probably the result of less-than-perfect photography and development; our photographic reproductions of the drawings, therefore, do not show white properly (the lines have a green tinge). Srnec, who was not a perfectionist in the technical sense, was probably not troubled by this departure from exact colors, so it was necessary for us to transfer these details faithfully onto exhibition copies. Each slide copy would be labelled accordingly during the process, so that the copy and the original could be clearly and easily distinguished.

Another option was to film *Luminoplastic 1* in operation, and present it so that the nonfunctioning original would be on display next to a projected video of the functioning work. This has become standard practice in museum exhibitions in recent times. However, in that case, our work would have been a documentation of the original.

Considerations under Permanent Revision

Luminokinetic objects create a constantly changing space in which the idea of the artist—that is, the performativity of the artwork—is realized. Since context and function are crucial to their identity, it is difficult to focus solely on the material aspect during conservation and presentation.

The complicated interactions of integrity (Muñoz Viñas 2005:65–69), change, and the preservation of authenticity (Wharton and Molotch 2009:210) require the museum profession to adopt a wide view of basic ethical principles and technical possibilities, so that these exceptional objects retain their true nature (Caple 2000:62), identity, and accessibility to the public, for this is where their real value lies.

By asserting the distinction between originals and exhibited copies, which in the case of *Luminoplastic 1* was guaranteed by the use of a new medium, the traditional approach was respected; that is, subjecting the work of art only to strictly necessary and minimal changes during conservation, preserving its integrity. Although the experience of observing interpretations in an old medium is quite different from doing so with today's new media (for example, analogue vs. digital projection), any divergence that results from transforming works into digital media can be justified when one respects the traditional distinction between the original material and the use of additional material for conservation and restoration. *Luminoplastic 1* is nonetheless a unique physical object and, as with many other kinetic works, its materials and construction are firmly associated with the period in which it was made. As objects age, they create challenges and debates regarding their identity.

As a multimedia artist, Srnec was motivated by creative curiosity, saying, "I have given most of my works to friends. I did not see any value in them. Value for me was explaining something to myself."[9]

The interpretative role of museum professionals who are entrusted with showing a work of art is undeniable. With contemporary art, there are moments when the conservator and curator become participants in the artist's intentions, as Vivian van Saaze explains:

> Rather than being a facilitator or "passive custodian," the curator or conservator of contemporary art can be considered to be an interpreter, mediator or even a (co-)producer of what is designated as "the artist's intention" (Van Saaze 2013:33).

This highlights the responsibility that all museum professionals have in deciding how to show a work of art so that its meaning is interpreted faithfully.

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Notes

1. Kolešnik 2012. The robustness of this period in art led to five exhibitions entitled *New Tendencies* held in Zagreb between 1961 and 1973, organized by what is today the MSU. In fact, some of the museum's most important holdings are the works of art and archive documentation produced by the New Tendencies participants.

2. Srnec, in Gordana Brzović and Kristina Leko's documentary *Aleksandar Srnec* (2000), 57 min.
3. The MSU was originally the Gallery of Contemporary Art, and it was housed in a baroque palace with a rather small space (400 m^2) used only for temporary exhibitions. The new building finally provided appropriate space for the permanent display.
4. The authors are grateful to Krešo Vlahek for his expert assistance.
5. Goodman 1976:113 calls art forms such as painting and etching "autographic" arts: "a work of art is autographic if and only if the distinction between original and forgery of it is significant; or better, if and only if even the most exact duplication of it does not thereby count as genuine."
6. Technical characteristics: scan resolution 660 dpi.
7. The rotational scanner creates high-quality files with resolutions ranging from 2,400 to 9,600 dpi, in contrast to flatbed scanners, which can reach a maximum resolution of 1,200 dpi. A digital file scanned on a rotational scanner deviates only minimally from its template.
8. Skaner Studio, Stubička 49, Zagreb, Croatia.
9. Srnec, in Gordana Brzović and Kristina Leko's documentary *Aleksandar Srnec* (2000), 57 min.

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9.

Engineering a Solution: Latin American Light-Based Kinetic Art at the Museum of Fine Arts, Houston

Jane Gillies
Ingrid Seyb

Works by Latin American artists Abraham Palatnik, Horacio García Rossi, Gyula Kosice, Gregorio Vardanega, Martha Boto, and Julio Le Parc were conserved prior to an exhibition in 2015 at the Museum of Fine Arts, Houston (MFAH). We examined the authenticity of the current mechanisms, and in some cases replaced components. Where possible through research, we identified aspects of their original operating processes such as the speed, color, and configuration of elements. We also considered how these works can be maintained in the future without compromising the artists' intentions.

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The Latin American department at the Museum of Fine Arts, Houston (MFAH), began collecting kinetic art in 2004, including works by pioneering artists of the 1960s such as Abraham Palatnik, Horacio García Rossi, Gyula Kosice, Gregorio Vardanega, Martha Boto, and Julio Le Parc. They used various mechanisms—mirrors, the interplay of lights, and bubbling water—to produce movement and create both regular and random patterns. These artworks were displayed in multiple exhibitions, which provided challenges in maintaining their functionality. A recent exhibition, *Cosmic Dialogues* (2015), brought together the largest number of these works to be shown at one time at the museum, and it provided an opportunity for the conservation department to examine them closely. We addressed questions about the authenticity of the current mechanisms, replacement of components, and the appropriate length of running time. In the past, changes to the works of art were made at the last minute and by anyone who could make them function. This often meant minimal documentation and the use of whatever materials were readily available.

This paper details some of the conservation decisions and treatments made before, during, and after the exhibition, how these affect the longevity and integrity of the works, and where further study is still needed. Where possible through research we identified aspects of their operating processes such as the correct speed, color, and configuration of components. We consider how these works will be maintained in the future, when the supply of original components is exhausted and where defects in the original design, which affect both safe operation and undue wear of components, can be corrected without compromising the outward appearance and authenticity. Whenever possible, we collected information from the artists or their associates as part of the documentation process, but often the details most useful to conservators had been forgotten.

The MFAH is planning permanent display of this collection in a new building (opening 2019), the first permanent galleries of this kind of art in the world, and the work done for *Cosmic Dialogues* will serve as a pilot program for this complicated undertaking.

The MFAH has been actively acquiring modern and contemporary Latin American art since 2001, partly inspired by the museum's goal to reflect the diverse population of Houston in its collection. Among the department's 755 objects, 38 are kinetic and electric works, ranging in date from 1946 to 2010.

The 1950s and 1960s in South America, as elsewhere, was a time of tremendous innovation and change in the art world. European intelligentsia had emigrated in great numbers both before and after World War II, strengthening the already robust cultural ties. Many young artists went to Europe to study, and some stayed permanently (Rossi 2012:47–67; Suárez 2007:243–47). One group of these artists used science and technology as a vehicle for discussing a utopian future (Ramírez 2004). Rejecting the perceived self-centeredness of North American Abstract Expressionism, they de-emphasized the artist as individual and instead focused on the audience, turning spectators into participants with Op Art and kinetic installations (Popper 1968:150). Many artists made sculptures that were scale models for visionary futuristic architecture (Popper 1968:139, 192). The Groupe de Recherche d'Art Visuel (GRAV), active in Paris from 1960 to 1968, particularly focused on the theme of participation (Gagneux 2007:14); members included Latin American artists Julio Le Parc and Horacio García Rossi. Martha Boto, Gregorio Vardanega, Jesús Rafael Soto, and Carlos Cruz-Diez also worked in Paris. In Brazil, Abraham Palatnik pushed painting into the fourth dimension, and in Argentina, Gyula Kosice used light, water, and translucent plastic to design cities for outer space.

The MFAH is one of the few museums to invest heavily in this type of art, and it can be difficult to find comparatives in public institutions that have staff conservators with whom to confer. The works are generally acquired from private collectors in Latin America or from the artists themselves or their descendants, and storage conditions have rarely been to museum standards. Many works had been in operation longer and more frequently than would be desirable in a museum setting, and worn-out components had been replaced without documentation.

The demands of frequent exhibition have necessitated a practical approach and a treatment-minded ethical framework. The conservation department has had an ever-increasing role in getting and keeping these works in running order, as the institutional mind-set shifts to seeing functionality problems in kinetic art as a preservation issue rather than an exhibition issue.

Gregorio Vardanega

Gregorio Vardanega's *Espaces chromatiques carrées en spirale* (Chromatic Spaces Turning in a Spiral) (1968) (fig. 9.1) had been shown at the museum twice before accessioning. When conservators first examined it in 2012, forty-nine of its sixty-three bulbs did not work.

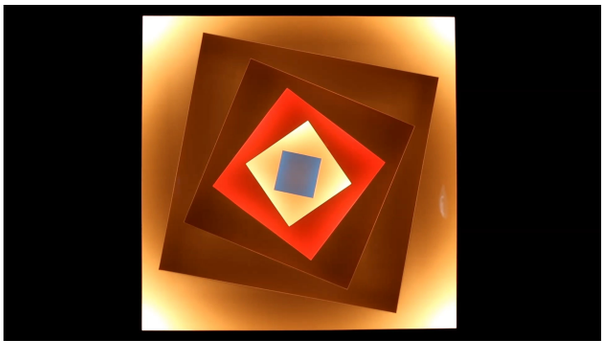

Figure 9.1. Gregorio Vardanega's *Espaces chromatiques carrées en spirale* (Chromatic Spaces Turning in a Spiral), 1968, Plexiglas, light bulbs, and motor; after treatment. The Museum of Fine Arts, Houston, museum purchase funded by the Latin Maecenas, 2010.173. Watch the video at https://youtu.be/zNr9YISTQfw.

Offset white square panels, receding in size to the back of the artwork, have colored lights at each corner that produce the effect of a spiral. Behind each panel are groups of three small bulbs with blue and red plastic sleeves that create blue, red, and white light. The motor-driven analog sequencing system located inside the back panel works well, but the cylinder of hand-carved white plastic disks, which turn the switches on and off (fig. 9.2), will eventually deteriorate. Before that begins, this system should be documented, perhaps by 3-D scanning of the cylinder.

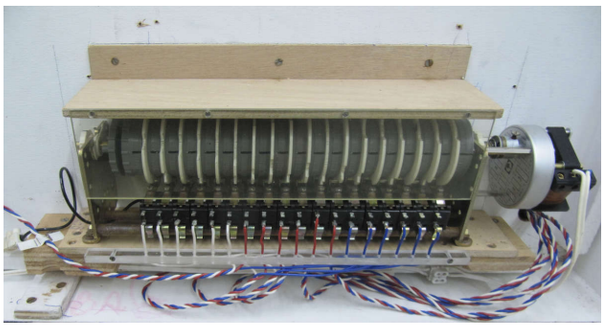

Figure 9.2. Interior detail of *Gregorio Vardanega's Espaces chromatiques carrées en spirale* (Chromatic Spaces Turning in a Spiral), 1968, Plexiglas, light bulbs, and motor. The Museum of Fine Arts, Houston, museum purchase funded by the Latin Maecenas, 2010.173.

The E5850 Orbitec 15W 230V E10 bulbs are no longer available with exactly the same glass shape, but a very similar type was found through Don Schnapp,[1] a specialty

dealer with access to European dead-stock bulbs. All sixty-three bulbs were replaced to ensure a uniform appearance and a consistent electrical load, and to preserve the remaining fourteen functional original bulbs for future reference.

Couleurs sonores (Sound Colors) (1963–79) (fig. 9.3), Vardanega's design for a futuristic city of skyscrapers, was accessioned in 2013, but, at 4.6m high, it was too tall for the intended gallery and unfortunately could not be included in *Cosmic Dialogues*. The work had been permanently installed in the artist's studio and was donated to MFAH by his estate.

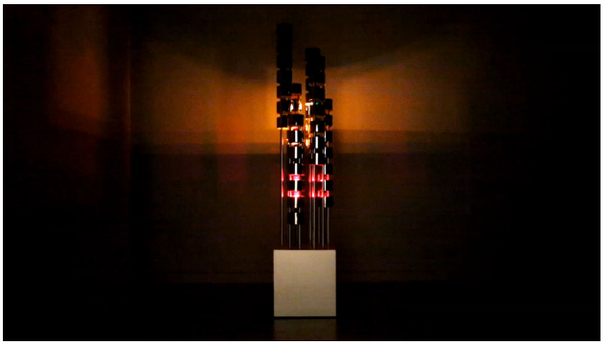

Figure 9.3. Gregorio Vardanega's *Couleurs sonores* (Sound Colors), 1963–79, metal, light bulbs, and electric motor; after treatment. The Museum of Fine Arts, Houston, gift of the estate of the artist and Sicardi Gallery, 2013.665.A-.G. Watch the video at https://youtu.be/PVJR2aAmdU4.

Plastic sleeves over clear bulbs create the colored lights, as in *Chromatic Spaces*, and the sequence is similarly controlled by a music box–like drum hitting a row of switches. These simple mechanical devices often resist obsolescence better than colored bulbs or modern, software-based programming, and the mechanisms were again found to be in very good working order. However, some of the plastic sockets for the bayonet-base bulbs had become brittle with age and light exposure, and three socket cups broke under the pressure of inserting the bulbs. Repairs done with epoxy reinforced with polyester mesh had a tendency to fail, and replacement of all these sockets with a brass version may have to be considered before display. All the bulbs currently work, but more have been purchased for the future.

Martha Boto

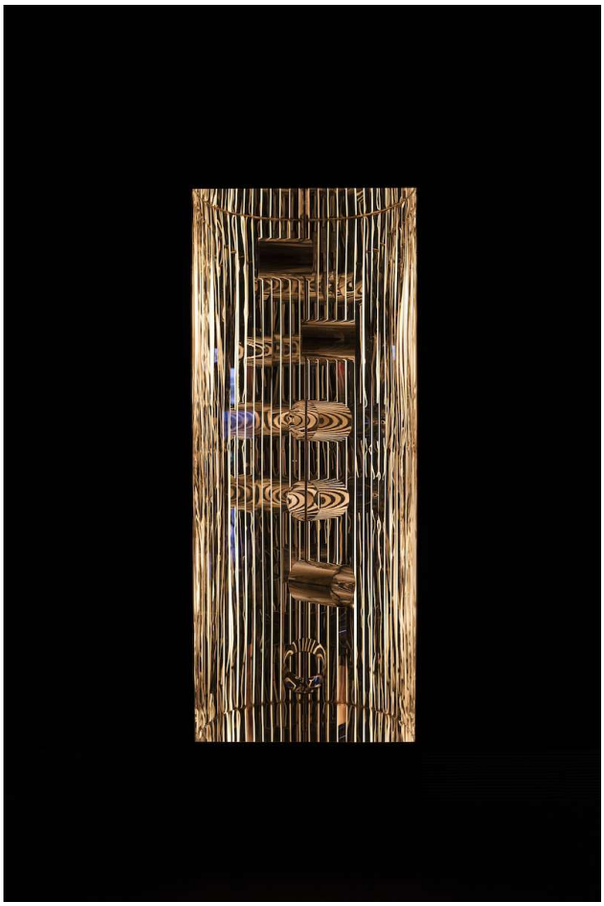

Figure 9.4. Martha Boto's *Déplacements optiques* (Optical Displacements), 1967–69, painted wood, light, aluminum, and motor; after treatment. The Museum of Fine Arts, Houston, gift of Benbow and Jean Bullock, 2004.1617.

The initial examination of Martha Boto's *Déplacements optiques* (Optical Displacements) (1967–69) (fig. 9.4) prior to exhibition found that two bulbs were dead. Luckily, Boto and her partner Vardanega seem to have shared materials: the bulbs were of the same type he had used in *Chromatic Spaces* and were therefore on hand in the conservation lab.

Toward the end of the exhibition, however, *Déplacements optiques* began to have intermittent problems. The motor would noticeably slow down and make a harsh grinding noise, and then stop making the noise and return to normal speed within a few minutes. After deinstallation, we examined it in the lab, and we discovered that a thick layer of grease had been applied, unnecessarily, to the workings in the gearbox. The motor

itself ran smoothly when separated from the gearbox; after the gearbox was cleaned, the object worked perfectly.

Boto's *Optique electronique* (Electronic Optic) (1965) runs on 110V and uses E26 screw-base 60W bulbs. Therefore, unlike many other works in the collection, replacement bulbs have always been easily obtainable in Houston, and the object had run reliably through two previous exhibitions. Twelve days after installation in *Cosmic Dialogues*, however, the motor died.

The original was a Crouzet synchronous motor with a SAPMI Type 835 SYN gearbox with an output of 2 rpm. As a suitable-size 2-rpm direct-drive motor was on hand in the lab—an extra purchased during treatment of the Abraham Palatnik work, discussed below—the original motor and gearbox were both removed and replaced, allowing immediate reinstallation. The original components were saved for future reference. Although some might argue that an element of the object's integrity is lost by this change in running mechanism, this minor loss is far outweighed by the preservation of the viewer's experience, which was the primary interest of this group of artists.

Julio Le Parc

The MFAH has two Julio Le Parc sculptures, one from 1960–66 and another from 1968, both titled *Continuel-lumière mobile* (or Continuous light mobile or Unceasing Light Mobile). They produce a complex, irregular pattern of moving lights on the surrounding walls. Although this pattern appears to be the result of programming, it is actually caused by simple garlands of metal disks strung on monofilament, illuminated from below by incandescent bulbs. The air currents in the room move the disks, and they cast reflections throughout the darkened gallery. We noted during installation that the boxes housing the bulbs got extremely hot, and replacement with LEDs was considered for safety reasons. It was decided, however, that the heat generated by the bulbs contributes to the movement of the disks, and the incandescent bulbs were left in place.

Horacio García Rossi

Horacio García Rossi's *Structure à lumière instable no. 29* (Unstable Light Structure No. 29) (1966) (fig. 9.5) had been shown in a previous exhibition just after acquisition, but the lights had since stopped working. There are ninety acrylic rods of different thickness and length on the exterior. Two lights on the inside of the front panel (fig. 9.6a) project light onto the back of the box, on which a wooden disk with a forest of shiny metal squares (fig. 9.6b) is mounted. The disk is turned by a motor, causing the metal squares to shift position on their wires, casting light randomly through the acrylic rods.

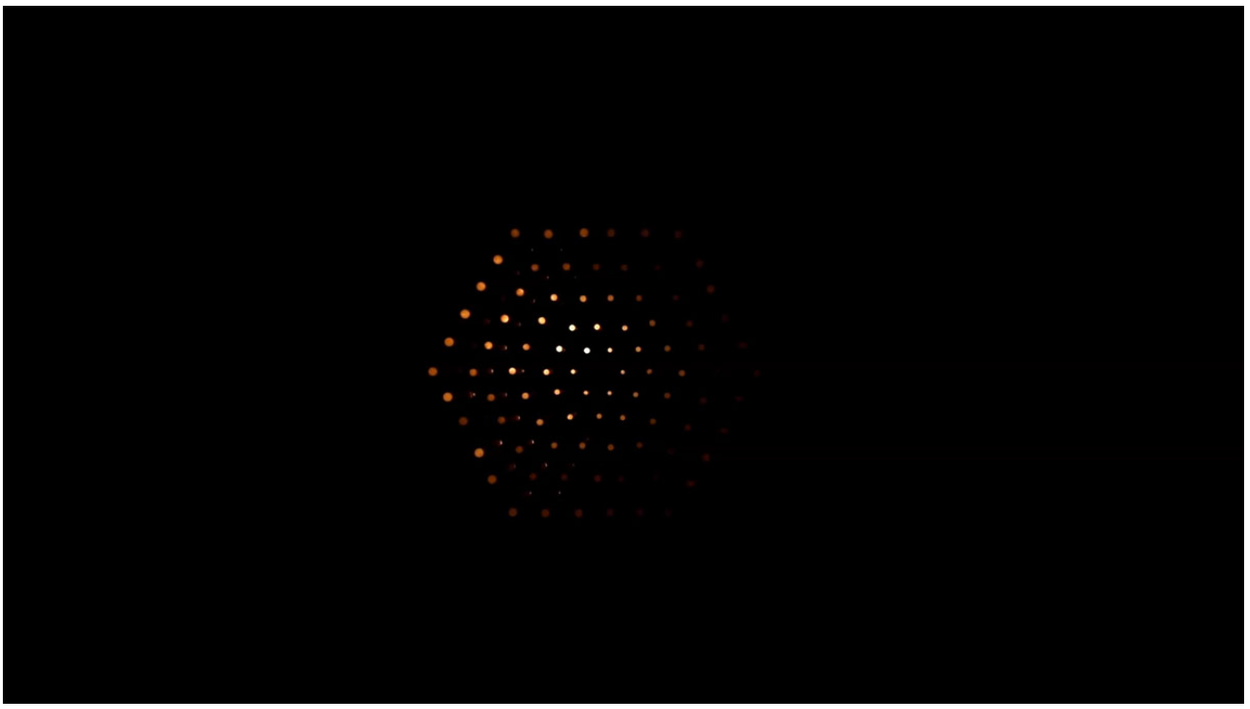

Figure 9.5. Horacio García Rossi's *Structure à lumière instable no. 29* (Unstable Light Structure No. 29), 1966, painted wood, Lucite rods, electric motor, and lights; after treatment. The Museum of Fine Arts, Houston, gift of Benbow and Jean Bullock, 2004.1618. Watch the video at https://youtu.be/E1HBHKpd46U.

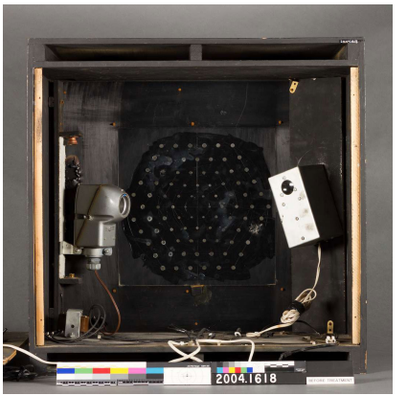

Figure 9.6a. Horacio García Rossi's *Structure à lumière instable no. 29* (Unstable Light Structure No. 29), 1966, painted wood, Lucite rods, electric motor, and lights. Interior front panel before treatment. The Museum of Fine Arts, Houston, gift of Benbow and Jean Bullock, 2004.1618.

Figure 9.6b. Interior back panel from side before treatment.

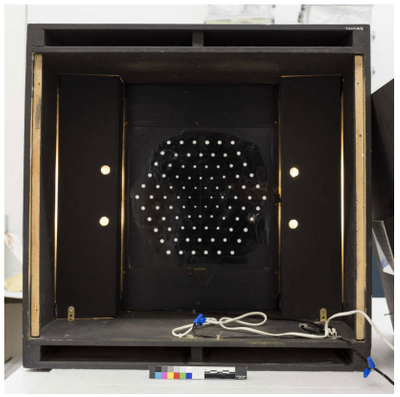

Figure 9.6c. Interior front panel after treatment.

The light fixtures were reused parts from electric-eye systems, one of which still had its label: "Berkeley Dynamic, Burlingame, California, 1981." Before purchase by the MFAH, this work had only one owner, California sculptor Benbow Bullock, so the Berkeley Dynamic fixture must have been installed by Bullock. Four severely charred holes on the inner acrylic layer behind the front panel do not

correspond in location to these fixtures, indicating that the original configuration was considerably different.

We contacted García Rossi's family for information but received no reply. Working on a theory that the original light source had been four bare incandescent bulbs, replaced by Bullock with a safer alternative after a fire, we tested a substitute system of four 60W-equivalent LED bulbs aligned with the burn marks. This created far too much even light inside the box, resulting in all the acrylic rods in front being solidly illuminated, with almost none of the flickering necessary for the required "unstable" effect. The two pieces of asbestos-lined wood used by Bullock to mount the projector fixtures seemed likely to be recycled elements of the original arrangement, providing a baffle to reduce the light; however, without concrete evidence, we could not make changes to the object. Instead, we found replacement bulbs to display the object running as originally received.

Shortly before installation, we finally succeeded in contacting García Rossi's family and arranged a visit by Domitille d'Orgeval, a French art historian who is intimately familiar with García Rossi's work. She judged that the object's appearance with the electric-eye fixtures was acceptable for display, but also contacted a friend of the artist, Alejandro Marcos, who has worked on similar objects for French collectors. He provided sketches of the two styles of baffle used by García Rossi, which confirmed that the pieces of wood used by Bullock as a mount, one with two circular cutouts, were indeed very likely part of the original arrangement. He also said that the bulbs would have originally been 40W incandescent, which he has been replacing with LEDs in his own treatments.[2] The validity of Marcos's sketch was confirmed by later examination of a smaller work in the same series owned by Houston's Sicardi Gallery, which was found to have similarly shaded bulbs.

After *Structure à lumière instable no. 29* was deinstalled, we used Marcos's sketch as a reference for treatment. The replacement LED bulbs[3] greatly reduced the amount of heat generated, so we eliminated the asbestos lining and substituted four-ply mat board for the original wood (for convenience) (fig. 9.6c). The visual result when the object was turned on was somewhat brighter and livelier, with the flickering fully restored (see fig. 9.5).

Abraham Palatnik

In Brazil, Abraham Palatnik, an artist and engineer of Russian descent, abandoned traditional painting after seeing artwork made by schizophrenics, which he felt surpassed his own efforts despite their lack of formal training (Osorio 2004:97). Seeking to connect more directly to the subconscious, he made his first kinetic work in 1949, in which colored lights are diffused through a plastic screen and shaded by moving cardboard shapes. The museum owns a 1962 version, *Aparelho cinecromático (Chromo-kinetic set)* (fig. 9.7).

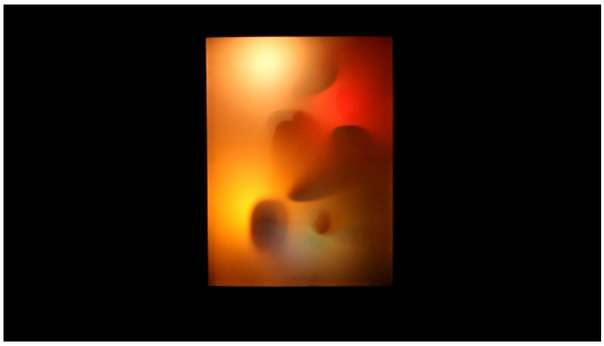

Figure 9.7. Abraham Palatnik's *Aparelho cinecromático* (Chromo-kinetic set), 1962, wooden box with plastic cover, electric motor, and colored light bulbs linked to a programmed electric circuit and cardboard paddles; after treatment. The Museum of Fine Arts, Houston, the Adolpho Leirner Collection of Brazilian Constructive Art, museum purchase funded by the Caroline Wiess Law Accessions Endowment Fund, 2007.21. Watch the video at https://youtu.be/wRws0HvLPB8.

Twenty-five colored and clear frosted bulbs inside *Aparelho cinecromático* turn on and off in a programmed sequence, while black cardboard shades move in front of the bulbs, casting shadows and obscuring lights (fig. 9.8). Some of the bulbs no longer functioned. When Palatnik visited the museum before this work was shown in the 2007 exhibition *Dimensions of Constructive Art in Brazil: The Adolpho Leirner Collection*, we discussed the problem of bulb replacement, because the bulbs were no longer made in the same color tones. We decided to replace the nonfunctioning bulbs with locally sourced colored bulbs for the exhibition, but the new bulbs produced noticeably less saturated colors. Some of the old bulbs are almost certainly replacements, but there is no documentation of the original color configuration, so the condition of the object upon accessioning is being used as the benchmark. Palatnik himself was unconcerned about the exact color of the bulbs or the replacement of any parts. During the 2015 treatment, we colored replacement bulbs with glass paints[4] using an airbrush to mimic the saturation of the older ones. The surviving old bulbs were removed for future reference.

Figure 9.8. The interior of Abraham Palatnik's *Aparelho cinecromático* (Chromo-kinetic set), 1962, wooden box with plastic cover, electric motor, and colored light bulbs linked to a programmed electric circuit and cardboard paddles; after treatment. The Museum of Fine Arts, Houston, the Adolpho Leirner Collection of Brazilian Constructive Art, museum purchase funded by the Caroline Wiess Law Accessions Endowment Fund, 2007.21.

Since then, we have explored Philips's Hue system[5] as a possible alternative to the painted bulbs. According to the manufacturer, these wireless-connected LED lights can create sixteen million different colors. Testing has shown that this is not yet the case: none of the color matches was as good as the painted replacements in value, hue, or saturation. Also, the Hue bulbs created a white center to the cast light that the old bulbs did not. Such "smart" bulbs will probably be useful to conservators in the future, however, as technology improves.

Other issues that have arisen include the wearing away of the copper comb, a critical element that makes the electrical connection from the power source to the various wires for the bulbs (fig. 9.9). When the comb does not meet the circuit board, some bulbs do not light as they should, and sparks occur as the current jumps that short distance. In 2014 the comb had worn away to such an extent that it was necessary to replace it with a replica cut from copper sheet. The replacement comb became noticeably worn during the 2015 exhibition, which suggests it will have to be remade quite frequently. The copper elements on the circuit board are also wearing away, and this will need to be addressed in the future.

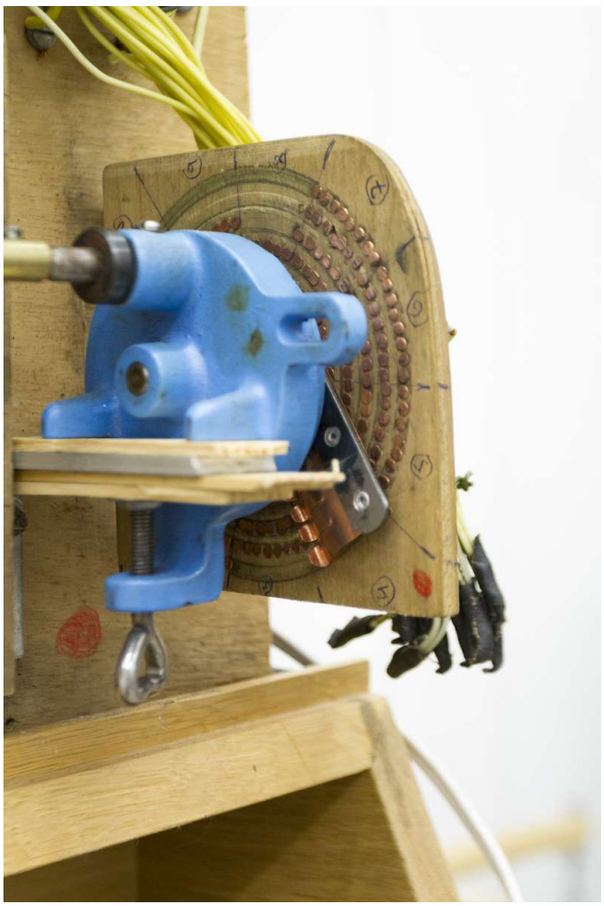

Figure 9.9. A detail of the interior of Abraham Palatnik's *Aparelho cinecromático* (Chromo-kinetic set), 1962, wooden box with plastic cover, electric motor, and colored light bulbs linked to a programmed electric circuit and cardboard paddles; after treatment. The Museum of Fine Arts, Houston, the Adolpho Leirner Collection of Brazilian Constructive Art, museum purchase funded by the Caroline Wiess Law Accessions Endowment Fund, 2007.21.

The motor, which moves both the cardboard paddles and the copper comb, is the other main problem. By 2009 the original 2-rpm SAPMI Type 392 motor had stopped working and needed to be replaced urgently for a loan. We could not find a 110V 2-rpm motor of suitable size in time, so we substituted a 24V 1-rpm motor plus transformer,

intending to find a more appropriate motor in the future. The half-speed replacement motor also ran in the opposite direction to the original motor, requiring the removal of two gears that Palatnik had used to reverse the direction of movement. The resulting output is therefore at the correct speed and in the correct direction, but the means of achieving it is different. The alteration in the location of the circuit board caused by the subtraction of the two gears might be considered ethically problematic, as a change to the artist's original design for the mechanism. However, it eliminated a true weak link in the design, reducing the likelihood of future breakdowns that might damage other parts of the object, and it produced a functional object from a nonfunctional relic. During the 2014 treatment, the 1-rpm motor was replaced with a 2-rpm alternative,[6] restoring the object's original speed while maintaining the newly simplified version of the drive shaft.

Gyula Kosice

Figure 9.10. Gyula Kosice's *La ciudad hidroespacial* (The Hydrospatial City), 1946–72, acrylic, paint, metal, and light. The Museum of Fine Arts, Houston, museum purchase funded by the Caroline Wiess Law Accessions Endowment Fund, 2009.29.1-.26. © Gyula Kosice. Photo: Matt Golden © The Museum of Fine Arts, Houston.

The work of Slovakia-born Argentinean artist Gyula Kosice is similarly science-focused, with a particular emphasis on space travel—in 1944 he declared that "Man is not to end his days on Earth" (Kosice 1944) and commenced a decades-long project imagining hydraulics-powered living environments for humans in space. Kosice's iconic installation *La ciudad hidroespacial* (The Hydrospatial City) (1946–72) (fig. 9.10) is kinetic only in the sense that the hanging "habitats" move slightly with the air currents in the room. However, we have had to replace many elements on the wall-mounted *Constelaciones no. 1–6 (Constellations no. 1–6)*, molded acrylic light boxes backlit with fluorescent tubes. The sockets and ballasts are reaching the end of their lives, and currently available components are slightly different in shape, making replacement far from straightforward. Late in life, the artist replaced the lights on his older works with LED strips when they developed problems. At what point should the MFAH abandon the troublesome fluorescents and follow suit? The quality of the light would undoubtedly change, eliminating the characteristic flickering of fluorescents.

As the components of light-based kinetic artworks become technologically obsolete and irreplaceable, their conservation has a challenging future. In some cases it may become impossible to maintain functionality along with every aesthetic aspect of the original experience. If the artist's practice involved updating the technology of his earlier works, should the conservator imitate this? Or are visible changes only acceptable when it becomes impossible to keep the original lights operational? Thus far the MFAH has not taken such drastic steps for purely preventive reasons, but an upcoming loan of eight of these works, including *The Hydrospatial City*, may precipitate a reevaluation. Releasing these artworks to be operated under the stewardship of another institution has caused some concerns about preservation.

A work by Jean Tinguely displayed in a nonoperational state, while lacking a vital element of its original meaning and beauty, can still be appreciated for its form (Gagneux 2007:16). In contrast, the nature of the works discussed above generally precludes static display: some are not much more than a plain box when they are not functioning. Additionally, fetishizing the physical material and its connection to the artist over functionality is not in keeping with the philosophy of most of these artists, who explicitly described their works as industrial, scientific projects. In one of its manifestos, the GRAV group actually condemned the "cult of personality" of the individual artist in favor of the concept and the experience (GRAV 2004:513). Showing a video of the object in operation, next to the static original, is sometimes a good option for unreliable kinetic artworks. However, video is a less satisfying substitute for an immersive, light-based work, as the alteration to the appearance of the surrounding walls and space is entirely lost in the flat plane of a video monitor. Instead, at the MFAH, parts are replaced and repaired as needed, with limits on running time to reduce that necessity as much as possible.

During *Constructed Dialogues: Concrete, Geometric, and Kinetic Art from the Latin American Art Collection* in 2012, five of the electric works ran constantly during the day, and one could be activated by the visitor. In *Cosmic Dialogues* in 2015, the six works with more robust mechanisms were

run constantly, and three were activated by a single motion sensor. In retrospect, all of the works should have been turned on by individual motion sensors. The breakdown of the motor in Boto's *Déplacements optiques* served as a sharp reminder that works long considered robust are not immortal. In addition, the different states of the works confused both guards and visitors. The single motion sensor was not ideal, as it undermined the individuality of the works and, on a practical level, caused the security staff to stand in the doorway of the room rather than at its center, to avoid constantly activating the works. Separate proximity sensors for each object would allow a more contemplative viewer to experience a work for an extended period, while reducing runtime overall. This may be implemented in future installations.

The expanding role of MFAH conservators in the display of these objects has been an interesting exercise in compromise and collaboration. In the past, these objects have been worked on by the artist's friends and relatives, museum electricians, handy registrars, and preparators. All of these individuals have valuable expertise to contribute, and we continue to seek their assistance. But the conservator is better placed to collate this expertise, weigh the suggestions of all parties, and document all action undertaken. Preparing these artworks for permanent galleries offers further opportunities to develop best protocols for display while maintaining functionality.

✦ ✦ ✦

Notes

1. Orbitec E10 230V 15W. Don Schnapp Specialty Bulbs, 2600 Pope Canyon Road, Saint Helena, CA, 94574; http://www.donsbulbs.com/cgi-bin/r/b.pl/e5850~orbitec.html.
2. Alejandro Marcos, in discussion with the authors, April 2015.
3. LED bulbs, soft white A19 450 lumens, 2,700K, 40W equivalent, manufactured by Philips USA. Supplied by Home Depot, Atlanta, GA, 30339-1834; http://www.homedepot.com /p/Philips-40W-Equivalent-Soft-White-A19- LED-461145 /206783826.
4. Vitrea 160 Glass Paints, manufactured by Pébéo. Supplied by Dick Blick Art Materials, P.O. Box 1267, Galesburg, IL, 61402-1267; http://www.dickblick.com/items/02950-1109/.
5. Philips Lighting B.V. "Meet Hue." Philips, accessed July 28, 2016, http://www2.meethue.com/en-us/productdetail/philips-hue-white-and-color-ambiance-starter-kit-a19.
6. 2-rpm motor, counterclockwise synchronous geared Autotrol PX-300. Manufacturer: Autotrol.

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10.

Intertwined Strategies for Conservation and Display of Kinetic Art: Case Studies in the European Neo-Avant-Garde

Francesca Pola
Barbara Ferriani

This paper focuses on seminal case studies in the conservation and display of kinetic art from the European Neo-Avant-Garde, examined from the interdependent points of view of the authors: curator and conservator. Francesca Pola is an independent art historian and curator who has a special focus on conservation in her display concepts, while Barbara Ferriani is a conservator who pays particular attention to display in her practice of conservation. The case studies presented below resulted from the authors' direct and sometimes shared experience and from their discussion of issues in their intertwined strategies and practices.

Through four case studies of works by Italian artists, we address the issues raised by kinetic objects, installations, and environments in relation to both conservation and display. The focus of this paper is not on technology producing movement but rather on the viewer's interaction with these immersive devices, such as behaviors induced by the combination of these two elements. We explore action-based pieces and systems created by exponents, particularly Italian, of the European Neo-Avant-Garde, who used very simple technology.

Behavioral Kinetics

Giacomo Balla's *Bambina che corre sul balcone* (Girl running on a balcony), from 1912, is in the collection of the Galleria d'Arte Moderna in Milan and is currently undergoing restoration in Ferriani's studio (fig. 10.1). It has a direct relationship with photodynamic research on the kinetics and behavior of the body, and the artwork features an experimental technique. *Bambina che corre sul balcone* is one of the masterpieces of Futurism: the Italian root for the immersive, physical, tactile experience of movement—or, better, of space through movement. This kind of direct tactile and immersive interaction is a characteristic of the kinetic artworks we discuss, and it has generally been achieved by the artists' explicit choice of an elementary technology.

A human figure in motion means physical and psychical involvement, which is the topic of this paper. Images depicting human bodies in motion, such as *Bambina che corre sul balcone*, could be compared to Ugo Mulas's 1970 photograph showing artist Gianni Colombo walking inside one of his environments, *Topoestesia (Tre zone contigue—Itinerario programmato)* (Topoesthesia [Three contiguous zones—Programmed itinerary]) from 1965–70 (fig. 10.2).

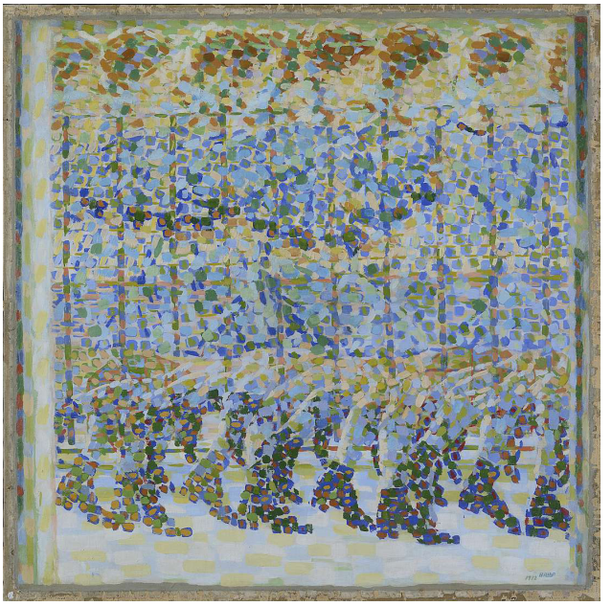

Figure 10.1. Giacomo Balla's *Bambina che corre sul balcone* (Girl running on a balcony), 1912.
Galleria d'Arte Moderna, Racc. Grassi, Milan. © Comune di Milano. All rights reserved.

Figure 10.2. Gianni Colombo walking through his environment *Topoestesia* (*Tre zone contigue—Itinerario programmato*) (Topoesthesia [Three contiguous zones—Programmed itinerary]), 1965–70, Palazzo delle Esposizioni, Rome, 1970.
Archivio Gianni Colombo, Milan. Photo: Ugo Mulas © Ugo Mulas Heirs. All rights reserved.

Case Study 1

Gabriele Devecchi's 1959 *Scultura da prendere a calci* (Sculpture to be kicked), one of the earliest kinetic behavioral pieces (fig. 10.3), was first presented after the artist's death in 2011 at the exhibition *Tecnica mista: Come è fatta l'arte del Novecento*, at Milan's Museo del Novecento in 2012.

Figure 10.3. Gabriele Devecchi's *Scultura da prendere a calci* (Sculpture to be kicked), 1959.
Photo: © Antonio Ria, 1983. Palazzo Reale, Milan.

The replica, carried out by Ferriani, was executed following a prototype in the artist's studio and directions from the artist's son. The kinetics of the piece depend on the action of the spectator: the artwork has no meaning without interaction. The shape of the sculpture changes haphazardly after it is kicked—and it must be kicked—but this interaction means that the piece is gradually being destroyed.

The work is composed of eight expanded polyurethane parallelepipeds linked together with an elastic string, which is attached to a circular metallic base. Each parallelepiped is made of two polyurethane blocks that have been glued together and through which the elastic string passes. When the work is kicked, the elastic string extends, begins to weaken, and eventually breaks. The breaks occur mainly on the edges of the parallelepiped, where the glue creates high tension and inhibits the elasticity of the string.

As the life span of the work is extremely short—sometimes just a few hours—while exhibitions generally last from one day to several months, replicas were created for the Museo del Novecento exhibition, so the work could be replaced when the elastic strings broke. Despite this, all the replicas broke within a few weeks; at the request of the artist's archive, a solution was found that would preserve the interactivity of the piece for a longer amount of time. To allow the elastic string to slide, we ran it through a small transparent tube, which was placed where the two polyurethane blocks meet. We also used a glue with an elasticity much closer to that of polyurethane. Although the modification is not visible, we let the curators decide

how to show the work: as originally conceived by Devecchi, despite its short life span, or as newly remade, which sacrifices the original technique but allows a longer-lasting display. In agreement with the artist's archive, the curators decided to display the new version during the exhibition.

Case Study 2

In Gianni Colombo's 1967 artwork *Spazio elastico—due cubi* (Elastic space—two cubes), the outline of two cubes sinks into a metallic surface in slow motion. The effect of movement is further enhanced by the reflectivity of the metal panel (fig. 10.4). The work is made of a flat, chromed metal surface inserted into a black-painted wooden frame. Eight holes in the metal plate allow eight metal tubes in the shape of two cubes to be pulled in and out. The back-and-forth movement of the cubes is created by two small, synchronized, single-phase motors. Inside the work, each cube is attached to a plastic plate. Each motor moves two levers, which in turn move two small wheels, raising and lowering the plastic plates, thereby moving the cubes up and down.

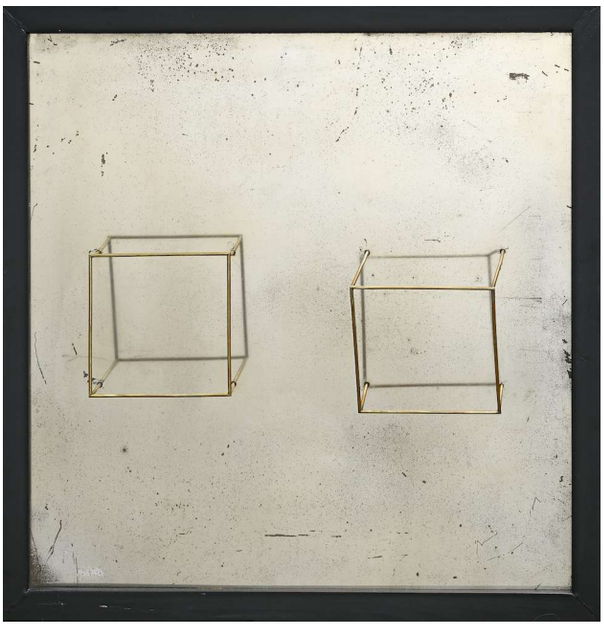

Figure 10.4. Gianni Colombo's *Spazio elastico—due cubi* (Elastic space—two cubes), 1967.
Archivio Gianni Colombo, Milan. Robilant + Voena, London, Milan, St. Moritz.

Over time, the chrome surface had become oxidized and scratched. It had lost its brilliance and reflectivity and no longer mirrored the movement of the cubes. In addition, the motors had stopped working. We evaluated the work to decide if we should accept the degradations of the original technological apparatus and not repair the components, or if we should repair them, even though this required removing or replacing some of the original elements.

With the assistance of an elderly technician who has a well-supplied warehouse, we decided to repair the motors, although the cubes' movement is no longer completely smooth due to a distortion of the original metal tubing. We also found two new motors, similar in form and function, that can replace the originals if necessary.

The surface degradation posed a more difficult question: should it be left as is, or would it be better to re-chrome it? This treatment, although common in the art market, would have meant irreversibly tampering with the original and different aging of the various components, giving the work an imbalanced and incorrect appearance. We decided to create a replica of the chromed metal piece. This way, the work can be shown in its present state, as witness to its history, or the original motors and the chromed piece can be replaced, to give the work its original appearance.

Case Study 3

These two pieces by Gianni Colombo—*Spazio elastico: doppio quadrato bianco intermutabile* (Elastic space: intermutable double white square) from 1973–80 and *Spazio elastico: rettangolo* (Elastic space: rectangle) from 1974—belong to his cycle of *Intermutabili*, or Intermutables, which addresses painted versus physical geometry. The works feature a grid of elastic strings or tubes with springs superimposed on a background of painted wood. The viewer can alter the shape of the grid by hooking the ends of the elastic elements to different fixed nails. The monochrome background contrasts with the tone of the elastic elements. In some works, the symmetrical form of the grid is painted on the bottom, and it interferes with any alteration made by the observer. The pieces are meant to be a true physical and metaphorical "exercise of freedom," with the spectator's hands on the surface, interacting with them.

The exhibition catalogue of the first show of *Intermutabili* at Studio Marconi in Milan in 1975 makes it clear that tactile involvement is essential to the behavioral kinetics of the artworks. In photographs taken by Maria Mulas, the artist himself is shown changing the configuration of the single pieces, and the catalogue's cover illustration focuses on the details of his hands in action on the surface.

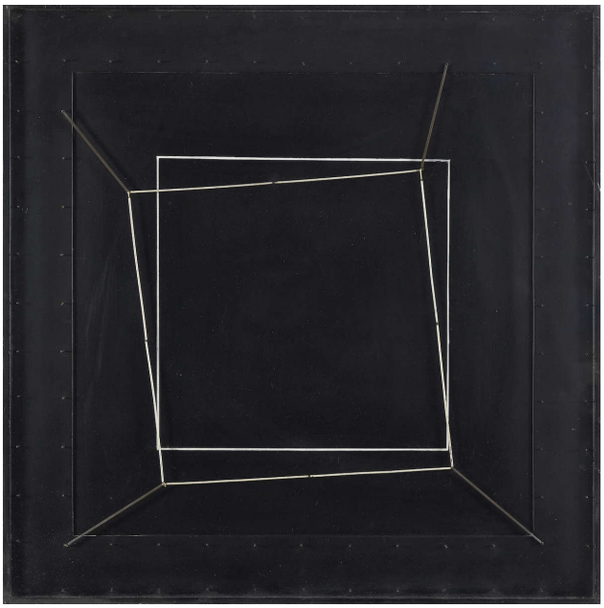

Figure 10.5. Gianni Colombo's *Spazio elastico: doppio quadrato bianco intermutabile* (Elastic space: intermutable double white square), 1973–80.
Archivio Gianni Colombo, Milan. Robilant + Voena, London, Milan, St. Moritz.

Spazio elastico: doppio quadrato bianco intermutabile (Elastic space: intermutable double white square) (fig. 10.5) is composed of a wooden board painted black; two square patterns are formed by white plastic tubes connected by a thin cord. Metal springs at the corners of the two squares can be anchored to any nail in a line of nails inserted along the perimeter of the black background, thereby changing the shape of the composition. Over time, the elastic springs that secure the squares had lost their elasticity and no longer functioned, and the white plastic tubes had weakened and, in some places, cracked.

A similar problem occurred with *Spazio elastico: rettangolo* (Elastic space: rectangle) (fig. 10.6). It is composed of a wooden board painted black, with a white rectangular and linear pattern painted in the center. Another pattern can be created by white elastic strings, the shape of which can be altered by attaching black elastic strings to any nail in two lines of nails inserted on the perimeter of the black background. All the strings had lost their elasticity and were elongated.

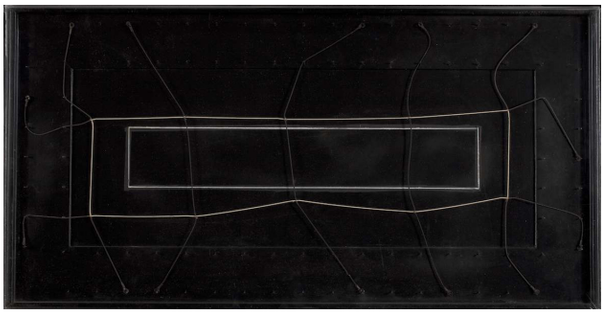

Figure 10.6. Gianni Colombo's *Spazio elastico: rettangolo* (Elastic space: rectangle), 1974. Private collection.
Archivio Gianni Colombo, Milan.

The question was: Should the various elements be replaced to make it possible to interact with the piece? Or should an exhibition copy be created, so that the interactive aspect could be retained while the original was preserved?

Pola was faced with a similar dilemma for the *Intermutabili* in *Gianni Colombo: The Body and the Space 1959–1980*, an exhibition at Robilant + Voena, London, in autumn 2015. Visitors would not be able to touch and manipulate the original *Intermutabili*, which are fragile, but there was not enough space to display exhibition copies next to the originals. Pola decided to display the originals next to Colombo's video artwork, *Vobulazione e bieloquenza neg (Wobbulation and Bieloquence Neg)* (fig. 10.7), realized in 1970 in collaboration with conceptual artist Vincenzo Agnetti and featuring the "intermutable" nature of the square. The two artists created it with a Wobbulator, a device that manipulates and distorts the electronic image of the square through human action and choice: the same concept as the *Intermutabili*. Because Pola could not allow the *Intermutabili* to be interactive, as they were originally intended, she chose a conceptual/contextual display strategy that respected the physical integrity of the objects while providing information on their full function as works of art.

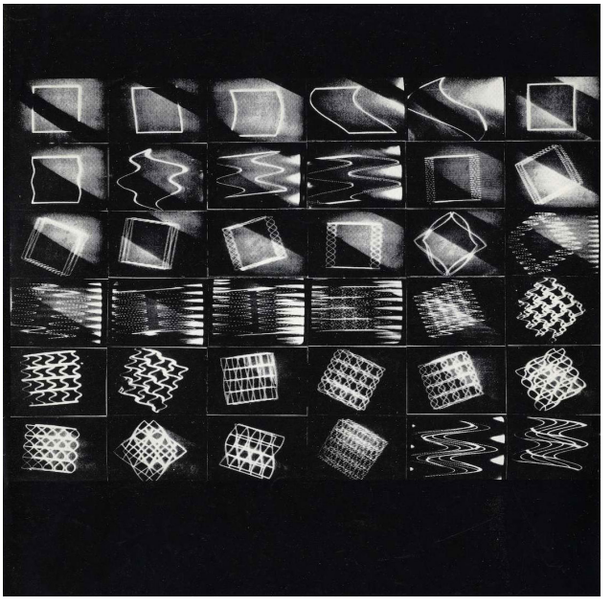

Figure 10.7. Vincenzo Agnetti and Gianni Colombo's *Vobulazione e bieloquenza neg (Wobbulation and Bieloquence Neg)*, 1970.
Archivio Gianni Colombo, Milan.

A similar solution was adopted for Jean Tinguely's *Méta-Matic No. 10* (1959). Exhibition copies are never allowed for these works by Tinguely, and curators sometimes provide a video of the artwork in action, as a documentation and presentation resource. However, we would like to underline that because *Méta-Matic* is about automatic motion, the video solution is practical. For Colombo's work, a video cannot replace the action of the spectator interacting with the art: the point of *Méta-Matic* is not the spectator's choice (as it is in Colombo's work) but the anonymity of the mechanical drawing.

Case Study 4

Gianni Colombo's *Topoestesia* (*Tre zone contigue—Itinerario programmato*) (Topoesthesia [Three contiguous zones—Programmed itinerary]), 1965–70, is the most immersive work of these case studies (fig. 10.8). This environment can be experienced at the Museo del Novecento in Milan, where it was first reconstructed in 2012. It was presented in London in 2015, its first appearance outside Italy. The Archivio Gianni Colombo has the original drawings, detailed plans, and even samples of original materials, so an exact replica of the original could be made using new materials. Immersive and "walkable" interactive environments such as this are not objects but experiences. They are more like a performance to be enacted by the spectator than an image or object to be looked at. Every time a performance is interpreted, it is not a reenactment but the real piece. We could ask ourselves: can we apply this kind of performative category to Colombo's "behavioral" environments?

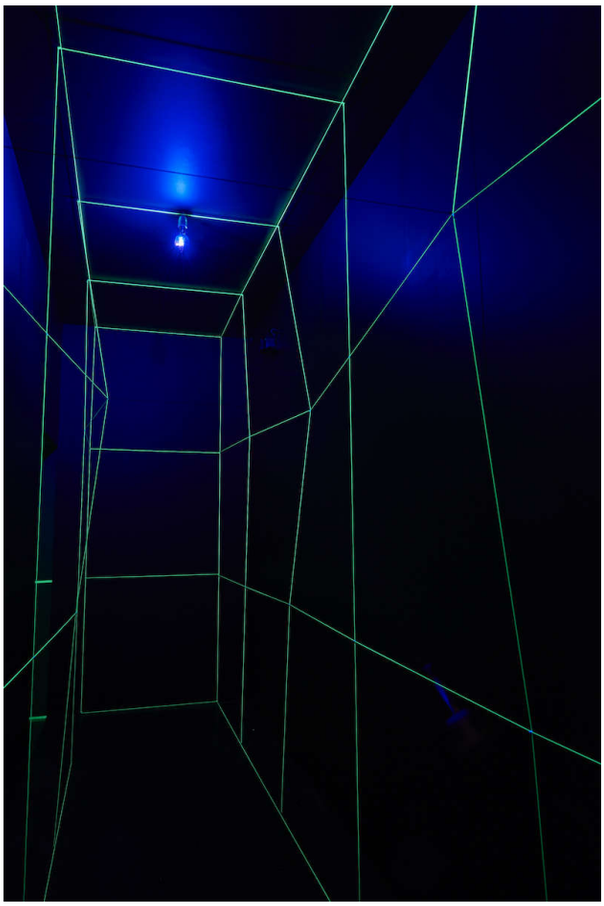

Figure 10.8. The third corridor of Gianni Colombo's *Topoestesia* (*Tre zone contigue—Itinerario programmato*) (Topoesthesia [Three contiguous zones—Programmed itinerary]), 1965–70.
Archivio Gianni Colombo, Milan. Robilant + Voena, London, Milan, St. Moritz.

Colombo coined the word *topoestesia* for this work: a sensory experience (*esthesia*) of a place (*topos*). We could call it an environment–itinerary or an environment–behavior. As the title *Tre zone contigue* suggests, it consists of three successive and parallel corridors of the same length. It is an itinerary that can be experienced only by being followed: it invites visitors to effect a psychic and physical immersion that does not end with the purely visual dimension, not even when they simply enter the environment, but requires further involvement, that of following it through to the end. The piece is activated each time a spectator walks in, so we could say that the artwork is the experience, as well as the physical environment that makes it possible. It is precisely this reenactment of the experience whenever one walks

through the environment that defines the uniqueness and the topicality of Colombo's work. It is analogous to performance practice, but with the responsibility of the action transferred to the viewer.

The viewer walks down the first corridor accompanied by the rhythm of a timed pulse of light, which reveals different geometric patterns on the walls, floor, and ceiling, depending on the type of illumination. Under ultraviolet light, an orthogonal green grid is revealed; under red light, a red cruciform layout. The second corridor adds a crucial element to this immersive destabilization, modifying the usual experience of space, which is generally orthogonal: a progressive twist of the floor and walls forces the viewer to walk in a situation of imbalance between inclined walls and on a surface that progressively changes its orientation.

In the third corridor, there is only a Wood's lamp (black light) and walls composed of a pulsating grid of elastic strings. The slow and almost imperceptible movement of the elastic strings is in stark contrast to the rhythmic pulses of light in the two preceding corridors, and the visitor is immersed in a darkness in which the only coordinates for finding the exit are provided by the "breathing" of the surrounding grid. With *Topoestesia* the artist wanted visitors to gain a more precise understanding of their habitual and conventional relationship with space, so they can free themselves of learned behaviors.

Colombo's intentions were expressed in the work's original installation at *Vitalità del negativo nell'arte italiana 1960/70*, in Rome's Palazzo delle Esposizioni, where *Topoestesia* was the first part of a longer itinerary. It was followed by two other walkable environments: *Campo praticabile* (Practicable field), by Colombo and Agnetti, and *Spazio elastico* (Elastic space). Further evidence can be seen in Ugo Mulas's photographs of Colombo, where the artist, as if on a theatrical stage, performs his own behaviors inside *Topoestesia*.

The reconstruction of this environment in 2015, as well as the reconstructions of all Colombo's environments, was carried out by the Archivio Gianni Colombo. As Marco Scotini, director of the archive, has stated: "Colombo's environment is a repeatable spatial device, a device which operates autonomously and, in some measure, anonymously … [and] which requires the direct participation of the spectator" (Ferriani and Pugliese 2013:100).

Conclusion

The purpose of this paper is to demonstrate how kinetic art, even more than other forms of artistic expression, requires a close collaboration between conservators and art historians/curators to ensure that it is conserved and displayed correctly. We are aware that the choices made to conserve artistic heritage often result from current approaches, not immutable criteria, and we have kept a range of solutions open to consideration.

We have attempted to identify, on a case-by-case basis, solutions that will maintain the historical value, the use value, the symbolic value and, not least, the economic value of kinetic art in such a way that, if not all works can be conserved, curators can choose which to favor. For example, one might decide to accept the deterioration of an original technological apparatus, thereby abandoning the recovery of the moving components, or decide to replace some elements, "updating" the work while acknowledging that its authenticity will be altered. As far as possible, we have sought solutions that can coexist.

Kinetic art is often interactive, and only in the exchange of information between curators and conservators is it possible to understand the limits and accuracy of conservation strategies and, at the same time, have these strategies allow a correct use of and involvement with the kinetic works, as close as possible to the meaning envisioned within their original concept.

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11.

The Examination and Conservation of Thirteen Artworks by Jean Tinguely in the Collection of the Stedelijk Museum Amsterdam

Esther Meijer
Susanne Meijer
Sandra Weerdenburg

Swiss artist Jean Tinguely (1925–1991) was a member of the New Realists and the ZERO movement, and he is known for his kinetic sculptures and reliefs. His association with the Stedelijk Museum in Amsterdam began with two exhibitions, *Bewogen Beweging* (Moving movement) in 1961 and *Dylaby* in 1962, and lasted until his death. The thirteen three-dimensional Tinguely artworks in the collection are being examined and, if possible, will be treated under the multidisciplinary Tinguely Conservation Project. This paper discusses the main focus and structure of the project and highlights some important issues and dilemmas within it.

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Tinguely and the Stedelijk Museum Amsterdam

The Stedelijk Museum Amsterdam holds thirteen three-dimensional kinetic works by Jean Tinguely (1925–1991). Created between 1954 and 1971, they provide a clear view of Tinguely's development as an artist. The earliest work in the collection is *Elément détaché III* (1954), a very fragile "thread relief," and the latest is the heavy machine *Méta II* (1971).

Former Stedelijk director Willem Sandberg and former curator Ad Petersen befriended Tinguely in the 1960s, and they started collecting his work for the museum after the Stedelijk's exhibitions *Bewogen Beweging* (Moving movement) (1961) and *Dylaby* (1962) (Schavemaker, Til, and Wismer 2016:155–61). Director Eduard de Wilde completed the current collection in 1974 with the purchase of *Méta-Malevich* (1954), *Gismo* (1960), *Baluba bleu* (1962), *Spirale IV* (1969), and *Méta II*.

Bewogen Beweging brought together works by artists including Daniel Spoerri, Marcel Duchamp, and Alexander Calder. It was a revolutionary exhibition, loved by the public but not well received by the art critics, who thought it too much of a "carnival" (Jobse and Schreuder 2014:61–65). The Stedelijk purchased *Méta-Matic No. 10* (1959) and *Elément détaché III* directly from the artist after this exhibition, and received *Fontaine* (1960), one of Tinguely's first fountains, as a gift.

In 1962, *Dylaby* shook the museum world. Tinguely was the project leader of and a participant in this legendary and controversial exhibition, which also showed works by Spoerri, Niki de Saint Phalle, Per Olov Ultvedt, Martial Raysse, and Robert Rauschenberg. The artists built the exhibition from scratch using all kinds of materials, mostly "found," and the public had to move its way through rooms designed by the artists, wandering between the objects and experiencing art in a completely different, nontraditional way. After the exhibition closed, almost all of it was literally thrown away as it was intended to be an ephemeral show. One of the few remaining artworks is Tinguely's *Radio Dylaby* (1962), making it an object of special interest. It was purchased immediately after the

exhibition, and Petersen's archives include pictures of Tinguely working on *Radio Dylaby* in the basement of the museum (fig. 11.1).

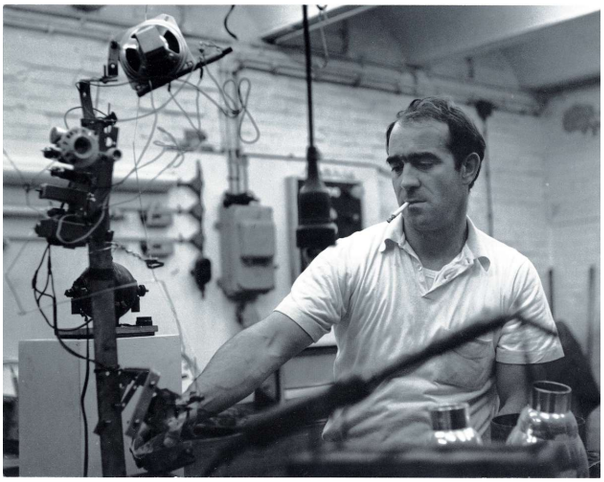

Figure 11.1. Jean Tinguely working on *Radio Dylaby* in the basement of the Stedelijk Museum Amsterdam, 1962.

Gismo (1960) is also of special interest because it was part of "Le Transport" in 1960, in which Tinguely drove his artworks through the streets of Paris (quartier Montparnasse) to the exhibition *L'art fonctionnel* in Galerie des Quatre Saisons (Schavemaker, Til, and Wismer 2016:60).

The Tinguely Conservation Project

While in the collection of the Stedelijk, the thirteen artworks were occasionally restored, primarily to keep them operational. Tinguely's works present complex conservation issues due to their construction, materials, and the original intention to show them in movement. This last aspect is one of the project's main concerns: can the works still function (move) and, if not, can they be returned to a functioning state? The machines are constructed in a way that can subject them to great force and stress when in movement, causing welds to break or parts to deform. The moving parts and motors can suffer from wear, and materials sometimes loosen, fall off, and get lost. Can materials be replaced and, if so, is it ethical to replace them?

Many of the materials Tinguely used were scrap and, from a conservation point of view, already in poor condition when the works were created. Consequently, conservators are confronted with practical and ethical issues related to the discrepancy between the meaning and intended appearance of the works and their current condition. It had long been a cherished wish of the conservation department to conduct an intensive analysis of the condition of these complex artworks and develop possible conservation and treatment options (Beerkens, Hummelen, and Sillé 1999:23–31). That wish became a reality after the museum's recent renovation and the construction of a new storage building. A new, large, multifunctional workshop, as well as upcoming Tinguely exhibitions, prompted the formation of the Tinguely Conservation Project (2015–16).[1]

Structure and Goals of the Project

The project, consisting of two phases, aims to document, preserve, and, where necessary, restore the thirteen three-dimensional works by Tinguely in the Stedelijk collection. Phase I includes research on the artworks and a condition assessment to formulate solutions to complex conservation issues. A special form (template) was developed to systematically gather and document information concerning the works' preservation, based on previous Stedelijk conservation projects such as Joan Jonas's *Vertical Roll* and Edward Kienholz's *Beanery*.

The form covers seven subjects. Both the current condition and the "original" condition (defined here as the point of entering the collection) are documented, as are any discrepancies between the two. Existing documentation, information on media, exhibitions, and literature, recommended conservation and restoration strategies, and any unanswered research questions are also included.

Extensive comparative research in the archives of the Museum Tinguely in Basel, among other places, provided valuable information about the history of the condition of the works and offered insight into changes in their appearance over time. Since the artist, conservators, and museum technicians have altered most of the works at some point, this type of research is important to determine the works' complete history and establish a point of reference for conservation purposes.

An expert committee helped formulate conservation options and strategies using a multidisciplinary approach. The committee members are specialists with specific knowledge, background, and experience in the conservation of Tinguely's works or are from other relevant disciplines. The decision-making model developed by the Foundation for the Conservation of Modern Art served as a useful tool in discussions (Beerkens, Hummelen, and Sillé 1999:164–72; Beerkens 1999).

Phase II involves the treatment of the works. The aim is to bring them to a stable state, coming as close as possible to the intention of the artist and their original appearance and function. Again, a multidisciplinary approach was indispensable in finding solutions for the many technical, practical, and ethical issues (fig. 11.2).[2]

The presentation of the artworks also receives special attention, including the possibility of showing them in an operational state or evoking this by other means (for instance, on video). All artworks in the project are documented photographically, on video, and/or on sound recordings. Phase II is still underway as of the writing of this paper.

Figure 11.2. Evelyne Snijders, Gerard Gleijm, and Esther Meijer working on Jean Tinguely's *Radio Dylaby*. Stedelijk Museum Amsterdam Collection.

Dilemmas and Issues Arising in the Tinguely Conservation Project

Tinguely's artworks present complex conservation issues due to their construction and materials, as well as the original intention to show them in movement. If a work is too fragile to function any longer (thus removing "movement" from the artwork's possibilities), we ask ourselves whether it is still truly a "Tinguely." What are we preserving? And how can we show the public the artwork in its present state and still convey the original expressiveness? If we want to stay or come as close to the intention of the artist and the original appearance as possible, movement is an important part of these kinetic artworks and should, ideally, be present.

During the project, various dilemmas and issues presented themselves, often relating to aspects of motion. After the works were visually inspected to see if motion would be possible without causing damage, they were plugged in to assess the functioning of the motor. In some cases, the motor was still functional but other factors hindered the intended motion, making operation inadvisable.

An additional challenge to conserving these objects is that most of the issues related to movement are not isolated but intertwined. Severe wear and tear can damage the work, influencing, for instance, the sounds produced. Historical functional additions and alterations can prevent wear and tear but sometimes alter the overall appearance. Water as an element of the artwork can cause severe damage to the base materials through corrosion, for example. As previously mentioned, many of the materials Tinguely used were scrap and already in poor condition when the works were made. Briefly discussed below are examples of issues encountered and how they were dealt with.

Wear and Tear

Wear and tear can be caused or accelerated by factors such as corrosion, material degradation, or external forces. Motion, however, is a great catalyst: any artwork shown in movement is subject to extra wear and tear. The intensity of wear is different for each work in this project; sometimes it was limited, but on other occasions the movement is so violent that the artwork is self-damaging. If wear and tear are inevitable, can it be reduced to a degree that is acceptable for preservation? And can that be done in such a way that it is in proportion to its original appearance and the artist's intention? One effective and widely used option to reduce wear and tear is to impose time limits on an artwork's operation (Bek 2013:203). Even though all Tinguely's artworks in the Stedelijk collection *can* move, they cannot responsibly be *made to* move all the time while on display, or even infrequently.

Figure 11.3. Filming Jean Tinguely's *Element détaché III (Relief méta-mécanique)*, 1954. Stedelijk Museum Amsterdam Collection.

Figure 11.4. Jean Tinguely's *Baluba bleu*, 1962. Stedelijk Museum Amsterdam Collection.

If an artwork can no longer be operated while on display, it can become a sort of "relic" to the public. One example in the Stedelijk collection is *Elément détaché III* (1954). When the work is in motion, the wires of its wheels can hook together. The motor keeps turning, however, and damage is very likely to occur, necessitating intensive and repetitive treatment. *Elément détachés* in other collections are also nonoperational,[3] which helped us to accept the fact that, due to its construction, this work is too fragile to be set in motion. Another supporting factor for this decision is that the artwork itself is relatively easy for the public to understand even without motion. It can be displayed with an accompanying video illustrating the movement to demonstrate the intention of the work (fig. 11.3).

Another method for reducing wear is to apply reversible protection, which was used with the traffic sign hanging on *Baluba bleu* (1962). The painted iron sign moves up and down when *Baluba bleu* is in action, and the non-original iron ring had damaged the traffic sign component on which it is suspended. (This traffic sign component had also stretched and been repaired in the past.) An iron insert now protects the opening on the traffic sign against further wear and stretching.

The non-original ring was replaced with iron wire resembling Tinguely's original attachment (figs. 11.4, 11.5a, 11.5b). The wire breaks fairly easy but is strong enough to hold the traffic sign during motion. This way, the wire wears and breaks before damage to the artwork occurs, and the original parts experience less wear. This principle was also applied to other works in the Tinguely collection.

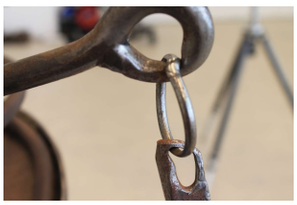

Figure 11.5a. Jean Tinguely's *Baluba bleu*, 1962, before treatment. Stedelijk Museum Amsterdam Collection.

Figure 11.5b. Jean Tinguely's *Baluba bleu*, 1962, after treatment. Stedelijk Museum Amsterdam Collection.

Black Paint

Tinguely used a black matte paint on many of his works to give them a more uniform appearance and to obscure the origin of the material (see Violand-Hobi 1995; Hulten 1975:275).

Due to wear and tear or degradation, this paint is not always in optimal condition and is sometimes even partly lost. The paint will be conserved and analyzed for both conservation and identification purposes. The results can later be compared with Tinguely works in other museums to gain more knowledge about the type of paints he used and, possibly, to establish cross-links with works of a certain time period to see if there have been changes over time.

Alterations and Additions

Alterations and additions were made to the artworks in the past, primarily to keep them operational. One recurrent issue is how to deal with those changes, especially if they are still functioning. Would replacing these additions or alterations be intrusive?

The approach depends on the type of alteration. Some alterations were approved by Tinguely and were done by him or under his supervision. It is uncertain whether other additions or alterations were performed with Tinguely's approval. It is very likely that Tinguely did not object to some alterations, such as the replacement of drive belts.[4] If no alternative treatment is available, we can consider replacing these parts and documenting and storing the original material for future reference (Bek 2013:204).

Figure 11.6a. Jean Tinguely's *Méta-Matic No. 10*, 1959. Stedelijk Museum Amsterdam Collection.

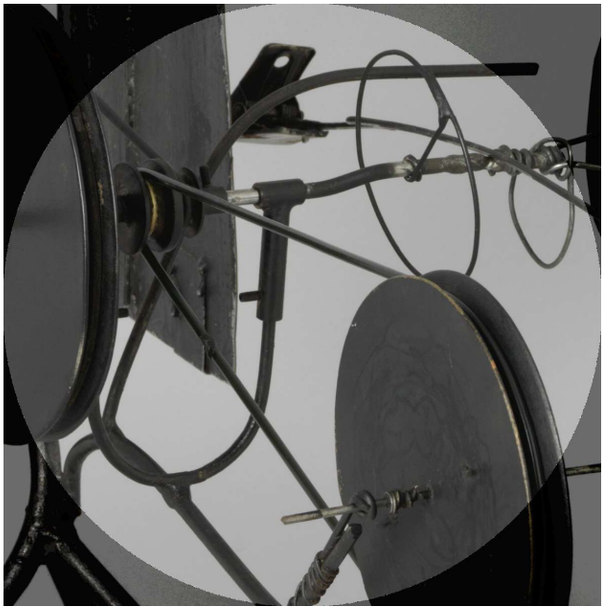

Figure 11.6b. Detail of the central element of Jean Tinguely's *Méta-Matic No. 10*, 1959. Stedelijk Museum Amsterdam Collection.

Some additions and alterations were neither approved (but not necessarily rejected!) nor performed by Tinguely; however, these clearly had been made to allow the works to move. It can be acceptable to keep and maintain these alterations if, as a result, the work remains safely operational and its appearance is not unduly compromised. Changes made without Tinguely's consent that compromise either safety or appearance should be considered for removal.[5] For instance, between 1963 and 1973 the central element of *Méta-Matic No. 10* (1959), a drawing machine, was replaced, but the reason for this was not documented. The original central element is visible in photos made around 1963, but films dated around 1972/73 show that, by then, the central element had been replaced. The central element still functions, although the appearance of the artwork has been altered (figs. 11.6a, 11.6b).

The new central element does not bear the hand of the artist. In the original, Tinguely had soldered the connections and wrapped them with iron wire, while the current version was produced in a factory and its center wheel is made of copper instead of the original wood. Both the new and original part were painted black. Tinguely could have been aware of the replacement (the drawing machine was in exhibitions in 1973 and 1983 that he attended); however, we have no documentation that he saw the alteration or approved it.

Currently the artwork is functional. The new central element was made to keep the work operational, and replacing it would entail an intrusive treatment. Therefore, this specific alteration will be retained as long as the drawing machine is able to operate, although for limited amounts of time and only under the supervision of a conservator.

If a work is no longer operational, then the removal of these later additions and alterations may be considered. The material from which the work is constructed then becomes more important than the "immaterial" elements, such as movement, sound, and interaction, which give the work additional layers.

Because the public can only experience a nonoperational work through the material object (apart from accompanying videos), it should be as authentic as possible. Preserving damaged original parts that could not be maintained in the operational work can be an option in a nonfunctional object. Therefore, in these cases, the material, together with additional (audio-visual) documentation, must be entrusted to tell the story the artist intended.

Sound

Tinguely's kinetic artworks produce sounds through movement: they squeak, clank, and creak. Sound as an element requiring preservation is a challenge: if the material changes due to wear, the sound changes too. Sound is a crucial element of *Radio Dylaby*. The artwork is a "radio" and broadcasts on AM frequency: the speaker produces a "live" sound that confuses the public because the motor arm continually changes the transmitter button, distorting the sound. Although the radio is currently functional, its tubes will no doubt be difficult to obtain in the near future because they will no longer be manufactured (as with, for instance, some types of light bulbs and photographic film).

The AM broadcast band signal is difficult to pick up, especially in the museum, and AM transmissions are disappearing (AM radio is no longer transmitted by Dutch broadcasters). However, stopping the actual radio from being used would mean that the radio tubes do not function, which influences not only the sound but also the appearance of the piece. The immediate feeling of time and place the radio emits would be lost (Bek 2011:205–15). When *Radio Dylaby* is working, the sounds produced vary by country and by broadcasting station; thus, the artwork changes as the location changes.

To preserve the sound and the local experience of *Radio Dylaby*, it was decided to produce a stand-alone AM transmitter that can be hidden in the pedestal.[6] Any audio source can be connected to this transmitter; for instance, digital/FM radio or historical or contemporary recordings. The radio tubes glow when the radio operates, and the audience experiences the sound. This temporary solution can only be maintained while we have spare tubes, and it is necessary to develop a strategy for the future, when all the tubes fail and can no longer be obtained.

Water

Tinguely used water as an element in his works, and two of his fountains are in Stedelijk collection. To experience the fountains as he intended, they should spray water, but this conflicts with the artworks' condition. So what exactly do we preserve without the water? And how do we document these fountains for future reference without good, early footage of them in operation? Can we safely make the fountains operational, if only just once, to see how they work and to obtain new footage? How else can the public and later generations understand and experience these artworks?

Documentation is a key element of this project, and documenting the sound, movement, *and* spraying of the water while we are still able, together with the physical work itself, does preserve the artwork. Such documentation entails a full risk assessment, taking into account possible material loss, before it is performed.

Conclusion

There are many facets to the Tinguely Conservation Project of which we have highlighted only a few, mostly related to motion issues. A multitude of issues and challenges (creation, techniques, ethics, history, transport, exhibition, etc.) addressed in the project cannot be discussed within the scope of this paper.

Motion is a major component of Tinguely's works, and one of the most important goals of the project is restoring the movement of the artworks while on display. However, if this cannot be achieved, other means are being explored to preserve it. Fully realizing that there are no clear-cut answers or solutions to many questions, we hope to have given some insight into the Stedelijk Museum's Tinguely Conservation Project and its ethical and practical challenges.

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Notes

1. Stiftung Museum Kunstpalast Düsseldorf, April 21–August 14, 2016; Stedelijk Museum Amsterdam, October 1, 2016–March 5, 2017.
2. From the conservation field, but also, for instance, a welding inspector, an electromotor specialist, a radio technician, and an expert in Tinguely fountains.
3. Other *Elément détachés* (number I and II) can be found in the collections of Museum Tinguely, Basel, and Museum of Fine Arts, Houston.
4. This assumption is supported by discussions with Tinguely's assistants and by the fact that the artist did not object to alterations in, for instance, electric components such as wiring and plugs (Bek 2013:202).
5. However, history is not clear on this point. Although we are not sure that Tinguely approved of some changes, this does not mean he disapproved. It is possible he did not express his approval or that these matters were left undocumented.
6. The AM transmitter broadcasts radio waves; the AM radio of the *Radio Dylaby* receives these radio waves and produces sound through the speaker.

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Part 4. Theoretical Issues

12.

The Hype about ZERO and Its Influence on the Conservation and Presentation of Early Kinetic Works

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Julia Giebeler

Increasing consideration is given today to the early kinetic works of the ZERO founders Otto Piene (1928–2014), Heinz Mack (b. 1931), and Günther Uecker (b. 1930). But is this hype a stroke of luck or misfortune for the preservation of their works? Through three case studies, this paper analyzes the influence of growing public interest on the preservation and presentation of kinetic artworks by examining the following aspects in more detail: 1) a changing evaluation of work components; 2) rediscovery and value enhancement; and 3) influences of exhibitions.

Introduction

In 1958, in search of a new artistic beginning—a *Stunde Null*, or "zero hour"—Otto Piene (1928–2014) and Heinz Mack (b. 1931) founded the artist magazine *ZERO*, which was later to give its name to an international art movement. In 1961 Günther Uecker (b. 1930) began to collaborate closely with Piene and Mack. They quickly gained considerable popularity through their light-kinetics, and they initiated numerous projects that involved other artists such as Jean Tinguely, Lucio Fontana, and Yves Klein. In 1966 Piene, Mack, and Uecker ended their collaboration and went their different ways. Inspired by a 2006 retrospective exhibition in Düsseldorf, the ZERO Foundation[1] was established in 2008 with the aim of preserving, presenting, researching, and supporting the oeuvre of the movement. Since then, numerous international solo and group exhibitions—including huge retrospectives in Paris, New York, Berlin, and Amsterdam, which ran from 2013 to 2015—reflect the new public appreciation of the ZERO movement.

But is this publicity a stroke of luck or misfortune for the preservation of the artworks? The following three case studies discuss the influence that this increased attention had on the conservation and presentation of these works, and the challenges it creates for conservators.

In the early years of ZERO and into the following decades, the artists or their assistants generally maintained the artworks, which involved occasional repainting prior to exhibitions, and conservators at the time continued this practice. The artworks' novelty value, artistic intention, and conceptual context were all given high priority; it was previously believed that the artworks should be flawless, and they frequently exhibited a brilliant white surface to achieve the effect of perfection without potentially distracting signs of aging or usage. Today the attitude of the artists seems to vary: while Mack continues to reject any form of patina on his works,[2] Uecker, who in the 1960s also desired art without any signs of aging, began to accept it in his early works in the 1990s.[3] In the past few years conservators have adopted the strategy of stabilizing and maintaining the works' historic condition with traditional conservation methods such as surface cleaning and inpainting, although repainting is still practiced. Today the repair of defective technical devices is given priority over replacement.

However, a significant crossroads was reached when Piene passed away in 2014. The well-established practice of involving artists in the mounting of their exhibitions and

in the decision-making process of preserving their artworks is now possible only to a limited extent.

Case Study I: The Rolandschule in Düsseldorf

In 1960 the architect Paul Schneider-Esleben, who designed and executed Rolandschule, a primary school in Düsseldorf, hired four young local artists—Piene, Mack, Uecker, and Joseph Beuys—to each create an artwork for the school. The work by Beuys was not fully appreciated at the time, and the school decided to return it to him shortly after the opening. *Lichtballett* by Piene, *Farborgel* by Mack, and *Schattenspiel* by Uecker were installed at the school, where they are still in situ today. Together they form a successful symbiosis of social architecture, functionality, and modern art.

In Piene's *Lichtballett*, incandescent bulbs mounted behind perforated aluminum plates light up in a programmed order and create a spherical light environment (fig. 12.1). The white panels of Uecker's *Schattenspiel* seem like heavenly bodies, simultaneously reflecting light and projecting shadows (fig. 12.2); the schoolchildren can move the panels and thereby influence the play of light. Mack's *Farborgel* consists of large, colorfully painted wheels with rotor blades; children can set these in motion with a flywheel that changes the color combinations (fig. 12.3).

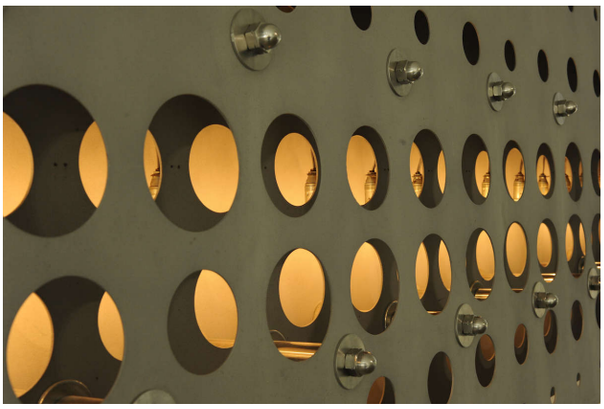

Figure 12.1. Detail of Otto Piene's *ohne Titel*, known as *Lichtballett*, 1961, at the Rolandschule, Düsseldorf, after treatment in 2011.

Figure 12.2. Günther Uecker's *ohne Titel*, known as *Schattenspiel*, 1961, at the Rolandschule, Düsseldorf, after treatment in 2011.

Figure 12.3. Heinz Mack's *Farborgel*, 1961, at the Rolandschule, Düsseldorf, after treatment in 2011.

However, two days after the school opened, a girl ran into a pane of glass and injured her hand. Although the artworks were not involved in the accident, Mack's and Uecker's works were deemed not compliant with safety regulations and were turned off; Mack's *Farborgel* was protected by a wire grid, and its flywheel was removed. Until recently, the children's experience of the artworks was still limited: barriers prevented them from using the *Farborgel* as intended. Piene's *Lichtballett* had been cleaned and decorated with plants; unfortunately, the control unit disappeared during renovation. Uecker's *Schattenspiel* had been covered with heavy white boards and all the light elements were lost (fig. 12.4); at that time, the artist no longer considered the installation to be one of his works.

Figure 12.4. Günther Uecker's *ohne Titel*, known as *Schattenspiel*, 1961, at the Rolandschule, Düsseldorf, before treatment in 2011. Photo: Gunnar Heydenreich.

As early as 1989 artist and lecturer Ulrike Scheffler-Rother supported the conservation of the works, and the Rolandschule was classified as a very important building in the city's architectural history (Scheffler-Rother 2004:2). The building and its contents have been listed as a protected monument since 1990 (Heimeshoff 2001:217).

The Conservation Project

The recent increase in public awareness in value of ZERO artworks led the ZERO Foundation to initiate a project for the preservation and mediation of the works in the Rolandschule, in collaboration with the city of Düsseldorf and the Cologne Institute of Conservation Sciences (CICS) (Heydenreich 2012:8–13). The goal of conservation treatment was to present the artworks as authentically as possible and to make them accessible to children. Students at CICS, in collaboration with the artists and a longtime artist's assistant, developed conservation concepts that were then executed with the assistance of external companies.

All of the planned measures had to be coordinated with and approved by the office of Artistic and Historical Heritage (Denkmalamt), and any alterations had to comply with safety regulations for public school buildings and community accident insurance. The municipal office of property management also had to agree to the suggested treatments.

For Piene's *Lichtballett*, priority was given to improving its safety and to reconstructing its original programmed light sequence. For safety reasons, the electrical wiring and the lighting unit were converted from 230V to 24V. The bulb shape, the original socket, and the light output, which defines the aesthetic of the installation, were preserved. Restoring the light sequence's programming was only possible in close collaboration with Piene, based on his recollection.

Using traditional conservation strategies such as minimal intervention and re-treatability, Uecker's *Schattenspiel* and Mack's *Farborgel* were cleaned, consolidated, and retouched. Both were equipped with new barriers that guarantee the artworks' and the children's safety and allow children to actively engage with the artworks. These new barriers (see figs. 12.2, 12.3) are not as incongruous as the old (see fig. 12.4). Because Rolandschule is a public building, the possibility of improper use of the artworks had to be taken into consideration, as well as the risk of injury from chain drives or insufficient wall anchorage—issues that are rather different from those in a museum context. Finally, fifty years after its creation, Uecker's *Schattenspiel* was—for the first time—presented in accordance with the artist's intention. However, children are only allowed to enter the space behind the barrier and play with the works when a teacher is present.

First Interim Conclusion

For the artworks in the Rolandschule, renewed appreciation for the ZERO movement has had positive consequences: a treatment was financed, and works that had been written off by the artists were brought back to life, with only minor changes, and can be appreciated once again. The conservation treatments reflect our shift in the approach toward early ZERO artworks in public settings. Interestingly, the artworks' preservation was also due to a growing awareness and the influence of the Ancient Monuments Protection Act. Works that had been turned off shortly after their creation survived several decades, motionless and nonoperational. Turning off the artworks helped preserve them, and they are now considered to be among the most important site-specific and authentically preserved light-kinetic installations by ZERO artists. However, the lack of maintenance provides a challenge for future preservation. Although a contract for regular maintenance of the works was suggested, it has not yet been implemented.

Case Study II: *Lichtraum (Hommage à Fontana)*

In 1964 Piene, Uecker, and Mack assembled seven artworks to create *Lichtraum (Hommage à Fontana)* at documenta 3 in Kassel (fig. 12.5a). The installation included both individual and collective works, as well as a slide projector that projected a photograph of a painting by

Lucio Fontana on the wall. Because they received their invitation to documenta later, all the exhibition spaces had been reserved for other artists, and *Lichtraum* was exhibited in the Fridericianum garret. This small, long, angled room had a low, gabled roof, and it was windowless and very dark. The concrete walls were initially untreated but were painted white before the exhibition opened.

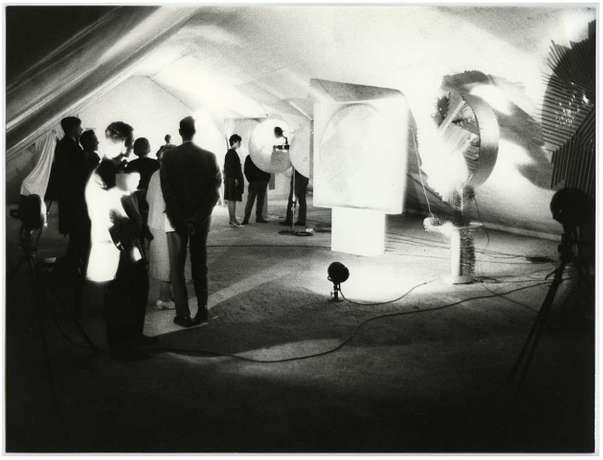

Figure 12.5a. Otto Piene, Günther Uecker, and Heinz Mack's *Lichtraum* (*Hommage à Fontana*), 1964, at documenta 3, Kassel, 1964.

1992 Kunstmuseum Düsseldorf

In 1991 the Kunstmuseum Düsseldorf acquired the available artworks from *Lichtraum (Hommage à Fontana)*, and in 1992 the artists were invited to reconstruct the installation in a museum context (fig. 12.5b). To complete *Lichtraum*, Mack made a replica of *Weißer Dynamo*. Uecker's *Lichtscheibe* was initially borrowed from the Kröller-Müller Museum in Otterlo, but it was also replaced by an artist's replica in 1993. In the new presentation, *Lichtscheibe* was not displayed on an easel, as it had been in 1964, but was laid horizontally on the floor (Caianiello 2005:71). The new room was much bigger and brighter than the Fridericianum garret and did not have a slanted ceiling. The artists tried to reconstruct the original installation, but the differences in the rooms' floor plans meant they had to arrange the artworks facing one another along a central aisle. This new arrangement also required some adjustments to the operating sequence for the different motors and light units. In Kassel in 1964, visitors had been allowed to experience the artworks up close; in Düsseldorf in 1991, two white lines separated the visitors from the art—for the artists, a very unsatisfactory safety measure.[4]

Figure 12.5b. Otto Piene, Günther Uecker, and Heinz Mack's *Lichtraum* (*Hommage à Fontana*), 1964, re-created at Kunstmuseum (today Museum Kunstpalast, Düsseldorf), 1993–2001.

2001 and 2005 Relocations

With the growing interest in ZERO, the Museum Kunstpalast Düsseldorf wanted to show *Lichtraum (Hommage à Fontana)* in a more central exhibition space, and a new room was provided in 2001. It was significantly smaller than the 1992 space, and Piene again changed the artworks' arrangement and adjusted their operating sequences. Although Mack criticized the new iteration, he accepted it; Uecker did not participate. In 2005 the installation was again changed, this time replicating the first presentation arrangement of 1964 in Kassel (fig. 12.5c). Uecker considered this result to be highly successful.

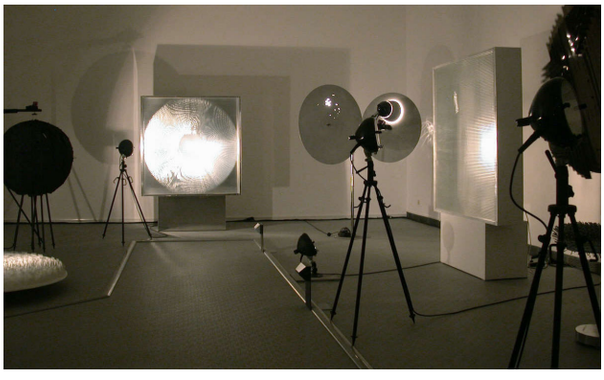

Figure 12.5c. Otto Piene, Günther Uecker, and Heinz Mack's *Lichtraum* (*Hommage à Fontana*), 1964, re-created at Museum Kunstpalast, Düsseldorf, in 2005–10, following the Kassel presentation of 1964.

2013–15 Exhibitions in Paris, New York, Berlin, Amsterdam

The kinetic objects composing *Lichtraum* are very fragile, and loan requests were rejected for decades. However, after a long discussion phase while planning the ZERO exhibitions in Paris, New York, Berlin, and Amsterdam,[5] the Museum Kunstpalast Düsseldorf decided to lend *Lichtraum* on the condition that replicas be used for the original light panels from *Weiße Lichtmühle* and *Lichtkugel*. For the New York exhibition, Guggenheim Museum curators reconstructed the spatial impression of the 1964 presentation by using fabric panels to suggest the slope of the ceiling, which unfortunately did not provide an ideal surface for slide projection (fig. 12.5d). Piene had previously rejected this type of historicizing reconstruction.[6] In Berlin, curators at Martin-Gropius-Bau arranged the artworks in a row in a comparatively large, bright exhibition space fig. 12.5e), with the size of the room predetermined by the museum floor plans. At the Stedelijk Museum Amsterdam, a relatively small exhibition space was chosen to present *Lichtraum*, and the artworks were installed in a more dense arrangement (fig. 12.5f). The strategy to adapt *Lichtraum* to new spatial conditions corresponds to the initial approach of the ZERO artists but caused some conflict with the artworks' preprogrammed sequences of operation.

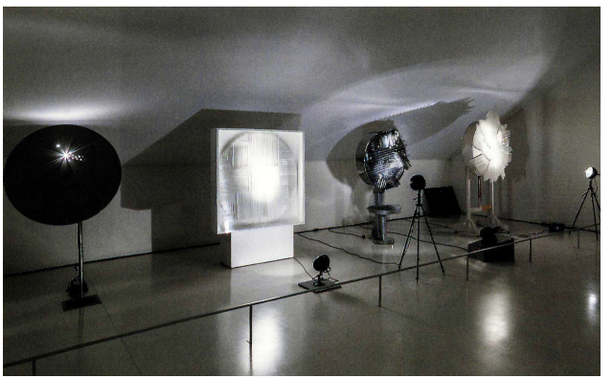

Figure 12.5d. Otto Piene, Günther Uecker, and Heinz Mack's *Lichtraum* (*Hommage à Fontana*), 1964, at the Guggenheim Museum, New York, October 10, 2014–January 7, 2015.

Figure 12.5e. Otto Piene, Günther Uecker, and Heinz Mack's *Lichtraum* (*Hommage à Fontana*), 1964, at the Martin-Gropius-Bau, Berlin, March 21–June 8, 2015.

Figure 12.5f. Otto Piene, Günther Uecker, and Heinz Mack's *Lichtraum* (*Hommage à Fontana*), 1964, at the Stedelijk Museum Amsterdam, July 4–November 8, 2015.

Second Interim Conclusion

Since its first presentation in 1964, *Lichtraum (Hommage à Fontana)* has been repeatedly adapted to fit different spatial conditions (Caianiello 2005:68–75). The work was initially displayed in the cramped, gabled-roof room of the Fridericianum because the other documenta 3 exhibition spaces were already in use; since 1984 the installation has been shown in larger rooms, which has pleased the artists. Since *Lichtraum*'s creation, varying exhibition conditions, financial resources, and artistic and curatorial interpretations have greatly influenced the work's appearance. At the Guggenheim Museum in New York the specific spatial situation in the 1964 exhibition, with its sloping roof, was reconstructed for the first time. But is

this an expression of a rising historicization or nostalgia, a sort of romantic idealization of the past? Does growing appreciation also bring with it a bias toward historically "accurate" presentation? The strategy of adapting *Lichtraum* to new exhibition spaces also raises the question of who is responsible for setting up *Lichtraum* and, if necessary, adapting the choreography of all the elements when the artists are gone.

Case Study III: *Weiße Lichtmühle*

Weiße Lichtmühle is a collective work by the three ZERO artists, and it represents their aim to overcome traditional painting. It consists of Piene's former easel, which serves as a basis for a white rotor by Mack. It was partly nailed by Uecker. The rotor has white blades; Piene created perforations through which a light-ballet is projected on the museum walls. *Weiße Lichtmühle* was exhibited in Berlin before documenta 3, and after Kassel it traveled to an exhibition in Philadelphia.[7] Damaged during transport, the work returned to Uecker's studio, where he repaired the base with additional wooden planks, repainted it, and partially resprayed it. The combination of aluminum, wooden battens, and numerous paint layers promoted stress cracks and reduced adhesion, with some paint losses, making a loan request untenable.

Exhibition Copy, Partial Replica?

To show *Lichtraum (Hommage à Fontana)* at all exhibition venues, the Museum Kunstpalast Düsseldorf decided to produce a partial exhibition copy of *Weiße Lichtmühle* by creating a replica of the light panel. Mack was asked to oversee the production of this partial replica, a strategy that, to some extent, continued the approach traditionally taken to maintain *Lichtraum* (Köhler 2013:26). The partial replica of *Weiße Lichtmühle* was intended to preserve and protect the current condition of the fragile light panel for the duration of the exhibitions. The artwork had been created about fifty years ago, and it was possible to discern the aging of its surfaces.

Figure 12.6. The condition in 2016 of Otto Piene, Günther Uecker, and Heinz Mack's *Weiße Lichtmühle*, 1963, Museum Kunstpalast, Düsseldorf.

However, contrary to the agreement with the museum, the artist reworked the original panel. Afterward Mack stated that he had wanted to correct the last repainting done by Uecker, who had, according to Mack, used the wrong white tone. Furthermore, Mack was no longer convinced of the advantages of using an exhibition copy.[8] Thus the original light panel was repainted for at least the fifth time, which unfortunately created a visual imbalance within the artwork: there is a considerable discrepancy between the bright white color of the repainted panel and the aged, yellowish-white paint on the easel (fig. 12.6). A conservation studio[9] was commissioned to produce the exhibition copy of the light panel, which should integrate harmoniously, and temporarily, into the overall structure (Erhan 2015:6-16).

In this case Mack followed his artistic practice and prioritized the functionality of the work. The museum asked Mack to guide the production of the partial replica,

because this corresponds to previous practice. The curatorial decision also shows that the authenticity of this artwork is still closely tied to the involvement of the artist.

Discussion and Conclusions

Early ZERO works are still regarded as contemporary art, although they are also transitioning to historical art. Contemplation of the varied treatments of these works over time provides new insight: increased appreciation of the artworks can contribute to their preservation. The ZERO installations at the Rolandschule, for example, were essentially ignored for decades; now they operate in accordance with the artists' intentions and are considered the most important site-specific ZERO installations in Düsseldorf. Although these artworks are appreciated and promoted, continuous conservation maintenance is still lacking.

However, the increased attention to ZERO can also pose risks. The more frequent use of kinetic objects causes wear and tear, even when limited periods of operation are imposed. An escalation in the number of temporary exhibitions and associated transport create further risks for the fragile objects. The attempt to loan *Weiße Lichtmühle* without endangering the original by asking the artist to produce a partial replica backfired. The historical paint layer that corresponded to the paint on the easel was partly removed, and the new, white, glossy paint layer on the original light panel diverges greatly in appearance from the aged white paint on the easel. As the artworks continue to age, constant repair and updating by the artists or their assistants, on the one hand, and a growing museumization and the aspiration to preserve an almost unaltered "authentic condition" on the other hand can lead to conflicts and dissatisfying compromises.

The reconstruction of the programming of Piene's *Lichtballett* in the Rolandschule can be viewed as a successful example of involving the artist to ensure the integrity and identity of the work. The example of the replica light panel in *Weiße Lichtmühle* shows that involving artists can produce unexpected and unintended results that curators and conservators may consider undesirable. The repainting or reworking of artworks by artists or their assistants was once accepted as a legitimate strategy. Today an approximation of traditional conservation strategies and the goals of minimal intervention and reversibility are observed. The once fundamental novelty value, or *Neuheitswert* (Riegl 1903:22–29), of the ZERO works, which required a flawless artwork, has been replaced by an appreciation of aging, or *Alterswert* (Riegl 1903:46–57). Signs of aging and patina are frequently accepted today—at least in the museum context—and are occasionally even considered proof of authenticity, as they communicate the history of the objects. Even Mack, Piene, and Uecker began to differ in their evaluation of those signs of aging, and Uecker's contradictory statements demonstrate that artist interviews are of limited assistance in developing a conservation concept.[10]

An artwork's value is established by individuals involved at any given moment, and the problem is to define the shift from the appreciation of the *Neuheitswert* to the *Alterswert*. This also raises the question of who is allowed to negotiate prioritized values, and under which conditions. In this context it was observed that past treatments, such as repainting or the production of replicas, are often reevaluated over time. When they were added to the installation, the two replicas created by the artists in the 1990s for *Lichtraum*—Mack's *Weißer Dynamo* and Uecker's *Lichtscheibe*—first attracted negative attention because of their brilliant white surfaces. Today, they are seen as integral parts of the installation.

The restaging of installations now also seems to have reached a crossroads of contemporary versus historical art. The established practice of adapting *Lichtraum* to each different exhibition stage and to adjust the light sequence is part of the installation's identity. But there is a danger that the installation might lose authenticity when the artists are no longer available, and assistants, curators, or conservators inevitably bring in their own ideas. Should a historicized restaging with the sloping roof, or the installation from 1992 that Piene described as the new "standard," or a future "white cube" presentation define the guidelines?

Monuments from the 1960s are increasingly being granted special preservation status. All treatments "that could cause destruction or damage to monuments" are regulated by the heritage protection law and the permission restrictions therein, as well as other legal requirements (Schmidt 2008:140). Artworks in museums, however, are committed to guidelines set down by the International Council of Museums (ICOM),[11] and these allow considerable scope for decision making. Could the objectives and experience of heritage preservation, which provided clear guidelines for dealing with the artworks at the Rolandschule, also provide useful guidance for the preservation of artworks in the museum context, in particular those on the threshold between contemporary and historical art? This requires further investigation.

The experience of these three case studies suggests that the established practice of commissioning artists to

perform conservation measures or update their works within the museum context should be thoughtfully reconsidered. The importance and necessity of involving the artist needs to be balanced against the risk of irreversible changes and optimizations of the artwork (of course taking legal aspects into consideration). Further, heritage preservation guidelines should be contemplated by museums to meet the demands of the diverse expressions of contemporary art and address their long-term preservation, keeping them as authentic as possible for future generations by maintaining, retiring, and/or replicating.

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Acknowledgments

Tiziana Caianiello of the ZERO Foundation, and Ulrik Runeberg of Restaurierungszentrum der Landeshauptstadt Düsseldorf.

Notes

1. The ZERO Foundation, http://www.4321zero.com/.
2. Heinz Mack, interview by Kristina Herbst, in Herbst 2005, appendix D1, pp. 9, 15; Heinz Mack, interview by Gunnar Heydenreich and Julia Giebeler, in Giebeler 2011:appendix A1, p. 30.
3. Uecker 1961; Günther Uecker, interview by Tiziana Caianiello, Gunnar Heydenreich, and Cornelia Weyer, in Caianiello 2005:207.
4. Otto Piene, interview by Tiziana Caianiello, Gunnar Heydenreich, and Cornelia Weyer, in Caianiello 2005:182; Heinz Mack, interview by Tiziana Caianiello, Gunnar Heydenreich, and Cornelia Weyer, in Caianiello 2005:198; Caianiello 2005:72.
5. *ZERO—Paris-Düsseldorf*, Passage de Retz, Paris, July 11–September 18, 2013; *ZERO: Countdown to Tomorrow, 1950s–60s*, Guggenheim Museum, New York, October 10, 2014–January 7, 2015; *Zero: The International Art Movement of the 1950s and 60s*, Martin-Gropius-Bau, Berlin, March 21–June 8, 2015; and *Zero: Let Us Explore the Stars*, Stedelijk Museum Amsterdam, July 4–November 8, 2015.
6. Otto Piene, interview by Tiziana Caianiello, Gunnar Heydenreich, and Cornelia Weyer, in Caianiello 2005:181.
7. *Möglichkeiten*, Haus am Waldsee, Berlin, March 3–May 3, 1964; and *Groupe Zero*, Fine Art Department, University of Pennsylvania, Philadelphia, 1964. Cited after Caianiello 2005:87.
8. Heinz Mack, statement and clarification, March 23, 2013, in Köhler 2013:26.
9. Die Schmiede GmbH, Duisburg.
10. Uecker 1961; Günther Uecker, interview by Tiziana Caianiello, Gunnar Heydenreich, and Cornelia Weyer, in Caianiello 2005:207.
11. International Council of Museum (ICOM), Professional Standards, http://icom.museum/professional-standards/.

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13.

Kinetic Multiples: Between Industrial Vocation and Handcrafted Solutions

Isabel Plante

In the 1960s, kineticism attracted a wide audience, and exhibitions of kinetic art drew large crowds, apparently fulfilling the most ambitious objective of the avant-garde: to integrate art and life. Some kinetic objects were made in series: the idea of multiples was at the core of these artists' strategies of "demystifying" art objects by avoiding the uniqueness fetish. The idea of an industrial production of kinetic multiples made it possible to imagine the extension to a wider audience of the optically destabilizing effects of the visual artifacts. This paper analyzes kinetic multiples as an artistic production that discovered its limits and contradictions amid arguments about culture, standardization, and consumption around 1968.

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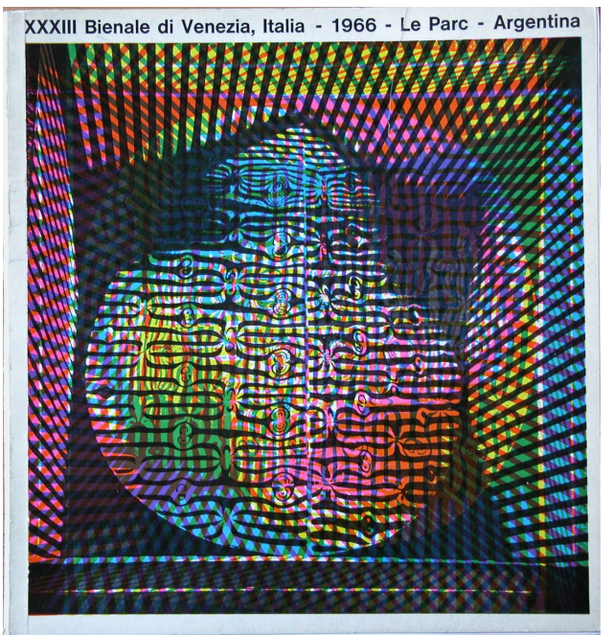

Figure 13.1. *Julio Le Parc*. Catalogue of the *XXXIII Biennale di Venezia, Italia*, 1966. Cover designer Rogelio Polesello overprinted a plot of colors on the black-and-white photograph of Le Parc's kinetic multiple. Museo Nacional de Bellas Artes Archive, Buenos Aires.

In 1966, Julio Le Parc represented Argentina in the Venice Biennale (fig. 13.1) and received the international grand prize in painting. According to the reviews, his space was one of the most visited.[1] As the appeal of kinetic art continued to grow and draw crowds to museums, kinetic artworks seemed to meet the most ambitious objective of the avant-garde: to integrate art and life.

Kineticism[2] was an international trend composed of different groups of artists who were in contact with one another, including the Groupe de Recherche d'Art Visuel (GRAV) in France, Gruppo T and Gruppo N in Italy, ZERO in Germany, Dwizjenije in Moscow, and USCO in New York. In 1964 the *Nouvelle tendance* exhibition at the Musée des Arts Décoratifs, Paris, had gathered about fifty artists from eleven countries.[3] In Pascal Rousseau's words, kinetic art was viewed "as a kind of Esperanto through which each individual would communicate with the world in the ecstatic intoxication of optical vibration" (Rousseau 2005:142–150).

A cognitive understanding of perception allowed the kineticists to claim that optical effects were not merely illusions. Altering visual and synesthetic perception entailed the literal and symbolic alteration of the ways in which each participant perceived him or herself and the

world. As Umberto Eco and Victor Vasarely pointed out in the early 1960s, while this art helped develop the sensorial capacity of modern viewers under new social and technological circumstances,[4] the resources implemented by kinetic art also intended to call into question not only the system of the fine arts but also a society that artists such as Le Parc thought had become automated.

Unlike central vision, which privileges the recognition of objects, peripheral vision takes in the surroundings and facilitates spatial orientation. Using it under extreme conditions of perceptual instability means attacking the viewer's sensation of his or her position in space. For example, Le Parc's eyeglasses altered vision through fragmentation, kaleidoscopic effects, and inversions of image.[5] Some of these artistic objects were made in series: the idea of kinetic multiples was at the core of these artists' strategies of "demystifying" art objects by avoiding the uniqueness fetish. A potential future that included the industrial production of kinetic multiples made it possible to imagine the extension of those destabilizing effects to a wider or unusual audience, such as Catholic priests (fig. 13.2).

Figure 13.2. Julio Le Parc's space at the Venice Biennale, 1966. The priest trying on Le Parc's eyeglasses may give an idea of the wider audiences artists hope to reach through art multiples. Denise René Archive.

In this paper, I analyze the kinetic multiple as a visual production that discovered its limits and contradictions amid the arguments about culture, standardization, and consumption around 1968. Although, as we shall see, kinetic multiples never achieved industrial production, within the context of the rise in the cultural market in Paris in the 1960s, kinetic artists (and some critics, such as Jean Clay) nonetheless felt that it could happen at any time. Focusing specifically on multiples—a crucial aspect of kinetic art production and circulation in the 1960s that art history has not previously problematized—may allow us to explore whether this industrial vocation could inform approaches to its conservation and restoration. Collaborative work between conservators and art historians on the materiality of kinetic art could lead to a pivotal question: did the edition of multiples contribute to standardized models, components, and solutions? Although I do not provide an answer in the text that follows, I invite you to consider that we may have arrived at the point of being able to formulate new discussions.

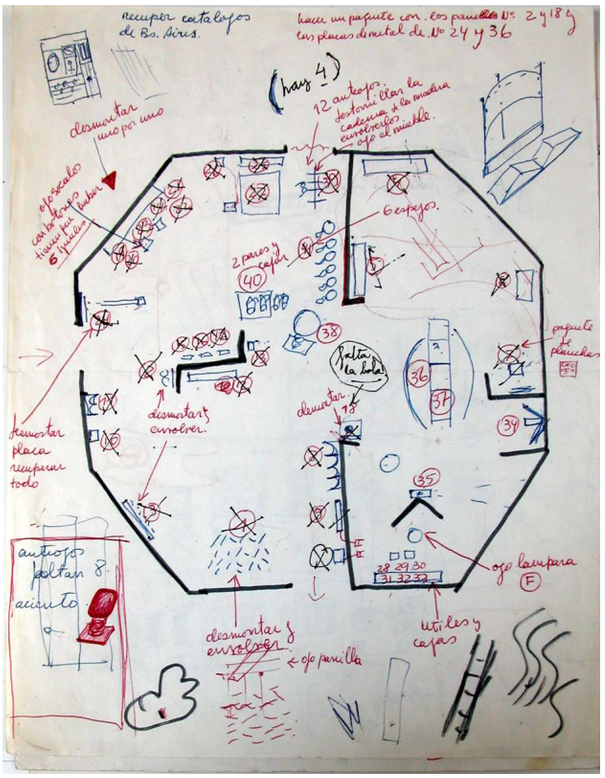

Figure 13.3. This plan of Julio Le Parc's space shows the layout of the works in the context of the international Venice Biennale, 1966. Le Parc Archive.

Le Parc's space in Venice (fig. 13.3) gathered around forty pieces,[6] an anthology of the research done in the context of GRAV.[7] The works were so appealing to the public that, through overuse, many of the mechanisms broke down only weeks after the Biennale's opening. Le Parc, trying to solve this problem, was told by a friend that Luigi Scarpa (who was responsible for the international section of the Biennale) had said that Le Parc's artworks were among the public's favorites because they could be handled, and it would be a pity if the works remained nonfunctional through the rest of the show. However, because the space was open to visitors ten hours a day, it

was a difficult problem logistically. Scarpa also asked if Le Parc wanted to have a Venetian put in charge of his exhibition.[8]

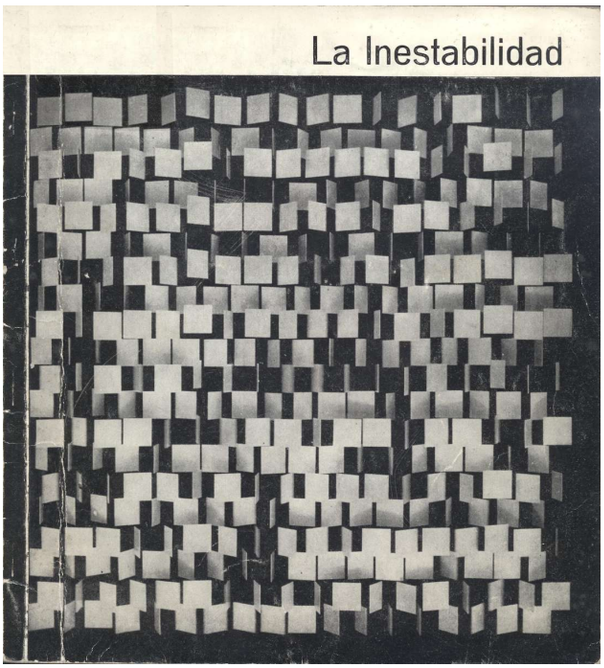

Figure 13.4. Cover of the catalogue for *La Inestabilidad*, the 1964 GRAV exhibition at the Museo Nacional de Bellas Artes, Buenos Aires, illustrated with a photograph of one of Julio Le Parc's *Continuels-mobiles*. Museo Nacional de Bellas Artes Archive, Buenos Aires.

It is likely that more people visited Le Parc's space after he won the international painting prize, but it was not unusual for his shows to be very well attended. GRAV's 1964 exhibition in Buenos Aires had attracted 50,000 visitors (fig. 13.4).[9] Two 1967 exhibitions—*Lumière et mouvement* at the Musée d'Art Moderne de la Ville de Paris, and Le Parc's retrospective at the Instituto Torcuato di Tella's Center for the Visual Arts in Buenos Aires—attracted unprecedented crowds. More than 150,000 people viewed the retrospective over twenty days.[10] The formal and material qualities of kinetic multiples also gave them wide appeal. Crowds were attracted to kinetic art exhibitions by the possibility of transforming an artwork's shape (that is, volumetry) and by the use of novel materials, including bright, translucent, or reflective surfaces such as Plexiglas and stainless steel.

After he won the prize, Le Parc took advantage of subsequent interviews to spread GRAV's tenets about kinetic productions. They were meant to be collective, multiple, and foreign to the art field:

> We should tend to the collective multiple, the playroom, the public demonstration, in which every group of spectators will be simultaneously involved and each of them become actor and object of the show at the same time. These labyrinths, these playrooms, have to be set up in military barracks, and HLMs.[11] It is necessary to overcome the solitude of the crowds and, in a way, rediscover the conditions of participation typical of primitive societies.[12]

The multiple as it was conceived by kinetic artists in the mid-1960s converged with the conventions of engravings, in that both involved the artistic production of series rather than unique pieces. But unlike engravings, the identical and reproducible kinetic artifacts were pervaded by the tensions between their industrial vocation and their effective insertion in the exclusivist logic of the art market (figs. 13.5, 13.6): series of kinetic objects were not numbered, as print series were, because the artists did not want to control the number of works in a series (and therefore the price in the art market). They desired an industrial manufacture that, although it seemed probable in the mid-1960s, never took place.

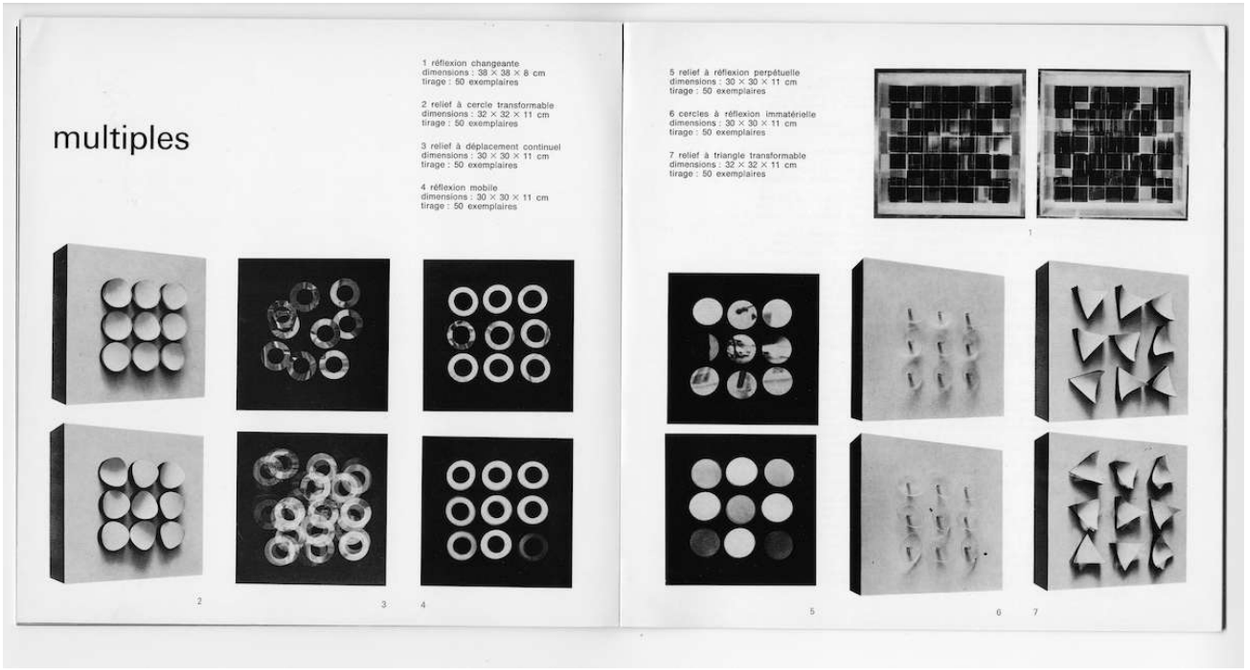

Figure 13.5. *Multiples* by Hugo Demarco, featured in the Galerie Denise René exhibition *Demarco: Dynamique de l'image* (April–May 1968) and the accompanying catalogue. The Parisian gallery supported the production of multiples and reserved a section for them in its exhibition catalogues.

From *Demarco: Dynamique de l'image, Galerie Denise René, Paris … avril–mai 1968*. Paris: Galerie Denise René; Société Mondial d'Impression, 1968. Reproduced with permission / © Hugo Demarco

There are precedents of multiples before GRAV; for example, Victor Vasarely and Daniel Spoerri had explored the serial production of artistic objects.[13] In fact, in 1959 Spoerri had tried, to no avail, to acquaint the Galerie Denise René with his Edition MAT (Multiplication d'Art Transformable). For these editions, he had called on artists connected to René's gallery: Yaacov Agam, Pol Bury, Jesús Rafael Soto, Jean Tinguely, and Vasarely, as well as German artists Heinz Mack and Dieter Roth. But René's strategy was based on the artists' proven recognition before their multiples were placed on the market. The artists recommended by Spoerri were young and not yet established, and René did not pursue his initiative. Thus, it was only around the mid-1960s that the conditions to launch this form of art seemed more suitable.

Figure 13.6. A card advertising works by both Martha Boto and Gregorio Vardanega, ca. 1969. These artists were a couple and shared a workshop as well as exhibitions. Museo Nacional de Bellas Artes Archive, Buenos Aires.
Courtesy of the estate of Gregorio Vardanega and Martha Boto, and Sicardi Gallery.

Le Parc's triumph in Venice provided the exposure and recognition necessary to place multiples in an art market already crammed with all kinds of artworks and reproductions. In July 1966, René opened a second gallery on the Left Bank in Paris specifically for multiples. The first exhibition focused on Vasarely; the second exhibition, *Multiples recherches*, opened in October and featured Le Parc.

Norberto Gómez, a young Argentine artist who had helped Le Parc assemble the artworks sent to the Venice Biennale, recalls that the first multiples had been handmade, but that after obtaining the prize, Le Parc and his assistants standardized the process and increased their production considerably. "After the Biennale, the sales came. They set up a large studio,"[14] said Gómez. Having moved to Paris, Argentine artists Armando Durante and Gabriel Messil began to work on the production of Le Parc's multiples commissioned by René. Antonio Seguí, another Argentine artist living in Paris, recalls that "Fatty" Durante and Messil also earned handsome sums of money.[15]

After 1965 an increasing number of galleries and artists produced and sold multiples to a restricted market that was quickly saturated.[16] René registered the term *multiple*[17] in the hope of enjoying exclusive use of it and thus asserting her long practice as an Abstract Art dealer and her close relationship with Vasarely, a pioneer in the serial production of geometric art. In late 1967 art critic Otto Hahn presented an overview of the success achieved by the multiples in Paris:

> In less than a year, this trend developed and grew to the extent that the word "multiple" now sounds like "open sesame." Even lithographs use the sweet

> name of "Multiples." [...] Some want to do away with the structures of art distribution; others would socialize art. In times of euphoria, confusion is inevitable.[18]

Prices and options varied. The Galerie Givaudan opened in 1965 and specialized in multiples, following the model of publishing houses: large-scale editions, with the same price for famous artists and newcomers. Thus Givaudan aspired to moralize an art market that grew apace with France's modernization without modifying its elitist logic (see Hahn 1968).

René opted to have the production of the works supervised by their respective creators. Unlike Le Parc and GRAV members, she disliked unlimited editions. In her view, after 100 copies had been made, the others would be produced unsupervised by the artist, a fact that detracted from their quality. She also opposed the "demystification of art," so much discussed by GRAV members, because she felt it meant equating an art object with a mere consumer item. She maintained that "art must keep its aura and continue to be a high quality product that bears witness to a way of thinking about the world."[19] Charging more accessible prices, René intended to spread modern art among social sectors whose purchasing power prevented them from buying unique works. For her, it was about democratizing access to ownership of art objects ... and increasing sales.

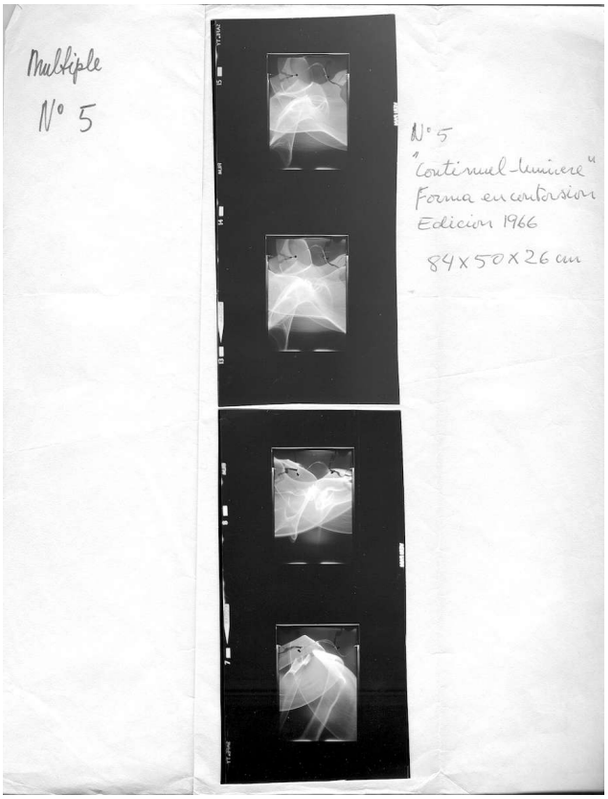

Figure 13.7. Julio Le Parc's *Multiple no. 5*. *Continuel-lumière*. *Forma en contorsión*, 1966 edition, 84 × 50 × 23 cm. Archivos di Tella, Universidad Torcuato di Tella.

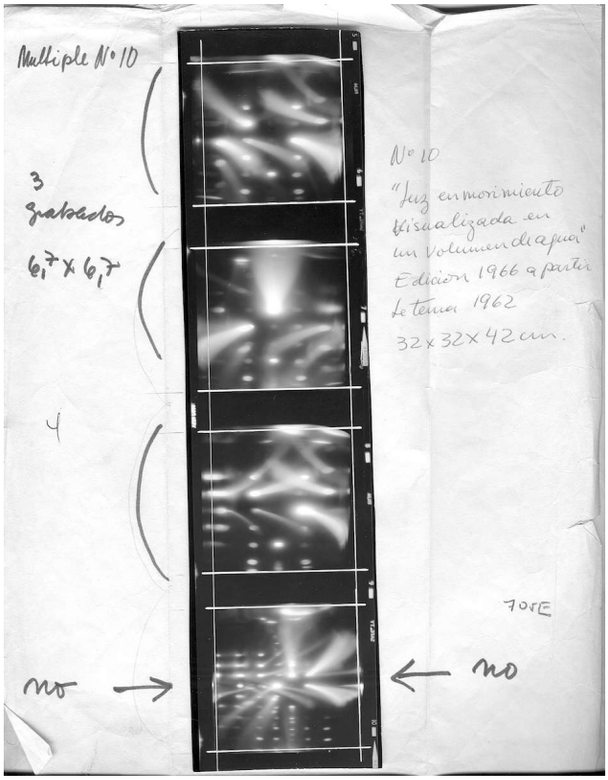

Figure 13.8. Julio Le Parc's *Multiple no. 10*. Light in movement, visualized in volume of water, edition 1966, 32 × 32 × 42 cm. These multi-schemas show how serial production of kinetic objects was projected and published. Each prototype corresponded to a series of works but was given a number rather than a title, and its visual qualities unfolded in a series of four photos. Although all multiples from the same series had to be identical, each of them was transformable. Archivos di Tella, Universidad Torcuato di Tella.

As Hahn pointed out, opinions about multiples varied. Blurring the work's aura and the boundaries of the traditional art market by producing serial art pieces that did not meet the requirements of "uniqueness" or manual "touch" did not necessarily coincide with the notion of turning the word *multiple* into a trademark (figs. 13.7, 13.8). Amid the confusion, a manifesto signed by Le Parc declared that multiples were developments related to geometric abstraction, and he specified their characteristics in terms of authorship and possibilities of reproduction:

> Multiples have come into being thanks to the quests undertaken by geometric, optical, and kinetic art, that have never ceased to emphasize that the intervention of the hand, the gesture, and the touch are definitely of secondary importance in an art proposal. […]
>
> 1. A Multiple is an art proposal conceived to be multiplied ad infinitum thanks to the industrial resources available. Every copy of a Multiple is identical and interchangeable with others. Each of them fully conveys the artist's original proposal.
> 2. Conclusion: any work conceived as a Multiple eliminates the material notion of an original (scale model, etc. …), which blends with the rest of the copies.
> 3. The notion of an internal transformation for each of the copies accompanies that of multiplication. Each Multiple involves a limited diversity principle (through permutation) or an unlimited one (an "open" kinetic work). Though strictly identical from a material point of view, time, movement, light, etc. endow Multiples with an ever-changing appearance, which makes them look different to different viewers.
> 4. To begin with, a Multiple may have a limited run. It can be gradually multiplied depending on the possibilities of the art market. However, it will be regarded as a Multiple as long as it is initially conceived as unlimited.
> 5. As part of its lack of limitations, the Multiple, which underscores the triumph of the artist's thought above the dated, fetishist conception of the art piece, excludes the author's signature. […]
>
> The Multiple is located at the junction of artistic creation and industrial production. It protects the whole of the former as it offers the possibilities of the latter. This is one of the meeting points between art and the technology of our days.[20]

René had made reproductions, screen prints, and tapestries, but the manufacture of multiples brought new problems related to the distribution system and to the status of the artwork. From Le Parc's point of view (and judging his complicated relationship with René), his own dealer was among the many who had distorted the profound, critical meaning of the multiple. At times, René was the enemy or, quite simply, the boss.

Le Parc arrived in Paris in 1958 for an eight-month fellowship (at a modest 300 francs per month) sponsored by French government; it was extended for another eight months.[21] In 1962 he signed his first exclusive contract with René for a similar monthly sum. It was not until the mid-1960s that Le Parc found it easier to support his family through his arrangement with his dealer, who sold editions of his multiples for $80 to $200.[22] This does not mean that the commercialization of multiples went smoothly. Marion Hohfeldt mentions that, in a number of cases, the pieces proved too costly for the nonspecialized public and lacked exclusivity in the collectors' view.[23] Moreover, even when the prices were accessible, the works would not sell unless they were signed and numbered. The paradox about the multiple was that, while it had abandoned the original as a way of unfetishizing the art piece as a luxury consumer object, it did not abandon its artistic status and its proprietary nature.

In mid-1966 art critic Jean Clay felt optimistic about the dissemination of kineticism by means of multiples. He envisaged a near future in which gallerists would make way for "industrial-scale organizations" that would disseminate "the art product" along the same lines as music albums and books.[24] A couple of years later, in 1969, speaking about an initiative to sell multiples at the Fédération Nationale d'Achats (FNAC), a store that originally sold photographic and phonographic materials and equipment but was expanding its market by including other cultural items,[25] Clay refined his ideas by saying it would be a mistake to offer multiples in this type of venue.[26] In order to retain their meaningfulness, they should be exhibited in such a way that people would understand that kinetic multiples were art proposals rather than gadgets. The term *gadgets* pervaded discussions in France about culture, standardization, and consumption. In *The System of Objects* (1968), Jean Baudrillard offered a critical analysis of the multiplication phenomenon: "Nowadays objects are actors in a global process in which

man is no more than a character or a spectator" (Baudrillard 1969:62). In turn, in the balance between structural and ornamental components, a "functional aberration" resulted in a gadget, a novel utensil of questionable usefulness.

In the context of an unprecedented abundance of small, ingenious objects, the eye-catching multiple ran the risk of being mistaken for yet another gadget. Paradoxically, while kineticists' main purpose in producing their works was to force viewers out of their passivity, those very works exhibited in a shop window could be mistaken for artifacts that, as Baudrillard pointed out, reduce the user to a mere spectator of the technical imaginary deployed by an undetermined set of consumer objects. The recreational nature of kinetic multiples revolved around this misinterpretation, for gadgets also were defined at the juncture of technology, recreation, and automation.

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Acknowledgments

I thank the Biblioteca di Tella for making material available for this paper.

Notes

1. Pierre Mazars, "La peinture se meurt, la peinture est morte," *Le Figaro littéraire*, June 23, 1966, 13.
2. I use "kineticism" rather than "kinetic art" because I am referring to an avant-garde art movement (Cubism, Dadaism, etc.) and because these artists were discussing the status of art, the traditional aura. The production of multiples was part of their strategies, as discussed in this paper.
3. Popper 1967. The first encounter of New Tendencies was held at GRAV's studio in Paris in November 1962. It was attended by the ZERO group, Gruppo T, Gruppo N, and some critics, such as Matko Meštrović. *Nove Tendencije*, the first New Tendencies exhibition, was organized in Zagreb in 1961 by Meštrović. On kinetic art history, see also Brett 1969 and Bértola 1973.
4. Arnauld Pierre, "Accélérations optiques. Le régime visuomoteur de l'art optique et cinétique," in Emmanuel Guignon and Arnauld Pierre, eds., *L'oeil moteur: Art optique et cinétique, 1950–1975* (Strasbourg: Musée d'Art Contemporain de Strasbourg, 2005), 34.
5. Arnauld Pierre, "De l'instabilité. Perception visuelle/corporelle de l'espace dans l'environnement cinétique," *Cahiers du Musée national d'art moderne* 78 (Winter 2001–2): 41–69.
6. Two documents offer a list of forty-one or forty-two pieces, respectively: *XXXIIIe Biennale de Venise 1966*. *Le Parc représente la République Argentine* (Paris: Galerie Denise René, 1966), and "Biennale de Venise," manuscript, ca. 1966, Le Parc Archive.
7. In 1960 GRAV was established by eleven artists under the name of Groupe de Recherche d'Art Visuel. The foundational document announced objectives such as making collective works "to overcome the traditional behavior of the outstanding unique painter that created immortal works." An earlier theoretical writing from 1960 declared that GRAV artists explored vision through methodical experimentation with surface, relief, volume, color, and movement. They also experimented with materials such as plastic, Plexiglas, metals, electric matter, projections, reflections, black light, etc.; and implemented methods related to the control of visual phenomena and to probability and chance applications. From April 1961, the group was composed of six members: Le Parc, Argentine García-Rossi, Francisco Sobrino, François Morellet, Joël Stein, and Jean-Pierre Yvaral. They broached recreational research from 1963, when they erected their first walkable maze at the Paris Biennale. GRAV, "Acte de fondation," "Chronologie raisonnée des activités du GRAV," in Aupetitallot 1998:58.
8. Alberto de Angelis, letter to Julio Le Parc, dated "Viernes 8 de 1966." Le Parc Archive.
9. A document dated "19 de julio de 1964" gives 50,868 visitors. Museo Nacional de Bellas Artes Archive.
10. The archives of the Musée d'Art Moderne de la Ville have no attendance records; however, the press wrote about the unprecedented number of visitors: 159,287. *Memoria y balance 1967* (Buenos Aires: Instituto Torcuato di Tella, 1968).
11. *Habitations à loyer modéré* (HLMs) are rent-controlled dwellings built by the French government.
12. Le Parc in Christiane Duparc, "Julio Le Parc: voulez-vous jouer avec lui?," *Le nouvel Adam* (December 1966). Le Parc Archive. I translated all the citations of French newspapers from French to Spanish.
13. In his *Yellow Manifesto* (1955), Vasarely developed the notion of transformable works. In turn, Spoerri launched his first edition of multiples in 1959. See Hohlfeldt 2001.
14. Norberto Gómez, interview by the author, January 14, 2008.
15. Antonio Seguí, interview by the author, May 8, 2008.
16. René Block, Berlin; Edizioni Danese, Milan; Fluxus Editions and Multiples Inc., New York; VICE-Versand, Remscheid; Xart Collection, Zurich, etc. Artists also sent multiples by post (Karl Gerstner, Klaus Staeck), made direct sales (Robert Filliou, George Bretch), or sold them through magazines (Fluxusshops).
17. Jean Clay, "An Interview with Denise René," *Studio International* 175, no. 899 (April 1968): 192–95. The gallery copyright number was N343383.
18. Otto Hahn, "Les multiples à Paris," *Art International* 12, no. 1 (January 20, 1968): 47–49.
19. Hahn, "Les multiples à Paris."
20. Julio Le Parc. "Manifeste du Multiple," ca. 1966. In Amigo, Dolinko, and Rossi 2010:187–88. My translation from French to Spanish.
21. Juan Carlos Kreimer, "Julio Le Parc: cinetizar a las masas," *Confirmado* (December 1, 1996): 74. See also Le Parc 1988:191.
22. S. G., "Julio Le Parc, argentino. Triunfador en Venecia: 'Aquí se vive por reflejos'," *Gente*, August 1, 1967.
23. Hohlfeldt 2001. According to Hahn, René's prices ranged from 800 and 4,500 francs, while Givaudan charged between 30 and 300 francs for works in "unlimited" runs, although he also

sold multiples of which there were no more than twelve copies at higher prices. See Hahn, "Les multiples à Paris."

24. Jean Clay, "L'art du mouvement," *Réalités* (June 1966): 90.
25. The FNAC (Fédération Nationale d'Achats) was established in France in 1954 by André Essel and Max Théret. At the beginning, the store sold photography and cinema items. In 1969 a second store opened in Paris. "Décès de Max Théret, fondateur de la Fnac," *La Tribune*, February 25, 2009.
26. "La fin de l'objet et du lieu culturel. Débat organisé par la revue Robho avec Jean Clay, les artistes présents et le public"; program brochure by the Noroit Cultural Center, Arràs, March 8–24, 1969. Le Parc Archive.

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14.

The Collection of Nicolas Schöffer: From the Artist's Studio to the Museum

Manon D'haenens
Muriel Verbeeck
David Strivay

The collection of Nicolas Schöffer's works is composed of cybernetic art that interacts aesthetically with its environment. This paper investigates the transition of these artworks from the artist's studio to the museum from the perspective of the conservator's twofold role. The first considers relationships with the rights holder for the transmission of the artist's intent and "studio knowledge." The second concerns practical challenges for the preservation of Schöffer's works. This is a complex exercise of transmission that includes collaboration with the different stakeholders, and the conservator's role in this process is critical to the continued existence of these artworks in their new environment.

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Into the Artist's Studio: From Kinetic to Cybernetic

With more than 600 objects, the collection of Nicolas Schöffer (Hungarian, 1912–1992) is nearly complete. Currently installed in his Paris studio, it contains most of his unique artworks and at least one work from each of his series. In addition to paintings, drawings, archival materials, and plans, the collection is composed of kinetic, but mostly cybernetic, sculptures by the artist (fig. 14.1). His widow, Mrs. Eléonore de Lavandeyra Schöffer, manages their maintenance and exhibition and offers guided visits of the studio.

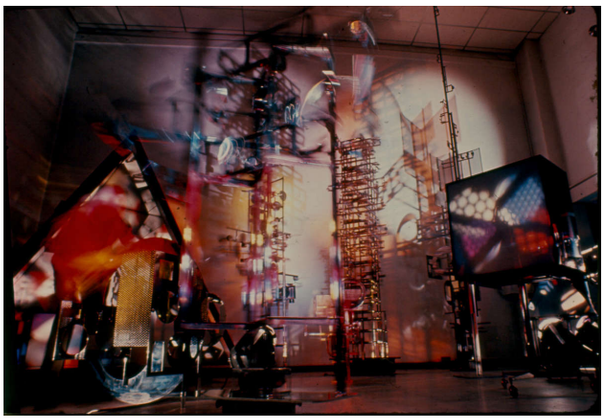

Figure 14.1. View of Nicolas Schöffer's studio in the Villa des Arts, Paris.

As early as 1948 Schöffer incorporated space into his sculptures with what he called *spatiodynamism* (fig. 14.2a), a dynamism creating a sensation of dematerialization through the perception of movement. He opened them to light with *luminodynamism* (fig. 14.2b), which unfolds energy and aesthetic potential, and to time with

chronodynamism (fig. 14.2c), in which artworks move in space, light, and time with a precise program and with almost infinite and unpredictable possibilities (Ligier and Mangion et al. 2004).[1] To do so, he introduced cybernetics—the science of self-regulated systems (Pierre 2011:116)—into his art via interactions with external factors such as light, movements, or sounds. With this purpose in mind, he integrated into his works the most innovative contemporary technology available, with the support of the Philips company. In fact, this kind of permutational system delimits a broad field of possible combinations and produces a finite but immense number of potential works (Moles 1970). Schöffer's artworks must continuously communicate practical information using aesthetic language with no repetition: they must constantly differ and have a societal impact (Schöffer 1970:19–21).

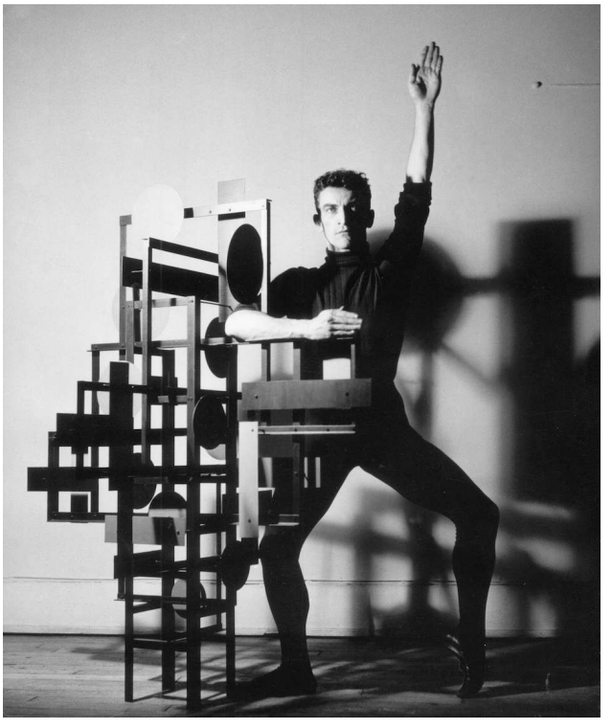

Figure 14.2a. Spatiodynamism as seen in Schöffer's *Spationynamique 16* with Maurice Béjart, 1953.

Figure 14.2b. Luminodynamism as seen in Schöffer's *Lux 2*, 1957.

Figure 14.2c. Chronodynamism as seen in Schöffer's *Chronos 10*, 1969.

Museum Project

The idea of a Schöffer museum has existed since the 1980s, with its first project—Espace Dynamique Schöffer—developed by Nicolas and Eléonore Schöffer.[2] Recently, there was an opportunity in Belgium to assemble the artist's collection around his first permanent cybernetic achievement: the *Cybernetic Tower* in Liège. The artist's collection is to be transferred to the Fédération Wallonie-Bruxelles of Belgium, where it will be preserved in the city of Liège. The ongoing project involves the transfer of the

artist's entire oeuvre to a new public museum, which differs from an artist's studio-museum,[3] for enhanced access and study, allowing for specific interpretation and analyses.[4]

The project was initiated after the artist's widow was contacted about the conservation of the *Cybernetic Tower*. As a native of Liège and a conservator of contemporary art, I (Manon D'haenens) quickly became a mediator.

The first task was to bring both parties together. The concept of the transfer project already existed, thanks to an old contact between Mrs. Schöffer and the Fédération Wallonie-Bruxelles, and it was now set in motion. I made the project accessible to institutional officials in practical terms by identifying and inventorying the artworks, as well as studying the basic needs for financial evaluation, transport, buildings consideration, and so on. If they had doubts about my broader role at this early stage, they nonetheless retained me as mediator: my competencies as a conservator for understanding art, and artists (as much as possible) on the one hand and institutional museum challenges (as much as possible, too) on the other, provided them with a realistic view of the situation and the needs of the artworks. Of course, many other stakeholders are involved in the project to address the legal, institutional, architectural, and management issues. If it is commonly agreed that a good contract for the artist's and the museum's intents and rights is required from a conservation perspective prior to the acquisition of contemporary art (Beunen 2005; Huys 2011; Quirot 2007), this is especially true when working with a complete collection of functional, variable, and interactive artworks. Such a contract involves exploring implications at both relational and practical levels.

The *Musiscope*, a representative artwork in Schöffer's oeuvre, is used below as a case study exemplifying these implications (fig. 14.3). Created in 1960, this work is a visual organ with an electronic keyboard and a screen (2 × 2m) in front of a complex installation of visual elements moved by engines and illuminated by lights. This unique artwork is composed of functional electronic components as well as handmade aesthetic elements in plastic and aluminum sheets for light effects; it requires a person's interaction to be operated.

Figure 14.3. Nicolas Schöffer's *Musiscope*, 1960.

Transmission and Interpretation

When entering the studio, the visitor is immersed in the universe of the living and evolving works of Nicolas Schöffer. Eléonore Schöffer passionately runs the space full time; she is closely linked to the artworks because she completed some of them with her husband and continually maintains their existence, following his desire to actualize his works with new technologies. From a museum perspective, a form of collaboration is needed to ensure the future variability of these contemporary artworks (Sommermeyer 2011). The trust and confidence (including empathy and emotion) of artist, or the artist's proxies, in the conservator are helpful when considering interventions that may need subjectivity or, in part, continuity of the artwork production (D'haenens 2016) and to understanding the context behind the display (Szmelter 2011).

While working on this transmission process, the relationship aspect is significant at a personal level. Even when I have questions prepared for Mrs. Schöffer, our interviews are more a discussion of part of her life with Nicolas. Unlike a formal artist's interview, informal discussions and a relatively close relationship appear to induce trust and give access to deeper knowledge. This is probably also due to the different approaches of the artist and the artist's widow. When we discussed the *Musiscope*, she explained not only the different stages of the artwork but also how she met Nicolas for the first time during *Musiscope*'s single public presentation. This story contains the fact that it was presented only once outside the studio and has never been moved since, providing the context of its presentation.

There is an equal demand to maintain a necessary distance to work efficiently. Becoming too involved could risk exceeding the limits of the professional conservator's role, or favoring certain values over others. Indeed, Mrs. Schöffer also has objectives, and privileges as rights holder, on how she wants the artworks to be presented, used, fixed, reedited, or produced. Implementing these actions with different stakeholders, she also tries to transmit different aspects of the oeuvre to each of them. She invests her time in us so that we may transmit this knowledge after her. She has built a team and has specific expectations. In this case, the artist would mostly consider the current effects of his artworks, while the rights holder thinks of the best visibility for the artist. The conservator, thinking forward to the future conservation of the artwork, must be aware of these differences (Davies and Heuman 2004; Huys 2011; Szmelter 2011).

I strive to analyze these discussions and relationships, taking a step back to meet conservation objectives. According to the literature, the conservator is often considered to possess the ethics and skills to ensure that the artworks are respected, to manage the subjectivities of the different stakeholders, and to process information with the focus on the artworks (Caple 2000; Sommermeyer 2011; Davenport 1995; Van Wegen 2005). This collaborative work has also emphasized that the artist's close relations may have a natural blind confidence in every small trace of the artist. For example, a simple note that said "red" on a spotlight in the *Musiscope* structure becomes sufficient evidence that it has to be changed to a red light. While the artist's relatives have a deep knowledge of the context that allows interpretation of each sign of the artist, as a conservator, I still need to systematically question everything. Combining discussions with Mrs. Schöffer with a study of the archives, the plans and documentation of the artworks, books by and on Nicolas Schöffer, and meetings with other stakeholders, I have tried to increase the number of sources to verify information through cross-referencing prior to the intervention: the practical interpretation. The process of investigating the artist's intent in contemporary art conservation, considered as a basis for interpretation in decision making, also participates in the artworks' variation in the future museum.[5]

Preservation and Functionality

A collection transfer to the museum implies practical challenges. I began by identifying the artworks spread throughout Schöffer's whole apartment and making a comprehensive inventory: comparing the physical state of the artworks in Paris, in another storage location, and in the archives with the previous partial inventory and historical information found in a handmade catalogue by the Galerie Denise René. The collection comprises more than two hundred graphic works, approximately one hundred works in relief, and about three hundred functioning artworks creating light and/or movement effects in space and time. There are also pieces to be reassembled, documentation for nearly every artwork, and old, functional parts that had been replaced (like light filament bulbs). Each artwork created by Schöffer is an improvement on the previous work, the development of his idea one step further, and having full access to the entire collection helps us to better understand and manage these artworks. For example, the current *Musiscope*, which had already been conserved and modified by Mrs. Schöffer under the artist's supervision, has a piano-type keyboard—a replacement from a more technological keyboard—for the effect of a more intuitive aesthetic transition. It is important to grasp the different creation and/or conservation steps to understand the current work.

The transport of the artworks is also a delicate operation, as some extremely sensitive handmade technological pieces have rarely, if ever, been moved. The *Musiscope* is made of gelatin sheets attached with paper clips to a metal support maintained in a wood structure and connected to engines and lights (fig. 14.4). While some artworks are made with more stable industrial or traditional methods, others, like the *Musiscope*, are handmade and not very stable, with risks of falling or breaking. The gelatin and aluminum sheets are very fragile, and the electronic components have to be consolidated and protected. A classic crate is not sufficient; every piece must be stabilized before transport, with an appropriate solution for crating them... .\ .\ .

Figure 14.4. Details of the structure of Nicolas Schöffer's *Musiscope*, 1960.

If some obsolete technological industrialized parts are considered replaceable, with caution and documentation (Dazord 2013; Imbert 2000), these handmade parts are not. They require more traditional conservation practice that preserves the materials but allows functionality. The readability principle—allowing the public to "read" the artwork—of conservation applies here to function (Gagneux 2007), as the artist wanted to preserve the intangible effects of his works. The whole contemporary art conservation process of decision making and investigation of artwork and the artist's intent allows these effects to be respected and conserved. To achieve this aim practically also involves electromechanical engineering, which is not typically part of a conservator's training. However, this was once true of chemistry as well and that discipline has been slowly introduced into conservation curriculums, with the help of conservation scientists. Why not electromechanical engineering at some point? Considering Derek Pullen's question about the role of the conservator (Pullen 2005), I think that I need to do more than simply know the artist's intent, but I cannot be a specialist in each process used in complex and variable contemporary artworks; artists also ask for the help of engineers.

In this context, "studio knowledge" is an important part of the transmission, and it is attained by collaborative conservation work in the studio. Keeping a step back to remain analytical, I needed to adapt my understanding to their practice in order to document it. The aim is also to learn the specificity of the works, such as value of the cybernetic parameters of Schöffer's artworks or the effects of obsolete parts, but not to become an artist's assistant.

We discussed our differences in practices during conservation of the *Musiscope*. Artist and assistant Santiago Torres wanted to preserve the original materials as much as possible, and made an aesthetic intervention for better light effects, also required by Mrs. Schöffer. I was looking for a more reversible or limited intervention in a long-term perspective. This approach, as well as learning from previous examples, experiences, and failures, helped us to understand each other: we both had the same aim, simply different ways that could be combined to reach it. It helps to specify the values and key parameters of the effects of the artist's works on one side and highlight the input of the conservation profession on the other.

From the Artist's Studio to the Museum: The Conservator's Role

Artworks owned by an artist, or even by his rights holder, are still connected to a creation process and have both moral and property rights. When these artworks enter a museum, the institutional process will stabilize them and change their relation to time, with historical values and the need for long-term conservation (Rodriguez 2013). This raises and will continue to raise many issues, like those discussed here, between the conservator and the widow but also helps define the transfer contract. The process highlights that variability may be preserved within a museum framework that is discussed with the artist and based on ethics about interpretation and replacement. It is more difficult to consider the sales, production, or reedition of artworks based on plans (for which Mrs. Schöffer has moral rights) for works that were never sanctioned by the artist and differ greatly from reproduction. More in-depth documentation is also needed, beginning with the archives and a project on different documentation types, including electronic programs. Finally, presentation and use of artworks will make them accessible to more people although in a more restrictive way, even for artworks that require essential public interaction such as the *Musiscope*, which has to be played to perform the artwork.

The conservator's involvement at the beginning of a museum project offers an opportunity to preserve the continuous existence of these artworks in their new environment. The specific position of the conservator in this situation has highlighted how professional competences could have both expected and unexpected impacts on the collection.

An important aspect has been recognition of the collection. The communication skills with the artist's rights

holder and the social approach have led to trust that has allowed the project to be relaunched. Contact with the different stakeholders has been and remains crucial to draw attention to some aspects through better understanding of the collection. Both archival and practical research were needed to build the inventory, which was a necessary document for various officials' recognition, for judicial negotiation, and for such pragmatic considerations as building needs, among others.

Ethical and theoretical knowledge is also required to make connections and find a balance between the artist and the museum's standards. A common language is needed, and an awareness of long-term issues in contemporary art conservation, particularly of variable media, to contemplate production, replacement, movement conservation, the artist's intention, and the rights holders' interpretation.

Finally, practical skills and approaches remain essential for these extremely fragile artworks with specific needs. Conservation of pieces with industrial and handmade components is delicate and requires an interdisciplinary approach. Both studio and conservation knowledge is essential to the safe transport and presentation of these works, which have to function, and to the performance of regular preventive measures.

The transition of this cybernetic collection from the artist's studio to the museum—wherever it will take place—is a complex exercise of transmission in which the role of the conservator, working with the different stakeholders, is critical in a global, upstream, and integrated approach.

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Notes

1. Spatiodynamism: [...] intégration constructive et dynamique de l'espace dans l'oeuvre plastique. [...] Ici le but est [...] énergétique, et non matériel. [...] Mus à une certaine vitesse, ils [...] une sensation de dématérialisation. Luminodynamism: La lumière [...] pénètre à travers l'oeuvre spatiodynamique et engendre [...] des développements plastiques qui libèrent un immense potentiel de valeurs esthétiques [...] Chronodynamisme: Leur action réciproque engendrera des séries susceptibles de développements à l'infini, qui feront éclater les limites temporelles imposées jusqu'ici. [...] Les éléments combinés [...] ont, entre eux, des rapports prédéterminés, mais modifiables aussi bien dans l'espace que dans le temps; [...] nullement limitatifs de sorte que les aspects successifs sont infinis et imprévisibles.[...] (Schöffer 1970:32–46).
2. See "Espace Dynamique Schöffer," archives of Mrs. Schöffer.
3. A historical Schöffer Museum already exists in his hometown of Kalocsa, Hungary.
4. Lacroix 2006. Also, for complete information about the project, see the audio recording of the interview with Mrs. Schöffer, May 2016.
5. Van Saaze 2009. This exchange approach between artist and conservator, and issues linked to interpretation and extrapolation of the artist's intent, are developed in Manon D'haenens, "De l'intention à l'extrapolation, interpretation des oeuvres de Nicolas Schöffer," in *Study Days in Paris on Nicolas Schöffer: Conserving/Restoring Works of a Technological Nature, Villa des Arts, Paris, November 3, 2016*, CeROArt (forthcoming).

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15.

"Pretty Good for the 21st Century": Restoration, Reconstruction, and Realization of Len Lye's "Tangible Motion Sculpture"

Paul Brobbel
Simon Rees

The New Zealand–born American artist Len Lye (1901–1980) is recognized as a pioneer for his experimental films and his "Tangible Motion Sculpture." More than thirty-five years after his death, Lye's artistic legacy is increasingly dependent upon the Len Lye Foundation to reconstruct and realize his sculptural works, particularly the engineering of larger-scale iterations of extant models. In this paper, curators Paul Brobbel and Simon Rees discuss the making of Lye's sculpture in the twenty-first century and the exhibition of Lye's work at the Govett-Brewster Art Gallery/Len Lye Centre in New Plymouth, New Zealand.

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Figure 15.1. Len Lye with *Flip*, ca. 1975.
Len Lye Foundation Collection, Govett-Brewster Art Gallery/Len Lye Centre.

The New Zealand–born Len Lye (1901–1980) remains one of the most enigmatic of modernist artists. Leaving his homeland in his mid-twenties to seek out less provincial pastures, Lye traveled between Australia and Samoa, becoming familiar with aboriginal and Pacific cultures before arriving in London in 1926, where he was immediately welcomed by the British avant-garde. Several years exhibiting sculpture, painting, and photography with the Seven and Five Society,[1] followed by an off-kilter relationship with the British Surrealists, are secondary to his career at the vanguard of experimental cinema. A series of films produced during the 1930s established Lye internationally as one of the most innovative filmmakers of the time. He developed the direct method of animation: painting, drawing, or otherwise applying imagery directly onto celluloid. Lye's most acclaimed film work would be a series of scratch films produced after his move to New York in the mid-1940s (fig. 15.1). Reengaging with experimental cinema in the 1950s, Lye began a series of experiments whereby he scratched away black emulsion from 16mm film leader. As light passed through the clear portions of film as it was projected, zigzag figures danced

and jerked on screen. With works such as *Free Radicals* (1957), Lye reduced film to its essential elements—light and motion.

Lye's practice was driven by this interest in motion, a pursuit he ascribed to a realization he had as a young man watching clouds roll over Wellington:

> As I was looking at those clouds I was thinking, wasn't it John Constable, the early English landscape painter, who sketched clouds to try and convey their motions? That's right! Well, I thought, why clouds, why not just motion? Why pretend they are moving, why not just move something? All of a sudden it hit me why not just movement? If there was such a thing as composing music, there could be such a thing as composing motion. After all, there are melodic figures, why can't there be figures of motion? Like the figure eight, for instance, and various other figures. So Christ, I start running around wagging my tail, thinking I have a nice idea! Anyway, I have stuck with it ever since (Lye 1984).

Early and unproductive experiments with motion (hand-turned sculptural mechanisms) were followed by experimental sketches of the flight of birds or rolling waves drawn as swirls and strokes on paper. Lye's interest in movement was, in a truer sense, an interest in the body, developing along kinesthetic lines, less a matter of transposing movement and more concerned with empathetic experience:

> I, myself, eventually came to look at the way things moved mainly to try to feel movement, and only feel it. This is what dancers do; but instead, I wanted to put the feeling of a figure of motion outside myself to see what I'd got (Lye 1984).

Lye used terms like "body English" to describe the reciprocal feeling we have in our bodies when observing another object in motion, and he described one of his later scratch films as "pin[ning] down a kinetic figure on film to make a feeling I feel at the back of my head," one of the "endless ways that energy can be depicted unconsciously as if by doodling" (Lye 1984).

In 1959 Lye abandoned experimental cinema (in principle, if not entirely in practice) to focus on kinetic sculpture. The kinesthetic scratches in *Free Radicals* were an end point for that particular medium, but a point for Lye to reengage with sculpture some thirty years after his first experiments. Lye's new sculptural works were profiled in an August 1959 piece in *Time* magazine; however, a more substantial unveiling came in *An Evening of Tangible Motion Sculpture* at New York's Museum of Modern Art (MoMA) on April 5, 1961. Lye's terminology signaled an "emphasis on motion rather than the object describing it" (Lye 1984).

Lye presented ten of his tangibles (including the now popular works *Fountain*, 1960, *Roundhead*, 1961, and *Grass*, 1961–1965) in the museum's auditorium alongside a screening of *Free Radicals* (emphasizing the conceptual continuity between his various modes). Some of his works were performed under colored lighting and some with musical accompaniment (Béla Bartók, Miles Davis, African drumming). Others provided their own audible soundtrack. Each was performed as one element in a meticulously sequenced order. The evening offered a very clear statement of intent from Lye: his works were performances above and beyond sculptural objects.

Lye's MoMA presentation had none of the impact of Jean Tinguely's destructive performance of *Homage to New York* at the same venue just a year earlier, in 1960.[2] However, Lye steadily developed a body of tangibles, comprehensively exhibited in contemporary surveys of the kinetic medium such as *Directions in Kinetic Sculpture* curated by Peter Selz at Berkeley Art Museum in 1966, regular exhibitions with New York's Howard Wise Gallery, and Pontus Hulten's *Bewogen Beweging* (Moving movement) at the Stedelijk Museum in 1961. The Berkeley exhibition involved a remarkable work, *A Flip and Two Twisters (Trilogy)*, 1966, sublimely attesting to Lye's interest in empathy. Two 3m strips of stainless steel are suspended from the ceiling, spun from a motor, and snake into a dance until the braking of the motor forces a sudden, violent, and noisy stop. Between the *Twisters* is *Flip*, a loop of steel slowly twisted by a ceiling-mounted motor until the loop turns inside out, rises in and up, and collapses under its own weight with a crashing tumble into its original position. Lye described the effect as "a bucket of iced water and icicles tumbling down the spine" (Lye 1966:1) (fig. 15.2).

Figure 15.2. Len Lye's *A Flip and Two Twisters (Trilogy)*, 1977 footage. Watch the video at https://youtu.be/fgqht8Ui8dw.
Len Lye Foundation Collection, Govett-Brewster Art Gallery.

Free Radicals is typically considered Lye's greatest achievement in film, and his most acclaimed sculptural work is *A Flip and Two Twisters (Trilogy)*, singled out by Philip Leider in his *Artforum* review of Selz's exhibition:

> The single artist in Dr. Selz's exhibition who seems to transcend all the confusion—esthetic, mechanical, rhetorical—of kinetic sculpture is Len Lye, whose work manages to compress so ferocious an energy that the viewer stands paralyzed, gripped by an emotion almost of terror. Lye's elements are supremely simple: hanging strips of stainless steel, six or seven feet long, are set to spinning around at very high speeds. The whiplash strain on the steel produces a series of frightening, unearthly sounds in perfect accord with the mood of the barbaric energy that seems to have been released. Installed by itself in a black-painted room, the viewer comes upon Lye's "Trilogy" as he would upon a volcano. The effect is beautiful, frightening, utterly beyond the petty limitations of the other artists in the exhibition (Leider 1966:45).

Leider's criticism of the artists in this exhibition anticipated the clear decline of the movement during the mid-1960s; however, Lye's ambitions for his artwork developed considerably. In a 1967 television documentary, *Art of the Sixties*, Lye, surrounded by a cacophonous medley of his sculptures in action, said that his work would be "pretty good for the 21st century." Although a somewhat sardonic statement, Lye followed it with, "why the 21st, it's simply that there won't be the means to have what I want, which is enlarged versions of my work."

In the late 1960s Lye returned to New Zealand briefly for the first time since leaving when he was in his mid-twenties. The visit sparked interest in the works of this maverick expatriate artist who had connections to Surrealism, British Modernism, and the postwar New York avant-garde. A decade later, Lye would make a remarkable artist's return to his homeland with a 1977 survey at the Govett-Brewster Art Gallery. The *Kinetic Works* exhibition, the first survey of Lye's practice mounted anywhere in the world, was an endeavor overdue but complicated by the artist's reluctance to work with museums and their directors and curators. Lye's disgruntlement at the treatment of experimental film in the 1950s became a distaste for the treatment his sculptural works received from institutions, especially after a disastrous experience with the 1967 Toronto International Sculpture Symposium.[3]

Adamant that he would only work with a museum in New Zealand that could supply a skilled and sympathetic engineer, Lye agreed to the *Kinetic Works* exhibition and a relationship with New Plymouth–based mechanical engineer John Matthews, whom he had met in New York. Traveling between New Plymouth and New York, Matthews was set the task of building new versions of Lye's sculpture for the exhibition. Principal among these was a new, scaled-up *Trilogy* (1977), more than twice the size of the Berkeley version, making it a site-specific fixture for Govett-Brewster's top-floor gallery.

Lye died in 1980 in Upstate New York while making preparations for another survey exhibition, *Personal Mythology*, at Auckland Art Gallery (New Zealand's largest metropolitan museum). Aware of his failing health, Lye established a foundation to take over his estate just three weeks before his passing. The Len Lye Foundation came into being on April 24, 1980, a charitable trust with a constitution outlining the following principal objective: "The acquisition, conservation, reproduction, and promotion of the works including the copyright therein of Len Lye."[4] The final objective notes this "shall be carried out for the public benefit of the people of New Zealand." John Matthews became chairman of the foundation, and Lye's wife, Ann, became one of six trustees. Writing in a memorial issue of the *Art New Zealand Journal*, Matthews announced the foundation's mandate:

> The Foundation is empowered to issue prints of the films (insofar as copyright allows), reproduce limited editions of the kinetic work (including newly conceived work), publish written works and promulgate Len's various theories (Matthews 1980:32–33).

A deed of trust between the artist, the foundation, and New Plymouth City Council (now named New Plymouth District Council, owners and operators of the Govett-

Brewster Art Gallery) set the terms for the care of Lye's works, with Govett-Brewster to be the principal site for their care and exhibition.

Since its formation, the Len Lye Foundation has undertaken numerous activities to maintain, conserve, and reconstruct Lye's sculpture. Perhaps the most illustrative example is also the most recent, a 2016 restoration of *Trilogy*. The *Trilogy* completed in 1977 for *Kinetic Works* has been exhibited regularly, and it developed close to forty years of wear and tear. The 7.6m steel bands routinely fatigue and break, rendering them consumable components of the work. Similarly, the motors and electrics have an undetermined but limited life span. Following the display of *Trilogy* in Govett-Brewster's 2011 exhibition *All Souls Carnival* and the development of the Len Lye Centre, a restoration of the work was necessary to keep it operational. In late 2016 Govett-Brewster presented *Trilogy* in the new Large Works gallery, a sculpture-focused space within the newly launched (July 2015) Len Lye Centre. The work is composed of several original components of 1977 vintage but with the requisite new steel bands and, crucially, a new programmable-logic computer (PLC) directing the performance rather than the previous twenty-two rotary switches. Not upgrading mechanics and control units to reliable contemporary methods would have resigned the work to nonoperational, archival status. Archiving of original works and motors is an important and complementary concern.

Figure 15.3. Len Lye's *Loop*, ca. 1964.
Len Lye Foundation Collection, Govett-Brewster Art Gallery/Len Lye Centre.

Prior to the conservation of *Trilogy*, the Len Lye Foundation completed a two-year project to conserve *Loop*, a 1965 work in the collection of the Art Institute of Chicago (fig. 15.3). In *Loop*, a band of steel bounces and rolls back and forward across a thin, trestle-like table, motivated by the activation of electromagnets at each end of the table. This seminal work was also featured with the early *Trilogy* in *Directions in Kinetic Sculpture* and was renamed *Universe* by Lye in subsequent larger iterations. Essential in the conservation of *Loop* were new magnets and electrical components to replace unsafe and expired originals. The work's steel band was tarnished with extensive rust that seemed unlikely to be remedied. A second steel band was commissioned to replace the original, should it have been beyond reconditioning; however, linishing (polishing and smoothing the surface of a material by grinding or sanding) provided suitable results. The table did not require treatment.

Of serious concern was the method of controlling *Loop*'s performance. With the original control unit missing and undocumented (neither in Art Institute records nor the foundation's), we decided not to attempt to replicate a vintage-style control system but rather to develop a modern PLC unit to direct the operation of the magnets and the choreography of the performance. There was only limited footage of *Loop* performing during the 1960s to reference, so the program was adapted from the foundation's 1998 reconstruction of Lye's 1976 *Universe* (a circular relationship, given the *Loop* to *Universe* genealogy).

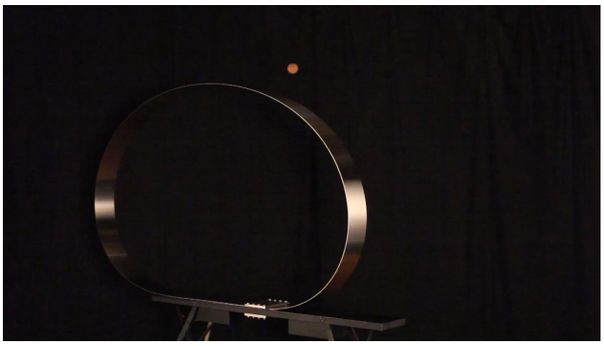

Figure 15.4. Len Lye's *Loop*, ca. 1964, after its 2016 restoration. The Art Institute of Chicago, Barbara Neff Smith and Solomon Byron Smith Purchase Fund. Watch the video at https://youtu.be/zuY2-yNpJ-8.

Loop returned to Chicago with its original, expired components marked for archiving. Its updated electrics and programming allow the Art Institute to exhibit the work, and, externally, it is entirely original in material. The new steel band offers the Art Institute a substitute to use should future conservation of the original band be impossible. The PLC unit allows easy fine-tuning of the work's programming, if necessary (for example, if historical footage of the performance surfaces) (fig. 15.4).

The conservation work undertaken on *Trilogy* and *Loop* stands in contrast to the foundation's projects to reconstruct nonoperational works in its collection and archive, or to complete unrealized projects. Even after Lye's engineering studio relocated to the Govett-Brewster in 1980, the artist's complete oeuvre of kinetic sculpture has been an evasive proposition. Disassembled works may share common components, such as control units or motors, and some components fatigue and expire. It's possible that dozens of sculptures conceptually and physically exist within the collection that cannot be exhibited unless a replica is fabricated.

Nonetheless, working from complete or nearly complete vintage components, the foundation has engineered several exhibition-grade reconstructions. Their performances and sonic qualities have been gauged against still operational models in the collection and against archival footage and recordings of original performances. In each example, the work is acknowledged as a reconstruction, with both the original and the reconstructed dates provided on gallery labels and in credit lines.

The question of authenticity—the touch of the artist's hand, or "contagion" (Newman and Bloom 2011:1–12)—was directly addressed in the 2007 exhibition *Five Fountains and a Firebush* at Govett-Brewster. Lye's seminal work *Fountain* was presented in varying scales across five iterations alongside a variant work, *Firebush* (also known as *Dancing Fountain*) (fig. 15.5). With the *Fountains* gently swaying under colored lights and with a recording of Pierre Boulez's *Le marteau sans maître* providing a soundtrack, curator Tyler Cann created an homage to Lye's *Evening of Tangible Motion Sculpture* of 1961. The theatrical presentation (interpreted from the artist's original performance notes held in the foundation's archive) emphasized the performative element in the artist's conception of his tangibles rather than their material quality.

Figure 15.5. Len Lye's *Five Fountains and a Firebush*, 2007. Govett-Brewster Art Gallery. Watch the video at https://youtu.be/t_Or2bTzcbg.
Courtesy of Govett-Brewster Art Gallery.

Cann created a proposition in this exhibition: which of these is authentic? Toying with the audience's perception of authorship, the exhibition presented two vintage works in *Fountain I* (both ca. 1960), a reconstructed *Fountain I* (2007), reconstructions of *Fountain II* (1995), *Firebush* (2007 reconstruction), and *Fountain III* (1977) (engineered in New Plymouth by Matthews for the *Kinetic Works* exhibition). In asking the audience to think of one of these as the most authentic *Fountain*, Cann posited that none of these *Fountains* was quite Lye's (Cann 2007:12).

The *Fountain* that most "captivated" Lye's mind, designed in 1962 as a 9m outdoor work, and eventually envisioned as sublime 45m version, does not yet exist (Cann 2007:12). Yet the launch of the Len Lye Centre in 2015 included a sequel of sorts to *Five Fountains and a Firebush* titled *Four Fountains*, here displaying four iterations of the work, including an 8m version newly engineered by the foundation in 2015. Cann's proposition stands—this is still not Lye's *Fountain*, and there is a platonic *Fountain* out there that the foundation is still striving for (Brobbel 2015:12).

In looking at Lye's practice through a single work in *Fountain*, we encounter his interest in scale. In conceiving of his tangibles as a way "to feel movement, and *only* feel it" (Lye 1984), Lye struck upon scale as the means to amplify that feeling:

> Our Muse also increases empathetic tension through an increase of scale in an image of motion. For example, the falling motion of a small shrub in contrast to that of a giant redwood tree, or the tiny wavelet on the beach and the big comber, have distinctly different effects on the degree of our empathetic response (Lye 1984).

Through the remaining years of his life, Lye's energies as a sculptor were spent conceptualizing large-scale applications for his works, rendering his kinetic oeuvre (as witnessed in *Art of the Sixties*) as models for a more vividly empathetic vision.

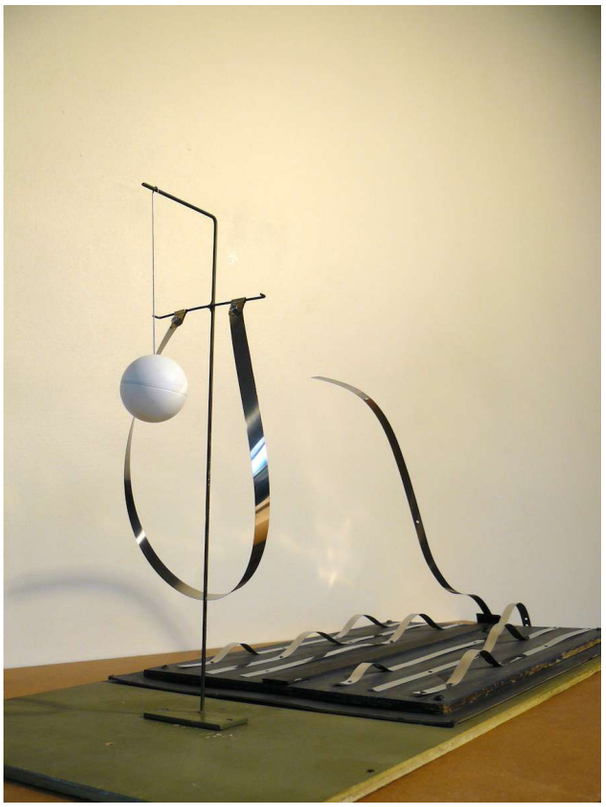

Figure 15.6. Len Lye's maquette for *Sun, Land, and Sea*, 1960s.
Len Lye Foundation Collection, Govett-Brewster Art Gallery/Len Lye Centre.

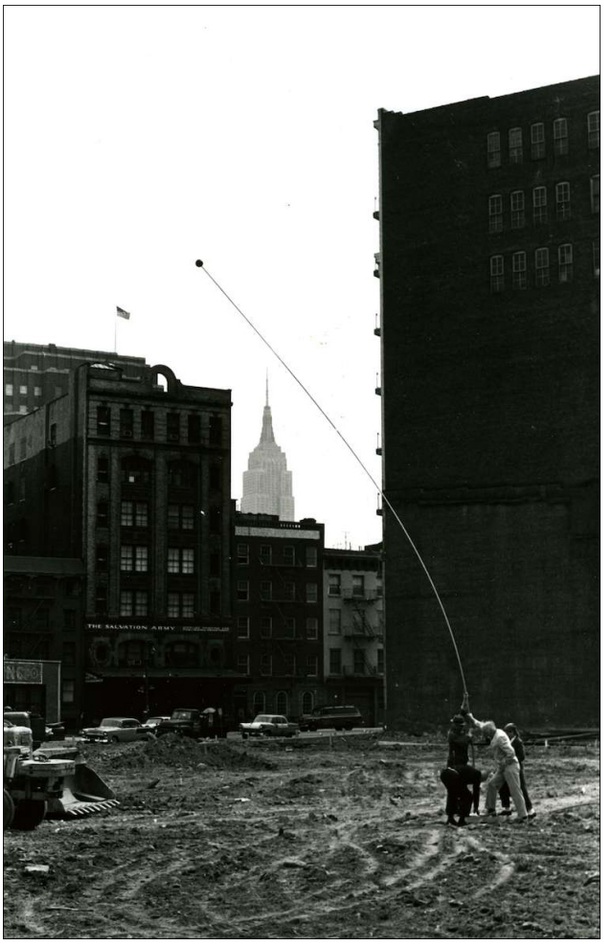

Figure 15.7. Testing Len Lye's *Wind Wand*, 1960.
Len Lye Foundation Collection, Govett-Brewster Art Gallery/Len Lye Centre.

Lye's ambitions were for large environmental settings for scaled-up, monumental versions of his tangibles—sculpture parks, for want of a better term—or, in Lye's vision, projects such as *Universe Walk* (ca. 1960), a giant gateway version of *Universe* (or *Loop*) through which the audience entered a walkway between an avenue of multiple spinning *Twisters*. The notion of composition is apparent here, with various artworks being combined into a new sculptural arrangement. The most ambitious of Lye's large-scale endeavors was the *Temple* complex, a theoretical composition in which his artworks (including *Wind Wands*) were each located in the "leaf" of a clover-shaped lake. In the center of the lake would stand the *Temple*, a cloud-shaped home to *Sun, Land, and Sea*—a composed work in which a 46m *Sea Serpent* performed a rucking motion and fired a bolt of lightning through an undulating *Flip* (fig. 15.6). Lye demonstrated a model *Sea Serpent* and *Flip* at the conclusion of *Art of the Sixties*, proving his concept as far as he was capable in his lifetime.

The foundation's success in honoring Lye's instructions is best illustrated in *Wind Wand* (2000), a now iconic 45m work erected on the New Plymouth foreshore to commemorate the millennium celebrations. Lye first produced *Wind Wands* in 1960 (fig. 15.7), testing a 12m aluminum version in New York's West Village, followed by an installation of similarly scaled *Wands* at Southern Illinois University, Carbondale, in 1962. The posthumous *Wind Wand* required the use of modern fiberglass technology to achieve Lye's desired scale, a material not widely associated with the artist yet familiar to him through a 25m fiberglass *Wand* in Toronto in 1967.

Another posthumously realized work is *Water Whirler* (2006), commissioned by New Zealand's Wellington Sculpture Trust (fig. 15.8), which involves a spinning rod, 10.6m high, that projects numerous streams of water outward as it spins. Unlike *Wind Wand* (2000), no direct antecedent was built by Lye. He instead designed the *Whirler* as a conceptual adaptation of one of his prototypical works, *Rotating Harmonic* (1959), which he had adapted into various works such as *Zebra* (1965), *Moon Bead* (1968), and *Bell Wand* (1965), creating the frame with which the foundation could deliver on this conceptual addendum.

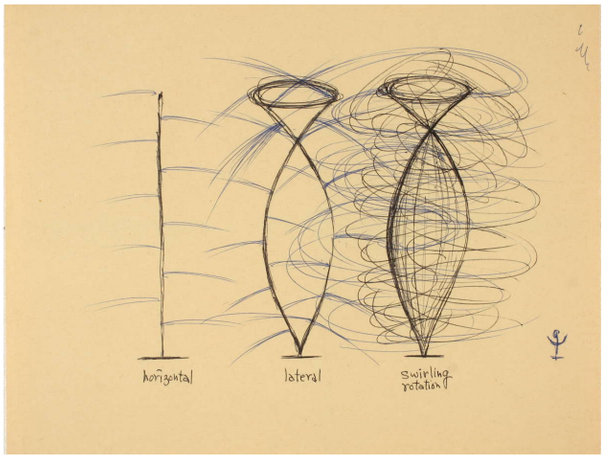

Figure 15.8. Len Lye's sketch for *Water Whirler*, 1960s.
Len Lye Foundation Collection, Govett-Brewster Art Gallery/Len Lye Centre.

Recent projects completed by the foundation include a group of 12m *Wind Wands*, exhibited at the Pulitzer Arts Foundation in St. Louis in 2013, and a second, similar group titled *Waving Wands*, installed in New Plymouth in 2017. A partnership between the foundation and the University of Canterbury's College of Engineering in Christchurch supports the development of a number of unrealized works, most notably a 10m (or one-quarter scale) model of *Sun, Land, and Sea*.

Cann's 2007 *Five Fountains* exhibition recognized the anxiety that the Len Lye Foundation and Govett-Brewster had experienced in the process of engineering and exhibiting the artist's kinetic sculpture. While the public is rarely antagonistic to the works on display or challenges the ethics of their creation, the judgment of other artists and colleagues is an occasional issue.

Sustained censure comes from critics Jim and Mary Barr, who have described the foundation as a "ouija board" of governors behind Lye's "ghost-written works" (Barr and Barr 2016). In reference to a reconstructed group of *Wind Wands* (as exhibited in St. Louis), the Barrs asked "do you think Len Lye would have ever done something like that?" (Barr and Barr 2014). The most pointed questioning of the foundation's activities came in a 2006 article by journalist Sally Blundell. In "Whose Lye Is It Anyway?," notable figures in the New Zealand art world took the foundation to task over the posthumous realization of the artist's work. Ian Wedde, curator at the Museum of New Zealand Te Papa Tongarewa, took issue with the interpretation of Lye's archives:

> He may even have anticipated the engineering and metallurgic progress that would make this happen, but this doesn't answer the critical question of when an artist's concepts, preliminary drawings and sometimes doodles are actually indications of final intention. Lye was a compulsive and highly creative doodler and dreamer-on-paper, and much of this material should perhaps be left in that condition. Without the artist being present to advance concepts or critically test the ways in which they are installed, it's not easy to benchmark the moments when Lye's vision stops and institutional ambitions take over (Blundell 2006).

Wedde's comments demonstrate a tendency of some critics of the foundation's work to assume familiarity with Lye's research and design notes that, in practice, they do not have. This concern is undermined by a limited understanding of the artist's practice, relying on a superficial yet persistent impression of Lye as a fantastical doodler distracted from serious design by whimsy. His sculptural designs ranged in detail but do not necessarily equate to his kinesthetic doodling in the way that Wedde suggests. Conflating the two diminishes the richness of Lye's practice and provides a means to disengage with him as an artist involved in conceptual thought.

A more serious opposition to the foundation's practice comes from sculptor Andrew Drummond, who teaches at the University of Canterbury's School of Fine Arts and is familiar with the College of Engineering's labors. He addresses the idea that any decision made by someone other than the artist himself is fraudulent:

> But how do you know that the decisions made are the decisions the artist would have made? It's a moral issue as much as an aesthetic issue—it's about the morality of someone making someone else's work (Blundell 2006).

Drummond's position denies Lye's agency in creating the foundation, and he takes the position that the foundation trustees are tasked with an unethical mandate regardless of the artist's instructions. Writing in 1975 (and conscious of his limited years ahead), Lye noted the challenge in his large-scale and unrealized works:

> It took six months of sorting out the size on the serpent's best size, to halt at one hundred and fifty feet—yet no one can really tell until the mock-up stage (Lye 1984).

Importantly, he anticipated that he would be relinquishing the decisions to others, and the possibility that they might deviate from what he would have done:

> I work on what looks best and you could do it—your judgement would be almost as good as mine, although you wouldn't be as familiar with it as I am, so that's where I would edge you out of getting the better effect. But anybody once they have tried the whole range of possibilities, then go back and pick out the one that they liked the best, then settle for that as the program and if they got tired of that in a week's time they could just invent another program.[5]

When Lye maneuvered his practice toward kinetic sculpture, he felt he was on the crest of a new and radical movement, and he likely expected more people to learn about the specificities of the field and about his work in particular. When movements like Pop, Minimalism, and Conceptual Art hit the art historical mainstream, they produce sustained and endorsing research cultures, supported through universities, that in turn produce experts in the field. Sadly for Lye, this didn't happen for the kinetic "moment," and its main protagonists and their works are often overlooked. For now (and in the future), the foundation staff is likely the only group capable of making informed decisions about the artworks. By shifting midcareer from London to New York and then changing the nature of his practice from British experimental

filmmaker to American kinetic sculptor, Lye himself unfortunately aggravated the situation. The totality of Lye's body of work is scattered between two seemingly disparate practices and between two times and places.

Art historians, curators, and conservators wholly appreciate the democratizing benefits of technological advances in moving-image media through the digital realm and the longevity it lends the moving image first made on celluloid. Moreover, they are content to witness the proliferation of "historical" film through social media such as YouTube and Facebook. One wonders, therefore, at the antagonism of Blundell and Wedde toward Lye's sculpture (when no argument is mounted against the film work) and the consequent lag of knowledge about it internationally. For most Northern Hemisphere observers, Lye's sculpture is known through limited magazine and textbook documentation of the 1960s kinetic art scene. Few have experienced the work firsthand, as Guy Brett notes:

> For one thing, there is very little kinetic art on show in museums. Museums, on the whole, have not cared to meet the challenge of this sort of work—which is only partly a technical and conservational challenge. And it is obviously only a static image which survives in photographic reproduction, still the normal form of information dissemination in art books, catalogues and magazines (Brett and Cotter 2000:9).

It was a sentiment the artist expressed himself during the 1960s, frustrated at collectors refusing to invest in the maintenance of an acquisition. Writing to his dealer Howard Wise, he suggested that he "charge them 10 times as much, to get replacement and maintenance fund out of it. They maintain budgets, don't they, for doors etc."[6]

Lye's claim to be "pretty good for the 21st century" became more than a realization that his work could only be partially executed under his own watch but also a rejection of the environment he was required to work in. Anticipating what could be achieved in the future, he was similarly invested in the value of kinetic art and reticent to rely on his contemporaries to maintain that value. The development of the Len Lye Foundation and, thirty-five years later, the Len Lye Centre falls short of his hopes for a temple of motion, but they are an active and essential part of Lye's vision … for inventing another program.

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Notes

1. The Seven and Five Society formed in London in 1919, gradually departing from a traditional aesthetic style toward abstraction under the leadership of Ben Nicholson. The group featured Henry Moore and Barbara Hepworth, with Lye active with the group from 1927 to 1934. The Seven and Five Society ceased in 1935.
2. *Homage to New York* was a self-destroying kinetic sculpture, created by Jean Tinguely with assistance from Billy Klüver and Robert Rauschenberg. On March 17, 1960, in a public presentation at the Sculpture Garden of New York's Museum of Modern Art, the work performed for twenty-seven minutes before the fire department intervened.
3. The symposium would place Lye's largest work to date, *Swing Wand*, alongside works by eleven other artists in the city's High Park. The 27 m work failed to meet with Lye's satisfaction because the fabricators ignored his directions, introducing tapering to his wand despite his instructions to do otherwise. Lye noted, "I don't want it [the wand] to go up unless it is to my specifications.... The aesthetic value was destroyed. It is now a work of engineering and not a work of art." The work was ultimately deinstalled under unclear circumstances. See Webb 1996.
4. Constitution of Len Lye Foundation 1980.
5. Len Lye, interview by John Matthews and Paul Fiondella, New York, November 9, 1978. Unpublished transcript, p. 1. Len Lye Foundation Collection and Archive, Govett-Brewster Art Gallery.
6. Len Lye, note on letter from Howard Wise to Len Lye, October 3, 1969. Len Lye Foundation Collection and Archive, Govett-Brewster Art Gallery.

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Part 5. Posters

16.

Conserving Mechanical Elements in Technological Artifacts: Three Case Studies from Museo Nazionale della Scienza e della Tecnologia "Leonardo da Vinci," Milan

Marianna Cappellina
Claudio Giorgione

Developing a single protocol for the preservation of kinetic artifacts in technical and scientific museums can be challenging. Many factors need to be taken into consideration, such as the number of identical technical and scientific artifacts produced and displayed in other collections, their productive processes, and whether they are serial or handcrafted as unique pieces. The museum also needs to address essential issues such as long-term storage of artifacts, perishable machines, whether or not to display objects with parts in motion, and how an exhibit can help visitors understand the movement of a machine.

Technical and scientific museums are involved daily with the issue of preserving objects with moving parts. A display of moving machines provides an immersive experience for the visitor, but it can generate risks to the objects' materials and components. Unlike unique works created by an artist with aesthetic intentions, technical and scientific machines were developed for practical purposes and often have a productive function. They can also be handcrafted, as in the case of scientific instruments, models, or replicas. For this reason, the development of a single preservation strategy can be difficult. The case studies below illustrate some of the challenges routinely faced by the museum.

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Cockcroft-Walton Generator

First designed in 1932, the Cockcroft–Walton generator is an electric circuit that produces a high voltage from a low voltage. A system of capacitors and diodes generates this voltage, along with kinetic components such as dynamos (fig. 16.1), which are housed inside rounded aluminum casings. The machine is assembled over two Bakelite isolating cylinders. The electrical components were lost during the first installation in the museum in the 1960s; furthermore, safety concerns prevent us from activating the machine. It was decided not to reintegrate the electrical functionality but to potentially keep the dynamo system moving. The conservation treatment was realized in January–June 2016 by Strati s.n.c.

40-Horsepower Cassani Tractor

The Cassani 40 is an important diesel tractor first produced in 1927. It underwent conservation treatment, performed by Strati s.n.c., in February–April 2015 for display in a permanent exhibition gallery about nutrition. The artifact involves two kinds of movement: the ignition of the diesel engine, and the kinematic motion of the wheels and gears. The movement of its wheels, including the steering wheel, was used to place it inside the gallery. The engine

remained turned off for safety reasons and, during conservation, all the diesel tanks were drained.

Nineteenth-Century Jacquard Loom

There were many discussions about the conservation of this complex Jacquard loom, which was originally used to create textiles with complicated patterns such as brocades. The first idea was to return it to working order by replacing many of its parts, such as ropes and dobbies. However, 1,200 silk warp threads out of the beam were destroyed and detached from the finished fabric. The installation of a new warp would have been very difficult and expensive. A simpler and more sustainable conservative restoration was chosen, with a static presentation. Only the broken ropes have been replaced; the damaged section of warp threads was cut and placed as near as possible to the finished fabric. The conservation treatment was realized by Giuseppe Pellegrini in June–September 2015.

Figure 16.1. Detail of one of the inner dynamos in the Cockcroft-Walton generator.

Courtesy of the Museo Nazionale della Scienza e della Tecnologia "Leonardo da Vinci," Milan.

17.

Think Big!: The Conservation of *Ballerina Clown*, a Kinetic Work of Art by Jonathan Borofsky

Mine Erhan

Artist Jonathan Borofsky (b. 1942) is famous for his large, kinetic, outdoor sculptures. This paper presents the conservation of *Ballerina Clown*, an outdoor sculpture in the Collection Museum Ludwig Forum Aachen (Germany), and gives an overview of the history, technology, and conservation of the mechanism inside the sculpture. Conservation and restoration treatments became necessary following damage due to vandalism. During the conservation process, the motion of the leg was adjusted.

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Figure 17.1a. Jonathan Borofsky's *Ballerina Clown*, 1990, installed inside the courtyard of the Museum Ludwig Forum Aachen.

Artwork and Art History

Ballerina Clown (1990) by Jonathan Borofsky (b. 1942) is composed of a female ballerina body wearing a male clown mask. This "transvestite figure (half clown, half ballerina)" (Ottinger 2004:39) dances on top of a box in front of a curtain. The figure's arms are outstretched, and one leg sways gently, "kicking" in the air. The work is accompanied by Frank Sinatra's "My Way" sung in a creepy, hollow voice by Borofsky. The figure holds a "flying" golden ring and lights illuminate the kinetic sculpture at night.

The figure of the ballerina clown occurs several times in Borofsky's oeuvre. The first version is a drawing from 1981 titled *The Entertainer (Self-portrait as Clown)* (Kunstmuseum Basel 1983:133, 183). The first sculpture version is the kinetic artwork *The Dancing Clown at 2,845,325* (1982–83), which is much smaller and an indoor sculpture; it is part of the collection of The Museum of Fine Arts, Houston (Clari 2004:242). Around 1986 Borofsky created a couple of color and occasionally kinetic screen prints of the ballerina clown similar to the first drawing. Later Borofsky created the two final versions of the ballerina clown, which are outdoor sculptures; one, built in 1989, is in Venice, California, and a second, built in 1990, is displayed in the courtyard of the Museum Ludwig Forum Aachen, Germany (fig. 17.1a).

The artwork is as high as a two-story building (about 9.0 × 5.7 × 6.4 m) and is made from stable materials including aluminum, steel, glass fiber reinforced plastic (GRP), two-part epoxy resins, and two-part polyurethane paints. (Information on media was supplied by the artist.)

The motion of the leg is powered by an electric motor that rotates a flywheel. Through a coupling rod, a gearwheel with an attached chain turns back and forth, and the sculpture's leg is moved by a second gearwheel that is installed as a "knee joint." Both gearwheels are connected through attached chains and a steel cable. Two guide rollers determine the direction of the steel cable (fig. 17.1b). Amplifiers, speakers, and a cassette recorder play the song, and lights illuminate the sculpture at night. The artwork can be activated by a switch in a nearby building.

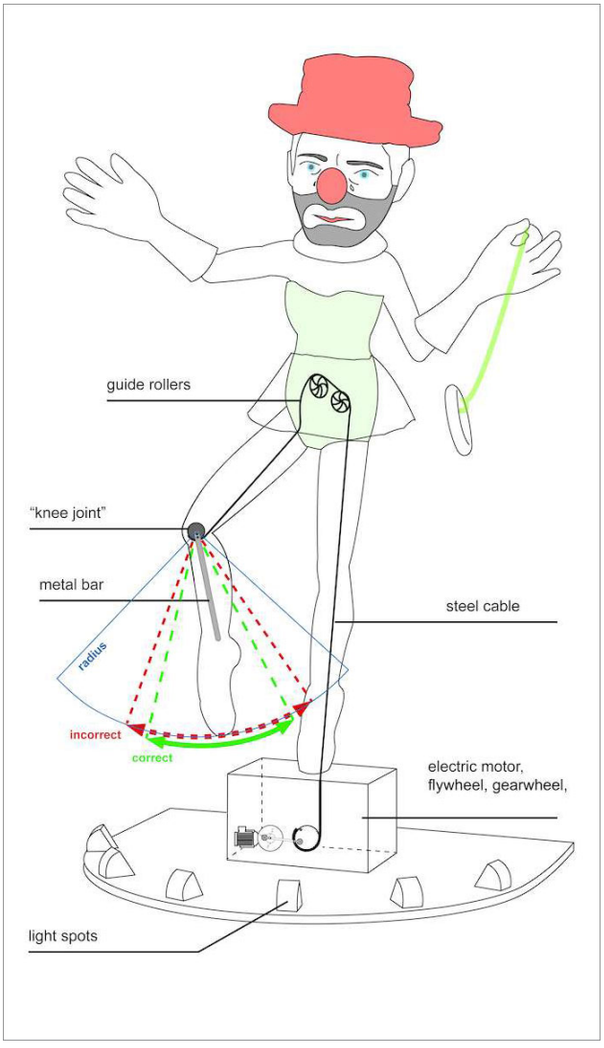

Figure 17.1b. Diagram of the mechanism that moves the leg of Jonathan Borofsky's *Ballerina Clown*, 1990.

Damage and Treatments

Ballerina Clown has been exhibited in the courtyard of the Museum Ludwig Forum Aachen since 1991. Conservation and restoration treatments were necessary after it was vandalized. The mechanism that allows the clown's leg to swing was broken, and sections of the original surface were cracked and damaged. Additionally, the paint had whitened through chalking, and partial delamination, cracks, and losses emerged.

When the movable leg was examined to replace the torn steel cable, it was evident that the leg swung very strongly in both directions (see fig. 17.1b), which raised the question of whether this was the original configuration. Further inspection of the flywheel revealed that one hole had distinct traces of wear, indicating that it had been used originally. Because the hole was already very worn, it could not continue to be used. After consultation with the museum, a new hole was drilled with the same distance to the center as the original. This allows the old hole to serve as a primary document.

Additional treatments were performed to stabilize frail parts of the GRP, consolidate delamination, fill losses, and retouch this painted outdoor sculpture.

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18.

Conserving a Kinetic "Rotor": *Light Dynamo* by Heinz Mack

Paola Iazurlo
Grazia De Cesare
Mariastella Margozzi

This paper presents the study and treatment of *Light Dynamo*, a Rotor by Heinz Mack (b. 1931), which was carried out by the Laboratorio di Restauro Materiali dell'Arte Contemporanea (Conservation Department of Contemporary Art Materials) of the Istituto Superiore per la Conservazione e il Restauro (ISCR) in Rome. *Light Dynamo* is an assemblage of wooden panels forming a box. Inside is an aluminum-coated disk connected to an electric mechanism, which allows its slow rotation. The work is in the collection of the Galleria Nazionale d'Arte Moderna e Contemporanea (GNAM), which acquired it from the Salita gallery in Rome in 1986. It had never been exhibited because of its poor condition. The treatment focused on the conservation of the constituent materials and the refunctionalization of the kinetic system, made possible with the collaboration of the artist's studio.

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During the second half of the 1950s, artist Heinz Mack (b. 1931) developed his interest in lighting and kinetic phenomena with his Rotors. This series of works is laminated with shiny metal and creates moving light reflections via movement produced by a small motor housed on the back. *Light Dynamo* belongs to this phase of the artist's production; it was recently identified as a work realized by Mack in 1960 for the ZERO group's only exhibition in Rome: *Mack + Klein + Piene + Uecker + Lo Savio = 0*, of 1961.

The kinetic play is produced by a rotating disk inside a mirrored box, observed through corrugated glass to amplify the optical effect and the reflection of lighting. The interiors of the box and the disk, which are covered with small parallel wings with different orientations, are made of wood and laminated with sheets of aluminum.

A condition assessment revealed that the work appeared to be seriously deteriorated. The particleboard panels of the box were very flaky, and their external faces, painted with white vinyl-acrylic copolymer, were covered with a thick deposit of dirt and disfigured by numerous small lacunae. The aluminum sheets were covered with a passivating oxide layer, and the two cellulose acetate strips that originally held the glass pane were deformed and broken. Furthermore, functionality was limited because the corrugated glass, which was a fundamental screen to modify and extend the kinetic play of the work, was missing.

As with most kinetic works, the problem presented by the treatment was how to balance the exigency of preservation of the original materials with the exigency of functionality.

The issue of preservation of the original materials was addressed according to a strictly conservative approach in terms of compatibility and reversibility. The particleboard panels were consolidated with a hydrocarbon resin (Regalrez™ 1126), the paint layer and the aluminum sheets were cleaned with a solution of triammonium citrate, and the small lacunae were filled with synthetic stucco and inpainted with a cellulose ether medium, to respect the opacity and solubility of the original paint layer.

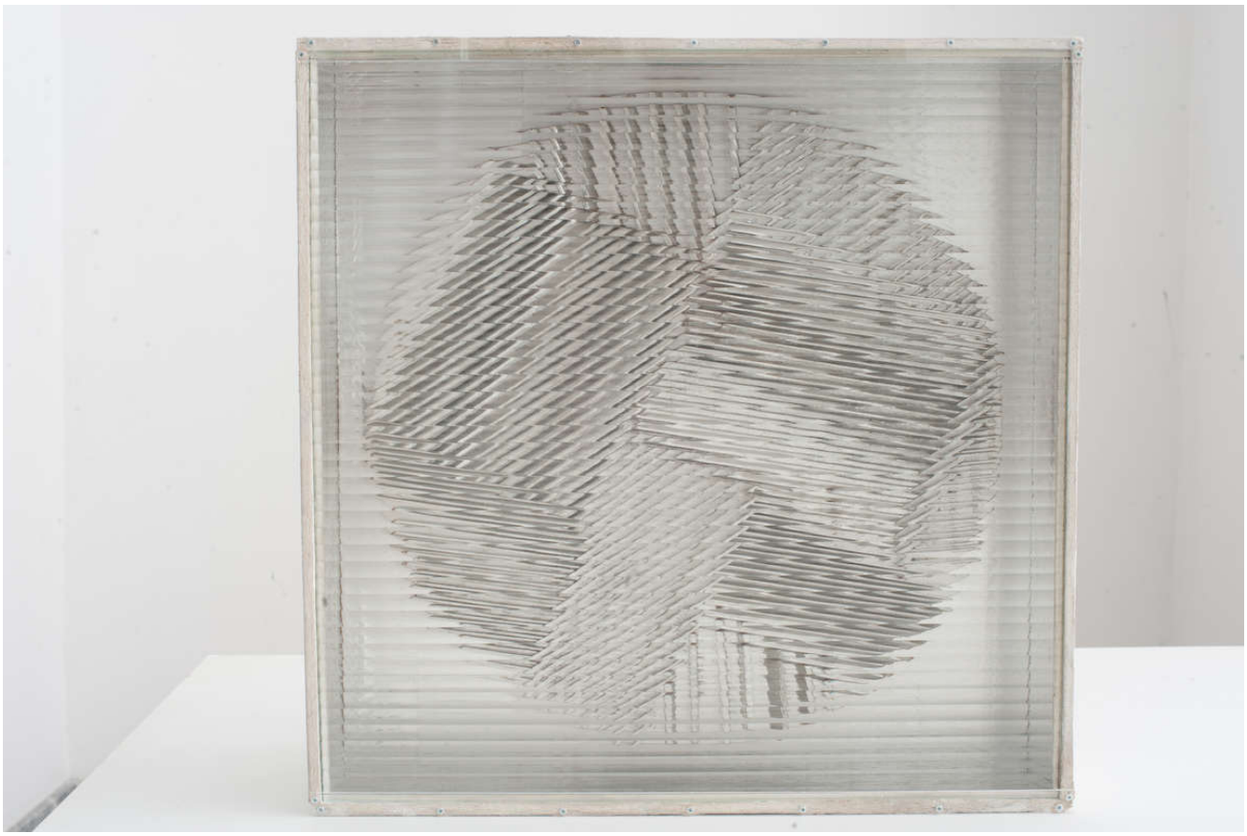

Figure 18.1. Heinz Mack's *Light Dynamo*, 1960, after conservation treatment. Atelier/Studio Mack.

Reestablishing functionality was a key issue to avoid the risk of the work being reduced to a relic, and this required substitution of the elements that were lost or damaged. This critical phase was carried out with the collaboration of the artist. He confirmed the correct functioning of the motor, which was still operational; it had come from a wall clock and moved slowly—approximately three revolutions per minute. Moreover, the artist's studio provided a sample of the glass used by Mack in that period. This allowed us to replace the lost pane with a new one, similar to the original, which we had found after a very long search of glass factories (fig. 18.1). It was installed onto the work with two polymethyl methacrylate (PMMA) bars, similar in appearance to the originals made from cellulose acetate. Finally, the elastic band on the back, which allowed the transmission of the movement from the motor to the disk, was replaced with an identical new one.

The treatment restored the kinetic function and enabled us to preserve the original materials, a necessity considering the singularity of *Light Dynamo* when compared to other works in the artist's series of Rotors, which are completely covered with shiny metal. *Light Dynamo* could be considered a sort of sketch, or extemperaneous work, quickly executed with makeshift materials, easily perishable, but always characterized by a rigorous planning of the kinetic movement under lighting effects.

19.

Considering the Continuum of Care for Outdoor Kinetic Sculpture

Abigail Mack
Friederike Steckling
Sara Levin

Large-scale, outdoor kinetic sculptures by artists such as Alexander Calder, George Rickey, and Pol Bury face new and formidable challenges from the effects of global climate change. Although the sculptures are well engineered, and many have been on continuous outdoor display for decades, more powerful and frequent storms brought about by climate change are creating both catastrophic and small-scale damage as well as increasing the overall rate of wear. Protocols need to be developed and implemented to address this rising threat. Innovative site-specific analysis and the implementation of protections by the Fondation Beyeler for Calder's *The Tree* (1966) present a possible model for long-term outdoor display of similar kinetic objects.

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Meteorological science has documented that climate change has resulted in more storms and increasing storm intensity over recent decades (Melillo, Richmond, and Yohe 2014). These new weather-related challenges necessitate that new display protocols for outdoor sculpture be adopted by the field, just as recommendations for indoor museum environments were standardized in 1978 with the publication of Garry Thomson's *Museum Environment*. Although some work is currently being done, a better understanding of the risks, the limits of the materials, and the means to mitigate damages is needed.

Conservators at the Fondation Beyeler in Basel, Switzerland, embarked on a study of how weather-related research can be used to develop such protocols. For Alexander Calder's *The Tree* (1966), staff at the museum monitored its outdoor display environment, developed partnerships with national weather stations, and made strategic modifications to the display site to reduce the risk of damage. To establish which wind directions and intensities cause the most violent movement and damage, on-site wind measurements were analyzed and correlated to triaxial movement measurements directly on the sculpture (fig. 19.1). A threshold of acceptable wind conditions was established after correlating that data with a review of past damage.

Informed by the collected data, the Beyeler planted a high line of trees to impede wind from the most dominant direction and determined the best tethering angles for the sculpture. Further measures include an advance-warning system for winds that exceed a defined threshold to allow staff to tether the mobile elements. Several specialists, such as meteorologists, weather station managers, and landscape designers, were consulted to support the conservators with this project. While this work is still in the testing phase, it highlights the potential effectiveness of measures that were customized for a specific object.

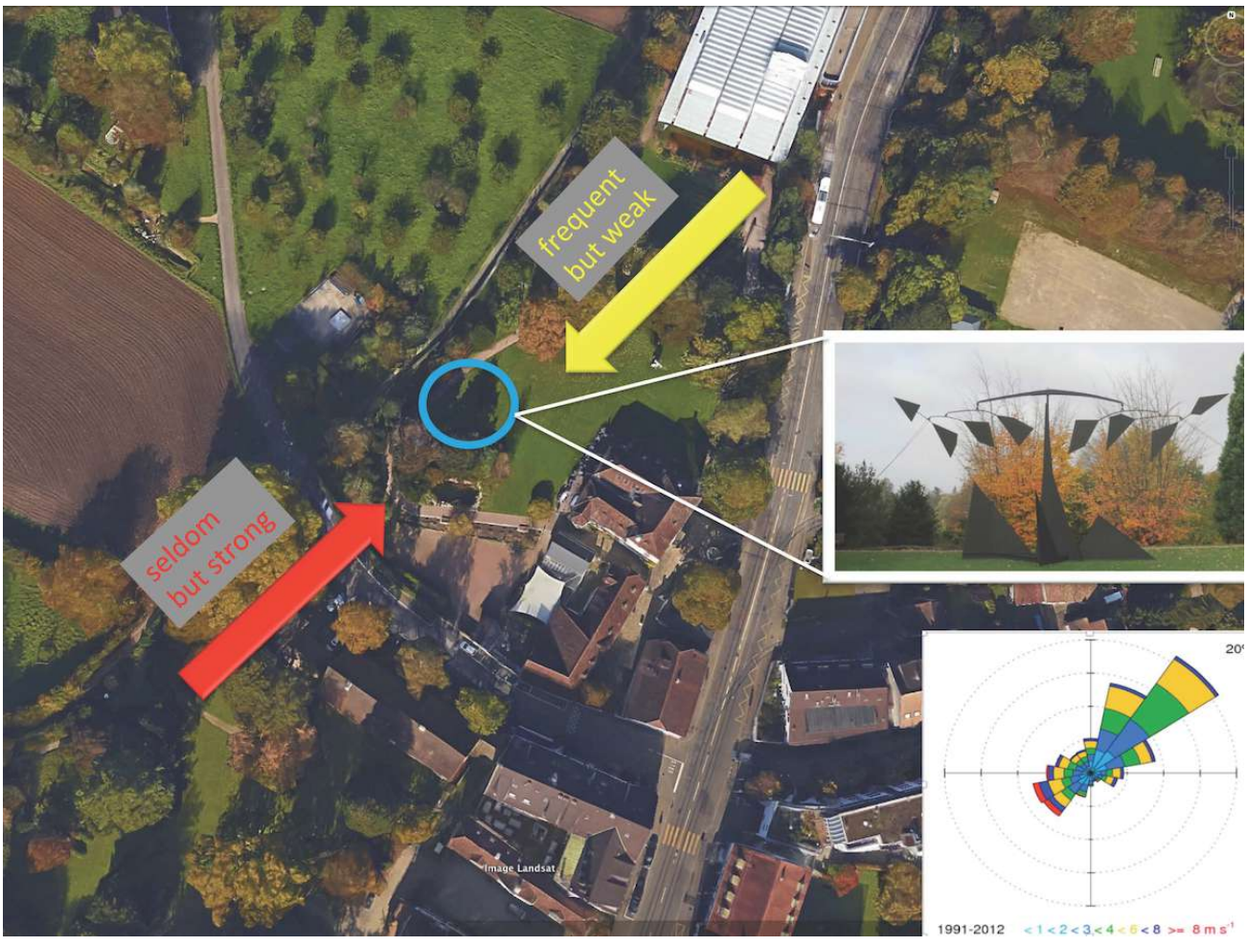

Figure 19.1. Aerial view of Alexander Calder's *The Tree* at the Fondation Beyeler, with arrows indicating wind direction and a graph illustrating intensity. Inset: Federike Steckling. 2001 Image Landsat Google Earth 47° 35′ 12.43″ N7° 39′ 00.17″ E elev. 923 ft., eye alt. 1818 ft.

We suggest the following protocols for future care of outdoor kinetic sculpture:

- monitor wind during each season to determine the best display location
- establish the wind speed that causes damage, and arrange for an advance alarm system from local weather stations
- create wind barriers as needed
- plan to deinstall or containerize during inclement months
- design and implement custom protective measures for predicted storm events

Each sculpture is unique and requires a customization of the suggested protocols, with particular emphasis on protective measures. Further study is needed to establish recommendations to protect kinetic sculptures during extreme events such as hurricanes and blizzards, since it has been shown that uninformed tethering can also be the source of damage. A solution will likely require consultation with an engineer, overseen by conservators, because sculptures from the 1960s through the 1980s have been subjected to prolonged weathering and may harbor hidden weaknesses. We hope that further discussions and case studies will provide guidance for conservators, museums, and collectors on the continued care and preservation of outdoor kinetic works.

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20.

Gianni Colombo's *Strutturazione cinevisuale abitabile*: From Flickering to Light

Marlies Peller
Gerda Kaltenbruner
Martina Pfenninger Lepage

"From Flickering to Light" was a master's thesis project carried out in 2014 at the Institut für Konservierung und Restaurierung, Akademie der Bildenden Künste, Vienna. It was based on *Strutturazione cinevisuale abitabile* (1964), a light-kinetic artwork by Milanese artist Gianni Colombo (1937–1993), now in the collection of Austria's Neue Galerie Graz, Universalmuseum Joanneum. Malfunctioning technical components restricted exhibition of the artwork. Based on in-depth research into the artist's conception, the history of the object, and its technology, preservation strategies were developed that focused on the installation's electrical and technical issues.

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Gianni Colombo's *Strutturazione cinevisuale abitabile*

Strutturazione cinevisuale abitabile (Inhabitable cinevisual structure) from 1964, a light environment by Milanese artist Gianni Colombo (1937–1993), is composed of two perpendicular square panels[1] fixed to a wall (fig. 20.1). The artwork is meant to be shown in a small, darkened room, with the spectator stepping into the space outlined by the lights. Short and intermittent bursts of light flash simultaneously on each panel.

Figure 20.1. Gianni Colombo's *Strutturazione cinevisuale abitabile*, 1964, on view in the exhibition *Fluxus, Happening, Konzeptkunst*, 2005/6, at Neue Galerie Graz, Universalmuseum Joanneum.
Archivio Gianni Colombo, Milan. Photo: Courtesy of Neue Galerie Graz, Universalmuseum Joanneum, Austria. N. Lackner, UMJ.

The structure consists of two wooden frames and eight triangular steel sheets painted black, which divide each of the two panels into eight symmetrical segments set at a slight distance from one another. Stripes of acrylic glass[2] are inserted into these gaps. The whole construction is precariously held together, partly with screws and partly mounted with self-adhesive tape.[3]

Eight candle-shape incandescent light bulbs are installed inside each panel. The flashing of the sixteen bulbs is controlled by four switches mounted on the upper side of the horizontal panel. All four are simple bimetallic switches—like indicator switches—in a parallel circuit. Each switch controls four bulbs independently, which illuminate correlating acrylic stripes (the light lines).

Deterioration and mechanical stress had caused changes to the artwork's constructional components, and the switches revealed partial blackouts and loss of function. Erosion of electrical contacts led to one light line in a permanent "on" position, and two light lines that slowly faded in and out,[4] accompanied by a weeping sound. The use of bulbs with lower energy consumption[5] seemed to influence the work's functionality.

Several resources were consulted before preservation strategies were developed, including philosophical texts by Colombo, descriptions in exhibition catalogues, and construction drawings. The Archivio Gianni Colombo in Milan was visited, where Colombo's former assistant Roberto Casiraghi[6] was interviewed. *Strutturazione cinevisuale abitabile* was also compared with an identically titled object.

An instrument analysis of the materials was performed. In addition, a custom-programmed microcontroller (Arduino) with different sensors was used to examine the behavior of the switches. It appeared that no exact and completely regular rhythm, and therefore no perfect recurrent sequence of the flashes, is possible with the original technical components.

Based on all findings, a minimally invasive treatment was developed to preserve the components that help situate the artwork in the 1960s, thus maintaining as much authenticity as possible. The authors were cognizant of its unpredictability over time.[7] The original switches were repaired, necessary treatment on the frame construction was implemented, and, in collaboration with Neue Galerie Graz, Universalmuseum Joanneum, detailed recommendations for transport, handling, and display were realized.[8] Also, corresponding replacement bulbs were stocked, for authenticity and continuity.[9]

This process was an instructive example of the challenges and contradictions faced by conservators: the same title for seemingly different installations and objects; varying descriptions, possibly of the same installation, in several languages; the artistic idea versus its actual manifestation; the relevance of construction drawings; the difficulty of knowing which came first, the object or the drawings; evaluating different expert opinions; incomprehensible and unpredictable changes in behavior of the switches over time; and historic value versus artistic intent.

The thesis "From Flickering to Light," which includes video documentation and art historical research, can serve as a guide for any future reconstruction of the artwork, such as rewiring the bimetallic switches or substituting similar switches or programming. All options take into account the difficulty of reproducing a specific random inaccuracy of the original components.

Notes

1. Each $1m^2$.
2. 2mm thick transparent acrylic glass.
3. Gaffer or Gaffa tape.
4. Caused by flickering bulbs.
5. 15W bulbs instead of the original 25W incandescent bulbs.
6. Roberto Casiraghi is a painter and a professor at the Accademia di belle arti di Brera, Milan.
7. It is not possible to predict if the repair of the old switches will last for the next ten years, or even through the next exhibition.
8. Including guidelines for activation for limited periods, safety instructions, and installation requirements.
9. Because the old switches are very sensitive to changes of consumption, responding with a higher risk of flickering and flying sparks, the light medium is extremely important and cannot simply be exchanged with, for example, LEDs.

21.

Death of a moment: Management, Installation, and Maintenance of a Site-Specific Kinetic Sculpture

Eugenia Stamatopoulou

Death of a moment (2007) is a kinetic, room-size installation created by the Swiss Neo-Dada artist Urs Fischer (b. 1973). The installation's floor-to-ceiling mounted mirrors are set in motion by a hydraulic system, making the space appear to distort and fluctuate. Acquired by the Dakis Joannou Collection in 2007, it was installed as a permanent artwork at the DESTE Foundation in Athens, Greece. This project presented numerous challenges related to the artwork's production and long-term presentation, including site obstruction, the availability of components, coordination with various specialists, and spatial planning. This paper discusses the solutions adopted by the Dakis Joannou Collection to install and maintain *Death of a moment* and to plan for its long-term preservation.

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Born in Zurich, Urs Fischer (b. 1973) is a prominent contemporary artist who uses a wide variety of media and materials to create assemblages, paintings, digital montages, spatial installations, kinetic objects, and texts. *Death of a moment* (2007) is a site-specific installation consisting of a wall (13.5 × 3.2m) mounted with floor-to-ceiling mirrors (fig. 21.1). The mirrors perform a regular, barely noticeable tilting motion, which has a disturbing effect on spatial perception. Visitors and other artworks in the space are reflected, multiplied, and distorted, which, in conjunction with the motion of the mirrors, creates a sense of malaise.

Figure 21.1. Urs Fischer's *Death of a moment*, 2007, on view in the exhibition *Fractured Figure: Works from the Dakis Joannou Collection*, 2008, at the DESTE Foundation, Athens, Greece. Mirrors, aluminum, hydraulics, and control unit. Dimensions variable. Mirrors tilt back and forth in a wavelike pattern.
The Dakis Joannou Collection © Urs Fischer. Courtesy of the artist and Galerie Eva Presenhuber, Zurich / Photo: Stefan Altenburger.

Description of the Work

The work has three primary components: an aluminum frame, eight tilting glass mirrors, and a hydraulic system. The movable aluminum frame is secured vertically to the floor and ceiling of the building. The mirrors are mounted vertically on the frame, and the frame is mounted on a secondary metallic structure with one arm at each corner. The arms are connected to a hydraulic system that makes them move up and down, pushing out and pulling in the mirrors. The hydraulic system is connected to an electric pump that provides the pressure for the arms to accomplish their movement.

Technical Information

For the installation of this site-specific kinetic work, several issues were taken into consideration, such as the building and floor load capacity, and much preparatory work was done, including the creation of an accurate layout by a geometrician.

Fischer approached the design company ACRUSH, based in Zurich, which specializes in the realization of ambitious artistic projects. The company works with several artists, often from the first stages of an artwork's conceptualization through its realization and restoration. To realize the installation of *Death of a moment*, ACRUSH, in collaboration with Fischer, made various modifications to the site, such as the construction of a new, level ceiling, the consolidation of the metal beam of the concrete ceiling's inner structure, and the installation of an ultrasound barrier at the front of the mirrors (for safety).

To cover the full 13.5m width of the wall with mirrors, the artist decided to use eight individual mirrors, each measuring 1.68 × 3.2m, and 7.5mm thick.

Each sheet of mirrored glass was secured to the top of the aluminum frame with a one-part compound MS-polymer glue specially made for mirrors (Polyflex 433® by GYSO). Each frame (3 × 390cm) was covered with lines of glue. The modified silicone polymers have high elasticity and polymerize quickly. The glue is suitable for linear bonded joints because the polymers are resistant to temperature fluctuations and humidity and are flexible (with a strength in excess of $1N/mm^2$ and an elongation at break of more than 150 percent). Also, because the glue has no solvent and isocyanides compounds, it should not affect or deteriorate the transparency of the mirror. The glue requires twenty-four hours to cure, but seventy-two hours are needed before setting the frame in motion. Stable temperature and relative humidity conditions (20–22^{o}C and 50–55 percent RH) were necessary to cure the glue. The glue's adhesive strength was further reinforced by the use of a self-adhesive double-face tape (GYSO-Mount 1500, 1.5mm).

Preservation and Long-Term Use

Death of a moment is set to move only when it is on view; however, because the work is part of several exhibition installations, it is on view almost permanently. At one point, however, a severe leak occurred in the central pump and subpumps because the artwork had been inactive for a long period. This caused the oil in the hoses to run back into the tank and the gaskets to dry. After checking the pressure in the pump and changing the gaskets, the work was operational again. In the future, regular inspection and maintenance has to be established, including cleaning and changing oil filters, cleaning the mechanical parts of the pump, and changing the oil.

Conclusion

The installation of a site-specific kinetic artwork presents a host of challenges and issues. The conservator has to communicate and collaborate with various experts to find the best suitable solution to each problem. The long-term preservation of this type of sculpture demands regular inspection and maintenance of all the elements (mirrors, glues, metallic structure, pumps, central unit, power, and so on) to keep it moving.

22.

Future in Motion: Conservation Issues of Seven Kinetic Artworks by Dutch Artist Ray Staakman

Carien van Aubel
Nikki van Basten
Katja van de Braak
Sjoukje van der Laan
Anouk Verbeek
Marleen Wagenaar

This paper presents the conservation of seven kinetic artworks created between 1965 and 1969 by Dutch artist Ray Staakman (b. 1941). The artworks are made of various materials—aluminum or tin plate in combination with polystyrene sheets, painted chipboard, painted metal, or metal springs—but all contain one or two electric motors. The artworks had malfunctions that were caused by broken motors and the deformation of moving parts. The challenge in this project was finding a balance between respecting the artist's intent and respecting the authenticity of the original materials. Is it permissible to improve kinetic mechanisms by replacing original parts of the artworks?

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Dutch artist Ray Staakman (b. 1941) was a pioneer in kinetic art in the Netherlands during the 1960s and 1970s, and the movement in his artworks creates intriguing optical effects by the displacement of shapes. Unfortunately, several of his works began to malfunction after repeated use and could no longer be displayed. In 2012 the University of Amsterdam (UvA), in collaboration with the Rijksdienst voor het Cultureel Erfgoed (RCE; the Cultural Heritage Agency, Netherlands), began a major conservation project of seven of Staakman's early kinetic artworks in the collection of the RCE. The objects, which Staakman made between 1965 and 1969, are composed of various materials, including anodized aluminum or tin plate in combination with polystyrene sheets, painted chipboard, painted metal, and metal springs (fig. 22.1). They all contain one or two electric motors, which activate the kinetic mechanisms.[1] The malfunctions were mainly caused by broken electric motors and deformation of the moving parts due to repeated use or to damage that occurred during exhibition and storage. In some cases, components were not resilient enough to withstand stress generated during movement.

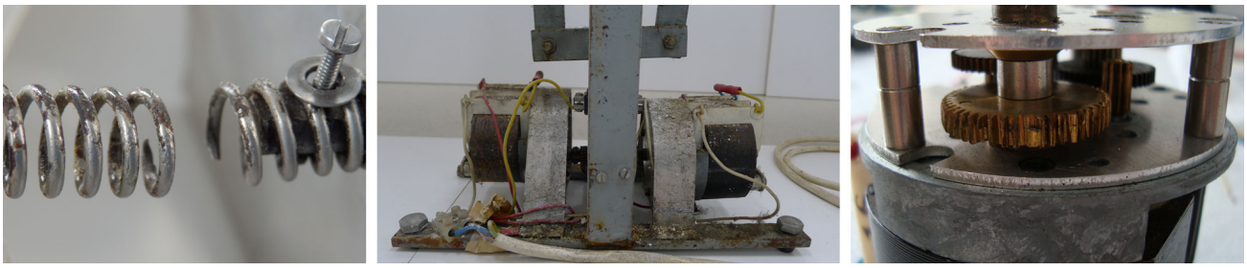

Figure 22.1. Components from Ray Staakman's kinetic works, before treatment. The metal spring (left), two electric motors that move each other in the opposite direction when switched on (middle), and a worn-down gear (right) were not, and are not, robust enough to support the stresses generated during movement. Rijksdienst voor het Cultureel Erfgoed.

Extensive research resulted in restoring both the materiality and the kinetic functions of the artworks; however, the conservators found themselves constantly questioning the practical possibilities and ethical boundaries of conserving and restoring the artworks. Following conservation ethics, is it permissible to improve or replace kinetic mechanisms? For a broader perspective on these dilemmas, we asked the opinions of three pioneers in the conservation of kinetic art: Lydia Beerkens, senior conservator, contemporary art, Stichting Restauratie Atelier Limburg (SRAL), Netherlands; Reinhard Bek, partner, Bek & Frohnert, New York City; and Ulrich Lang, senior conservator, LangSündermanRestauratoren, Germany.

Kinetic artworks can be divided into two categories: "sculptural" works, which still have high aesthetic value without movement; and works that are "dead" without movement. Staakman's can be placed in the second category, as he stated: "Without movement my work is dead. The materials I used are simply a means to create optical effects through movement."[2] Bek emphasized the importance of movement in Staakman's work and stated that "under certain circumstances the reversible replacement of functional parts, e.g., motors, especially when invisible to the audience, can therefore be considered acceptable."[3] Although Beerkens understood that Staakman's work doesn't have an explicit sculptural value without its movement, she expressed doubts: "improving the artwork with retroactive effect changes the artworks into more sophisticated contemporary pieces."[4] Lang said that "instead of improving a kinetic artwork by later technology, I would rather think about exhibition copies, 3-D models, or films. A faded color would never be repainted, so why would we be allowed to 'update' kinetic art?"[5]

The aim of the Staakman conservation project was to achieve at least temporary exhibition of the artworks through minimal intervention; however, the treatments seem to have been insufficient because some of the malfunctions are inherent to the quality of the kinetic components. More drastic measures are needed to allow a prolonged exhibition in the future. The choice between respecting the artist's intent, which would require improving the artworks, or respecting the material's authenticity will be made in continuing conservation treatments.

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Acknowledgments

We thank Ray Staakman for the valuable and informative collaboration. We thank Lydia Beerkens, Reinhard Bek, and Ulrich Lang for their invaluable opinions on this subject. Thanks are also due to Evelyne Snijders, Ellen Jansen, and Ingeborg Smit, University of Amsterdam (UvA); Ron Kievits and Simone Vermaat, Rijksdienst voor het Cultureel Erfgoed (RCE); private conservator Daan Brouwers; and Marcel van der Sande, Kröller-Müller Museum, for their assistance and input on this project. We are grateful to our other colleagues from the UvA and RCE for their contributions, advice, and support toward the conservation of these kinetic artworks.

Notes

1. Electric motors made by Crouzet (type: 965). Staakman used donated electric motors and industrial leftovers to create his artworks.
2. Ray Staakman, Skype interview with Carien van Aubel, Nikki van Basten, Anouk Verbeek, Katja van de Braak, Sjoukje van der Laan, and Marleen Wagenaar, Ateliergebouw Amsterdam, December 5, 2012.
3. Reinhard Bek, interview with Anouk Verbeek and Katja van de Braak, studio Bek & Frohnert, New York City, August 11, 2016.
4. Lydia Beerkens, e-mail correspondence with Nikki van Basten, August 26, 2016.
5. Ulrich Lang, e-mail correspondence with Carien van Aubel, August 25, 2016.

23.

The Conservation Ethics of and Strategies for Preserving and Exhibiting an Operational Car: The Motion and Standstill of Joost Conijn's *Hout Auto* (Wood Car)

Arthur van Mourik

This paper describes the decision-making process used in the conservation of *Hout Auto* (Wood Car) by Joost Conijn (b. 1971). One of the crucial questions behind conservation strategies was whether to interpret the vehicle as a kinetic artwork or as a motionless relic. Possible approaches toward the work's preservation were discussed with the artist and with a panel of professionals from various disciplines. These discussions, which resulted in the decision to preserve the vehicle as a static sculpture, brought new insights to different analytical approaches.

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Figure 23.1. Joost Conijn's *Hout Auto* (Wood Car) in the garden of the Centraal Museum. Centraal Museum Utrecht.
Photo: Ernst Moritz.

The Artwork

In 2001 artist Joost Conijn (b. 1971) created *Hout Auto* (Wood Car) (fig. 23.1) from the base of a Citroën DS, building the chassis from plywood and installing a wood-burning apparatus that powered the engine instead of gas. In 2002 the artist drove *Hout Auto* through fifteen countries in Europe, collecting wood along the way and documenting his journey on video. The artwork comprises the car and the video, which is on a DVD. (The master version is preserved on mini DVCAM.)

Collection Management, Preservation, and Presentation

The Centraal Museum Utrecht, Netherlands, purchased *Hout Auto* in 2003. Before the car became part of the museum collection, the wood-burning apparatus was disconnected and gasoline was used for fuel instead. The artist was involved with this modification. The presentation of the artwork requires complex instructions, conditions, and safety measures. *Hout Auto* is equipped with a hydraulic suspension system. To move the vehicle easily, and for presentation purposes, the engine must be turned on so that the base of the car is lifted. Storage

maintenance requires recharging the battery and driving the car to prevent failure and degradation. During installation, exhaust fumes are vented using flexible hoses.

Research and Methodology

In 2015 the Centraal Museum began research to gain insight into the vehicle's maintenance as a moving car or as an immobile artwork. This topic, discussed during an interview with the artist, resulted in the following conclusions:[1]

- moving the car or using the engine is not essential for the artwork, from the artist's point of view
- the car battery can be removed
- by maintaining oil in the engine, parts and devices can be preserved more effectively for a longer period
- the engine should not be removed
- a permanent raised driving position of the base can be realized

Several strategies and possible solutions were carefully considered during two multidisciplinary meetings organized by the Stichting Behoud Moderne Kunst (SBMK; Foundation for the Conservation of Contemporary Art).

Conclusions

The following decisions were made after examining conservation strategies and maintenance issues, the outcome of the artist interview, and the multidisciplinary sessions. Parts and materials will be restored; the engine will be disconnected but the possibility of future use maintained; the oil supply will be maintained; the vehicle will be technically modified for a permanent raised car base (driving position) for presentation purpose; and the car will be moved in the future without using the engine.

Reflecting on the history of presenting, installing, and conserving the artwork, it seems that the sensory experience of the car—its sounds and smells—influenced the idea that it was necessary to keep the engine running. This interpretation resulted in ongoing and intensive caretaking of the vehicle. Because such care involved complex museum practices, it was decided to reevaluate conservation ethics, and topics discussed during the research project resulted in new understandings about conservation theories and the artwork's authenticity. These new interpretations made clear that *Hout Auto* can be understood as a sculpture. The outcomes and new understandings will be used as primary reference points and as a directory in conserving the artwork. The Centraal Museum thanks all participants for their insights and cooperation.

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Notes

1. Joost Conijn, interview by Marije Verduijn, head of collection management, Centraal Museum Utrecht, October 29, 2015.

Contributors

Rachel Rivenc
Rachel Rivenc, associate scientist, has been working within the Modern and Contemporary Art Research Initiative at the Getty Conservation Institute since 2006. She studies the diverse materials and techniques used by contemporary artists, and their conservation. She is also coordinator for the Modern Materials and Contemporary Art working group of ICOM–CC. Rivenc holds an MA in paintings conservation from the Université Paris 1 Panthéon-Sorbonne and received a PhD in history from the Université de Versailles Saint-Quentin-en-Yvelines. She recently published the book *Made in Los Angeles: Materials, Processes, and the Birth of West Coast Minimalism*.
Preface

Reinhard Bek
Reinhard Bek completed his training as an objects conservator in 2002. That same year, he joined the Museum Tinguely in Basel, Switzerland, as its first permanent conservator. Bek was a founding member of the European Union project Inside Installations in 2003, and he was hired in 2008 by the Museum of Modern Art, New York, to spearhead an assessment of their technology-based artwork. In 2012, with his partner Christine Frohnert, he founded Bek & Frohnert LLC, based in New York City. He has lectured internationally and published widely on contemporary art conservation.
1. A Question of KinEthics

Paul Brobbel
Paul Brobbel studied ancient history and museum studies at the University of Auckland. He previously held curatorial, collection management, and conservation positions throughout New Zealand, and he is now curator of the Len Lye Foundation collection and archive at the Govett-Brewster Art Gallery/Len Lye Centre, New Zealand. In 2016 Brobbel was a research fellow at the Henry Moore Institute, Leeds.
15. "Pretty Good for the 21st Century": Restoration, Reconstruction, and Realization of Len Lye's "Tangible Motion Sculpture"

Tiziana Caianiello
Since 2009 Tiziana Caianiello, PhD, has worked as a research associate at the ZERO Foundation in Düsseldorf. She studied art history at the University of Naples (Italy) and the University of Cologne (Germany). Her research primarily focuses on theoretical issues in the conservation of kinetic art and media art installations, performative elements in the visual arts, exhibition history, and art of the 1960s.
2. The Fluid Boundaries between Interpretation and Overinterpretation: Collecting, Conserving, and Staging Kinetic Art Installations

Marianna Cappellina
Marianna Cappellina studied the conservation and restoration of metal artworks and jewelry at the Opificio delle Pietre Dure in Florence. She also studied at the Istituto Gemmologico Italiano (Milan), gradating as an FEEG (Federation for European Education in Gemmology) gemologist. She worked as a freelance restorer and gemologist until 2012, when she became a restorer in residence at the Museo Nazionale della Scienza e Tecnologia "Leonardo da Vinci," Milan. Since 2015 Cappellina, with other restorers, has been a partner in Strati s.n.c., a conservation and restoration company; she works on art as well as scientific and technological objects.

16. Conserving Mechanical Elements in Technological Artifacts: Three Case Studies from Museo Nazionale della Scienza e della Tecnologia "Leonardo da Vinci," Milan

Grazia De Cesare
Paintings conservator Grazia De Cesare studied at the Istituto Superiore per la Conservazione ed il Restauro (ISCR; formerly ICR) in Rome, where she received a postgraduate degree specializing in the conservation of stone artworks. She also received a postgraduate degree in the preventative conservation of cultural heritage from the Sorbonne University, Paris. She has participated in conservation assignments for UNESCO in Algeria, Iraq, Jordan, Israel, and other countries. She also works as a conservator, researcher, and teacher at ISCR, Conservation Department of Contemporary Art Materials, and as a private conservator.
18. Conserving a Kinetic "Rotor": Light Dynamo by Heinz Mack

Kari Dodson
Kari Dodson is the assistant objects conservator at the Menil Collection, Houston. She holds a BA in physical anthropology from the University of Missouri, Columbia, and an MA/CAS in art conservation from SUNY Buffalo State College. Dodson interned at the National Museums of Malawi, the Barnes Foundation (Philadelphia), and the Metropolitan Museum of Art, New York, and she completed a Mellon fellowship at the Worcester Art Museum (Massachusetts). She also serves the American Institute for Conservation as coeditor of the Objects Specialty Group Postprints.
7. Takis and the Fourth Dimension

Manon D'haenens
Manon D'haenens is a conservator-restorer of contemporary art. She holds an MA from the École Supérieure des Arts Saint-Luc de Liège (Belgium), and she is a PhD candidate at the Université de Liège (Centre Européen d'Archéométrie). Her research focuses on the conservator-restorer's role in contemporary art collections.
14. The Collection of Nicolas Schöffer: From the Artist's Studio to the Museum

Mine Erhan
Mine Erhan is a conservator of contemporary art and paintings. As project manager for the conservation studio Die Schmiede, she specializes in contemporary art, kinetic art, and outdoor sculptures. She applies two- and three-dimensional image-processing–based digital technologies to improve conservation and restoration treatments. Erhan studied at HfBK Dresden and the Academy of Fine Arts, Vienna.
17. Think Big!: The Conservation of Ballerina Clown, a Kinetic Work of Art by Jonathan Borofsky

Barbara Ferriani
Barbara Ferriani has headed her conservation studio in Milan since 1983, and she has been head of the conservation laboratory at the Triennale Design Museum (Milan) since 2010. She teaches conservation of contemporary art at the Centro Conservazione e Restauro "La Venaria Reale" (Turin), at the Università degli Studi di Milano, and at the Università Cattolica (Milan). She is assistant coordinator of ICOM–CC Modern Materials and Contemporary Art working group.
10. Intertwined Strategies for Conservation and Display of Kinetic Art: Case Studies in the European Neo-Avant-Garde

Carla Flack
Carla Flack is a sculpture and installation conservator working for various institutions in the United Kingdom and internationally, including the Science Museum (London) and the Statens Museum for Kunst (Copenhagen). She has been with the Tate, London, since 2012. In 2008, Flack received an MA from the University of Lincoln (UK) in the conservation of historic objects, with a focus on plastics in contemporary art. She collaborates with artists to ensure that the intention and longevity of their works is maintained.
5. Cybernetic Umbrella: A Case Study in Collaboration

Julia Giebeler
Julia Giebeler is a freelance conservator of historical, modern, and contemporary art. In 2012 she completed her MA at the Cologne Institute of Conservation Sciences (CICS) with a thesis on the preservation of Heinz Mack's early light-kinetics as a case study in conservation theory. Since 2013 Giebeler has been a research assistant at CICS, focusing on theoretical conservation issues in contemporary art.
12. The Hype about ZERO and Its Influence on the Conservation and Presentation of Early Kinetic Works

Mark Gilberg
Mark Gilberg received his BS and MS degrees in inorganic chemistry from Stanford University and his PhD in archaeological conservation from the Institute of Archaeology, University College London. He has been director of the Conservation Center at the Los Angeles County Museum of Art since 2005.

3. Fast and Furious: Operation, Maintenance, and Repair of Chris Burden's Metropolis II at LACMA

Jane Gillies
Jane Gillies earned a BSc in architecture from Edinburgh University in 1981, and she received her postgraduate diploma from West Dean College (Sussex, UK) in 1984. She is a professional associate member of the American Institute for Conservation.
9. Engineering a Solution: Latin American Light-Based Kinetic Art at the Museum of Fine Arts, Houston

Claudio Giorgione
Claudio Giorgione studied art history at the Università degli Studi di Milano (University of Milan), where he wrote a dissertation on the Milanese Renaissance painter Bernardino Luini. He has worked at the Museo Nazionale della Scienza e della Tecnologia "Leonardo da Vinci," Milan, since 1997, where he is curator of the museum's Art and Science Department; he also coordinates conservation projects.
16. Conserving Mechanical Elements in Technological Artifacts: Three Case Studies from Museo Nazionale della Scienza e della Tecnologia "Leonardo da Vinci," Milan

Gunnar Heydenreich
Gunnar Heydenreich is professor for conservation of modern and contemporary art at Cologne Institute of Conservation Sciences and head of the Cranach Digital Archive (lucascranach.org). He studied paintings conservation at the HfBK Dresden and earned a PhD from the Courtauld Institute of Art, London. From 1995 to 2009 he was head of paintings and contemporary art conservation at the Restaurierungszentrum in Düsseldorf. He was a founding member of the International Network for the Conservation of Contemporary Art (INCCA) and coorganizer of and participant in several European research projects, including Inside Installations, PRACTICs, NeCCAR, and NACCA.
12. The Hype about ZERO and Its Influence on the Conservation and Presentation of Early Kinetic Works

Paola Iazurlo
Paintings conservator Paola Iazurlo studied at the Istituto Superiore per la Conservazione ed il Restauro (ISCR; formerly ICR) in Rome, where she received a postgraduate degree specializing in the conservation of stone artworks and architectural finishings. She also received an MA in art history and a postdegree specialization in medieval and modern art history from Università degli Studi di Roma "La Sapienza." She works as a conservator, researcher, and teacher at ISCR, where she is responsible for the Conservation Department of Contemporary Art Materials, and since 2015 she has worked as a teacher and researcher at the University of Applied Sciences and Arts of Southern Switzerland (SUPSI).
18. Conserving a Kinetic "Rotor": Light Dynamo by Heinz Mack

Gerda Kaltenbruner
Gerda Kaltenbruner has been professor of conservation of Modern and Contemporary Art at the Academy of Fine Arts, Vienna, since 2005. She held various positions prior to that, including head of conservation at the Kunstmuseum Bonn and conservator at the office for the Preservation of Historical Monuments, North Rhine-Westphalia. She received her MA in Conservation at the Academy of Fine Arts, Vienna.
20. Gianni Colombo's Strutturazione cinevisuale abitabile: From Flickering to Light

Louise Lawson
Louise Lawson, conservation manager at the Tate, London, has worked within conservation for nearly twenty years, and her background spans both sculpture and time-based media conservation. She holds a BA and an MA in conservation, along with an MSc in disaster management. Her areas of research and interest focus on replication and reenactment of artworks in collaboration with artists and artists' estates.
5. Cybernetic Umbrella: A Case Study in Collaboration

Sara Levin
Sara Levin is assistant conservator of objects at the Metropolitan Museum of Art. She earned an MS in art conservation with a focus on archaeological artifacts from the University of Delaware/Winterthur Museum. She has previously held positions at the Brooklyn Museum, where she led the treatment of the monumental *Resurrection* by Giovanni della Robbia, and at Mack Art Conservation, where she attended to a range of conservation issues related to modern and contemporary sculpture.
19. Considering the Continuum of Care for Outdoor Kinetic Sculpture

Abigail Mack
Abigail Mack established her art conservation practice, Mack Art Conservation, in 2007 in New York's Hudson Valley. She focuses on modern and contemporary art, with a specific interest in large-scale and monumental sculpture. Mack holds a BFA and an MA in art conservation from SUNY Buffalo. Mack is a contract conservator for the

Getty Conservation Institute's Outdoor Painted Sculpture Project.
19. Considering the Continuum of Care for Outdoor Kinetic Sculpture

Mariastella Margozzi
Mariastella Margozzi graduated as an art historian from Università degli Studi di Roma "La Sapienza," where she also took a postdegree specialization in medieval and modern art history. Since 1988 she has worked with the Italian Ministry of Cultural Heritage, first at the Reggia di Caserta and then at the Galleria Nazionale d'Arte Moderna e Contemporanea (GNAM) in Rome (1993–2016). As director of GNAM's conservation department, she was responsible for works dating to the first half of twentieth century as well as the collection of kinetic and visual art, coordinating the conservation treatments carried out since 1996. She has planned and executed several exhibitions on Italian contemporary art and has written numerous essays on the subject.
18. Conserving a Kinetic "Rotor": Light Dynamo by Heinz Mack

Jack McConchie
Jack McConchie is a time-based media conservator with ten years' experience in museum and galleries. He has worked for various institutions across the United Kingdom, in Glasgow and London, and he has worked within the Time-Based Media Conservation team at the Tate, London, since 2013. McConchie graduated from the University of Glasgow with a degree in electronics and music. He has a passion for collaborating with artists on bespoke technical solutions for complex installations.
5. Cybernetic Umbrella: A Case Study in Collaboration

Esther Meijer
Esther Meijer trained as a metal conservator at the Cultural Heritage Agency of the Netherlands, where she contributed to a number of projects before becoming an independent metal conservator. She is interested in new media and in law and authorship in art, and she obtained a European law degree. Meijer is project conservator for the Tinguely Conservation Project.
11. The Examination and Conservation of Thirteen Artworks by Jean Tinguely in the Collection of the Stedelijk Museum Amsterdam

Susanne Meijer
Susanne Meijer studied cultural heritage at the Amsterdam University of the Arts (Reinwardt Academy). She trained at the four-year metal conservation program of the Cultural Heritage Agency of the Netherlands in Amsterdam. After graduating in 1999 she was as a freelance metal conservator for nine years. She worked in various capacities on such projects as the conservation of the bronzes of the tomb of William of Orange, and she coordinated the conservation of the ethnographic and military collection of Museum Bronbeek in Arnhem. Since 2008 she has been a sculpture conservator at the Sculpture Conservation Department of the Stedelijk Museum Amsterdam, responsible for the conservation and restoration of the collection's metal and stone sculptures. Meijer is coordinator of the current Tinguely project.
11. The Examination and Conservation of Thirteen Artworks by Jean Tinguely in the Collection of the Stedelijk Museum Amsterdam

Vesna Meštrić
Vesna Meštrić is a senior curator at the Museum of Contemporary Art, Zagreb, in charge of the Vjenceslav Richter and Nada Kareš Richter Collection. Her research interests include interpretation and presentation of collections, conservation, and avant-garde and postmodern movements. She has curated various solo and problem-oriented exhibitions and participated in several international scientific conferences and workshops.
8. Preserving Performativity: Conserving the Elusive in Aleksandar Srnec's Artwork

Mirta Pavić
Mirta Pavić is the head of the Conservation Department at the Museum of Contemporary Art, Zagreb. She received her MA in conservation from the University of Ljubljana, Academy of Fine Arts and Design (Slovenia). Pavić teaches modern and contemporary art conservation at the University of Split (Croatia) and is a visiting lecturer at the University of Ljubljana.
8. Preserving Performativity: Conserving the Elusive in Aleksandar Srnec's Artwork

Marlies Peller
Marlies Peller studied conservation-restoration of modern and contemporary art at the Academy of Fine Arts, Vienna, graduating in 2014. She was assistant conservator at documenta 13, Kassel (2012), and research assistant (head of studio, conservation of modern and contemporary art) at the Academy of Fine Arts, Vienna (2014–16). She has also been a freelancer at Museum Moderner Kunst Stiftung Ludwig (mumok), Vienna.
20. Gianni Colombo's Strutturazione cinevisuale abitabile: From Flickering to Light

Martina Pfenninger Lepage

Since 2007 Martina Pfenninger Lepage has been head of the studio for Conservation of Modern and Contemporary Art at the Academy of Fine Arts, Vienna. She holds a diploma in conservation-restoration of modern materials and media from the University of Applied Sciences in Bern.
20. Gianni Colombo's Strutturazione cinevisuale abitabile: From Flickering to Light

Sherry Phillips
Sherry Phillips is conservator of contemporary art at the Art Gallery of Ontario, Toronto. She has a degree in microbiology and zoology from the University of Toronto and is a graduate of the Conservation Program at Queen's University (Kingston, Ontario). Her work with contemporary objects led to a focus on nontraditional materials, from plastic to electronics to taxidermy specimens to living systems.
6. Moving with the Times: The Refurbishment and Restoration of a Choreographed Robotic Arm

Isabel Plante
Isabel Plante holds a PhD in art history from the Universidad de Buenos Aires. She is a researcher with the Consejo Nacional de Investigaciones Científicas y Técnicas (National Council of Scientific and Technical Research) at the Universidad Nacional de San Martín, Argentina. Plante's doctoral thesis, which includes a chapter on kinetic art, was published in Argentina as *Argentinos de Parîs. Arte y viajes culturales durante los años sesenta* (2013).
13. Kinetic Multiples: Between Industrial Vocation and Handcrafted Solutions

Francesca Pola
Curator and writer Francesca Pola is an Italian historian of contemporary art, focusing on the 1950s and 1960s. She teaches and conducts research at the Università Cattolica (Milan) and at IES Abroad in Milan, and she was a Fulbright Distinguished Lecturer at Northwestern University in 2016. Pola is Italy's representative on the International Scientific Advisory Board of the ZERO Foundation, Düsseldorf. She is also a contributor to *Artforum* magazine.
10. Intertwined Strategies for Conservation and Display of Kinetic Art: Case Studies in the European Neo-Avant-Garde

Iolanda Ratti
Iolanda Ratti obtained an MA and a postgraduate diploma in contemporary art history at the Università degli Studi di Milano (University of Milan), with a thesis on the conservation of video installations. She was at Museo del Novecento, Milan, from 2004 to 2010, and then joined the Time-Based Media Conservation Department at the Tate, London. In 2013 she was a conservator at Pirelli HangarBicocca, Milan, and in 2014 she became collections curator at the Museo del Novecento.
Opening Remarks: The Kinetic Collection at the Museo del Novecento, Milan

Simon Rees
Simon Rees is the director of the Govett-Brewster Art Gallery, New Zealand's museum of contemporary art that houses the Len Lye Centre and the Len Lye Foundation's collection and archive. Rees has held senior positions at national institutions in Austria, Lithuania, New Zealand, and Australia and has been involved in five national pavilion projects (for three countries) at the Venice Biennale.
15. "Pretty Good for the 21st Century": Restoration, Reconstruction, and Realization of Len Lye's "Tangible Motion Sculpture"

Richard Sandomeno
Richard Sandomeno was formerly trained and certified as an industrial diesel mechanic. In 2002 he left that career and transitioned into custom metal, jewelry, and art fabrication, and he worked at CB Studio (Chris Burden's atelier) as a fabricator on *Metropolis II* from 2007 to 2012. After working to install *Metropolis II* at the Los Angeles County Museum of Art, he joined the museum's conservation department (2012–present) to maintain and repair the sculpture. Since 2001 Sandomeno has owned and operated Spragwerks Inc., his design and fabrication business.
3. Fast and Furious: Operation, Maintenance, and Repair of Chris Burden's Metropolis II at LACMA

Ingrid Seyb
Ingrid Seyb received an MA in conservation studies from West Dean College (Sussex, United Kingdom), validated by the University of Sussex in 2008. She is a professional associate member of the American Institute for Conservation.
9. Engineering a Solution: Latin American Light-Based Kinetic Art at the Museum of Fine Arts, Houston

Carol Snow
Carol Snow is a graduate of the Winterthur/University of Delaware Program in Art Conservation. While at the Walters Art Museum (Baltimore), she participated in archaeological projects around the Mediterranean and received a Fulbright Scholarship enabling her to work in Turkey. She has been a conservator in private practice for twenty years. She is deputy chief conservator and the Alan

J. Dworsky Senior Conservator of Objects at the Yale University Art Gallery (New Haven, Connecticut).
4. Conserving Thomas Wilfred's Lumia Suite, Opus 158

Eugenia Stamatopoulou
Eugenia Stamatopoulou graduated from the Université Paris 1 Panthéon-Sorbonne with an MA in art history and an MSc in conservation, both focused on contemporary art. She acquired an MPhil in monuments conservation at the National Technical University of Athens, Architecture Department, where she is also a PhD candidate. She has been a conservator and collections manager for museums and galleries in France and Canada. For several years, she has been in charge of the management, installation, and conservation of the Dakis Joannou Collection, Athens.
21. Death of a moment: Management, Installation, and Maintenance of a Site-Specific Kinetic Sculpture

Friederike Steckling
Friederike Steckling trained as a paintings conservator at the Conservation Center of New York University, where she received a Certificate of Advanced Study in Conservation and an MA in art history. She has been conservator at the Fondation Beyeler in Basel, Switzerland, since 2001, where she helped establish the conservation department. Steckling is responsible for the care of the Beyeler collection of modern art and for conservation projects on works in various media.
19. Considering the Continuum of Care for Outdoor Kinetic Sculpture

Erin Stephenson
Erin Stephenson is the William R. Leisher Fellow in Modern and Contemporary Paintings Conservation at the National Gallery of Art, Washington, D.C., where she specializes in modern and contemporary painting conservation. She earned her MA in art conservation from SUNY Buffalo. Stephenson interned with the Fine Arts Museums of San Francisco and held fellowships at the Balboa Art Conservation Center (San Diego) and the Menil Collection (Houston).
7. Takis and the Fourth Dimension

David Strivay
In 2001 David Strivay earned his PhD in physics, in the field of ion-beam analysis techniques. He has been the director of the archaeometry research center of the Université de Liège (Belgium) since 2005. His main fields of research are the development and optimization of mobile noninvasive analytical and imaging techniques, technical art history, atomic and nuclear physics and ion-beam analysis, and modification of materials.
14. The Collection of Nicolas Schöffer: From the Artist's Studio to the Museum

Ming-Yi Tsai
Ming-Yi Tsai, PhD, is a scientist researching air pollution, pesticides, and public health. He studied mechanical engineering at the Massachusetts Institute of Technology and environmental health at the University of Washington (Seattle). His passion is developing novel systems that can affordably monitor urban air quality in areas that lack air pollution data. He is on the board of directors of the Tsai Art and Science Foundation.
5. Cybernetic Umbrella: A Case Study in Collaboration

Carien van Aubel
Carien van Aubel is trained as a chemist and conservator in modern and contemporary art at the University of Amsterdam. She works as an independent conservator in the Netherlands and London. Currently, she is involved in "Project Plastics," which was initiated by the Dutch Foundation for the Conservation of Contemporary Art (SBMK) and the Cultural Heritage Agency of the Netherlands (RCE).
22. Future in Motion: Conservation Issues of Seven Kinetic Artworks by Dutch Artist Ray Staakman

Nikki van Basten
Nikki van Basten, conservator of modern and contemporary art, is on temporary assignment at the Getty Conservation Institute. She has carried out treatments for a broad range of objects and specializes in the conservation of (outdoor) painted sculptures. She holds a professional doctorate in the conservation of modern and contemporary art from the University of Amsterdam.
22. Future in Motion: Conservation Issues of Seven Kinetic Artworks by Dutch Artist Ray Staakman

Katja van de Braak
Katja van de Braak holds an MA and a professional doctorate in contemporary art conservation from the University of Amsterdam (UvA). She has worked both within the Netherlands and internationally, at various private practices and internships at world-renowned museums. Currently, she is working as an independent conservator in the Netherlands and as a guest lecturer in conservation practice in the contemporary art training program at UvA.
22. Future in Motion: Conservation Issues of Seven Kinetic Artworks by Dutch Artist Ray Staakman

Sjoukje van der Laan
Sjoukje van der Laan holds both an MA and a professional doctorate in contemporary art conservation. Over the years, she has developed her specialization and practical skills within a broad range of contemporary materials (such as plastics, time-based media, light, and so on), art installations, and conceptual artworks. She is assistant conservator of contemporary art at the Art Gallery of Ontario, Toronto.
22. Future in Motion: Conservation Issues of Seven Kinetic Artworks by Dutch Artist Ray Staakman

Arthur van Mourik
Arthur van Mourik, who earned his BA in museology in Amsterdam in 2007 at the Reinwardt Academy, is collection manager at the Centraal Museum Utrecht, where he specializes in preserving contemporary artworks. He has worked for several institutions, including the Rijksmuseum Amsterdam and the Van Abbemuseum (Eindhoven, Netherlands). He was selected by the Mondriaan Fund for a research project at Instituto Buena Bista, Curaçao Center for Contemporary Art in 2016. He is interested in artist interviews and new approaches in the conservation of contemporary art.
23. The Conservation Ethics of and Strategies for Preserving and Exhibiting an Operational Car: The Motion and Standstill of Joost Conijn's Hout Auto (Wood Car)

Muriel Verbeeck
Muriel Verbeeck holds a PhD from the Université de Liège (Belgium) and an MA in the science of information and communication from the Université Libre de Bruxelles. She is currently a professor at the École Supérieure des Arts Saint-Luc Liège (Belgium) in the department of conservation of fine art and is a scientific attaché to Université de Liège faculty of science. She also worked as a coordination assistant for the ICOM–CC (history and theory of conservation) and is the scientific editor of *CeROArt*.
14. The Collection of Nicolas Schöffer: From the Artist's Studio to the Museum

Anouk Verbeek
Anouk Verbeek holds an MA and a professional doctorate in modern and contemporary art conservation from the University of Amsterdam. She has a strong interest in the conservation of modern materials, mixed-media artworks, and large-scale installations. She is pursuing a fellowship in modern art.
22. Future in Motion: Conservation Issues of Seven Kinetic Artworks by Dutch Artist Ray Staakman

Marcel Verner
Marcel Verner is a professional engineer (P. Eng, Canada) with degrees in Electrical and Mechanical Engineering. At the National Research Council of Canada, he researched robotics for use in medical and automotive industries. Currently at PV Labs in Burlington, Ontario, he is responsible for the design and development of aerial robotic imaging systems. He loves a good technical challenge.
6. Moving with the Times: The Refurbishment and Restoration of a Choreographed Robotic Arm

Marleen Wagenaar
Marleen Wagenaar is a private conservator, offering specialized services in the conservation of contemporary art in a wide variety of materials and techniques. Cofounder of the conservation studio RestauLab, she is responsible for the modern and contemporary art department. Wagenaar holds an MA and a professional doctorate in contemporary art conservation from the University of Amsterdam.
22. Future in Motion: Conservation Issues of Seven Kinetic Artworks by Dutch Artist Ray Staakman

Alison Walker
Alison Walker received her BFA from Otis College of Art and Design (Los Angeles) in 2001 and an MFA from the University of California at Riverside in 2009. She has worked as a fabricator for Carlson & Co. and for CB Studio (Chris Burden's atelier). Since 2012, she has been responsible for the care, maintenance, and operation of Burden's *Metropolis II* at the Los Angeles County Museum of Art. In addition to her professional work, Walker actively maintains her own studio practice.
3. Fast and Furious: Operation, Maintenance, and Repair of Chris Burden's Metropolis II at LACMA

Sandra Weerdenburg
Sandra Weerdenburg studied art history in Utrecht and later trained as a conservator in the five-year postgraduate course at the Limburg Conservation Institute, Stichting Restauratie Atelier Limburg (SRAL), in Maastricht (Netherlands). She has been a sculpture conservator at the Stedelijk Museum Amsterdam since 1996; since 2006, she has also been head of the Conservation Department. Weerdenburg is supervisor of the Tinguely Conservation Project.
11. The Examination and Conservation of Thirteen Artworks by Jean Tinguely in the Collection of the Stedelijk Museum Amsterdam

Lynda Zycherman

Lynda Zycherman is a graduate of the Conservation Center, Institute of Fine Arts, New York University. She has served as conservator of sculpture at the Museum of Modern Art, New York, for three decades. Previously she worked at the Freer Gallery of Art, Washington, D.C., where she specialized in the technical examination of ancient Chinese bronzes. Zycherman also trained at the Metropolitan Museum of Art, New York, and the Corning Museum of Glass, New York.

4. Conserving Thomas Wilfred's Lumia Suite, Opus 158

Symposium Participants

Affiliations are given as of the time of the symposium.

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Italy

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Academy of Fine Arts, Vienna
Austria

Alessandra Bassi
Centro Conservazione Restauro, "La Veneria Reale," Turin
Italy

Lydia Beerkens
SRAL Art Conservation and Research, Maastrich
The Netherlands

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Bek & Frohnert LLC, New York
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Ghent University
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New Zealand

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Sweden

Tiziana Caianiello
ZERO Foundation, Düsseldorf
Germany

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Strati s.n.c., in residence at Museo Nazionale della Scienza e della
Tecnologia "Leonardo da Vinci," Milan
Italy

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University of Glasgow
Scotland

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Marina Cristina Lanza
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Iolanda Ratti
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Simon Rees
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Switzerland

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USA

Ioseba Soraluze
Conservation Center, Cheng Shiu University, Kaohsiung
Taiwan

Francisca Sousa
Fundação Arte Moderna e Contemporânea–Colecção Berardo, Lisbon
Portugal

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MUDEC–Museo delle Culture/Maastricht University
Italy/The Netherlands

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Hellenic Ministry of Culture
Greece

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University of Amsterdam
The Netherlands

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Czech Republic

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Hungary

Thomas Zirlewagen
Freelance conservator, Zurich
Switzerland

Index of Videos

1. A Question of KinEthics

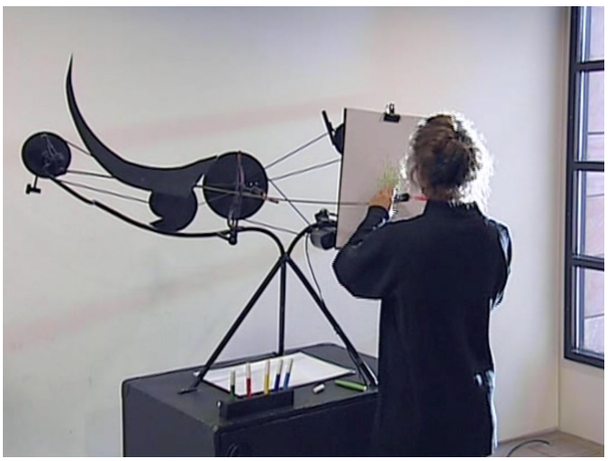

Figure 1.5. Woman creating a drawing on a 1990 replica of Jean Tinguely's *Méta-Matic No. 10*, 1959. Museum Tinguely, Basel. Watch the video at https://youtu.be/Mrvriy6TaEU.

Figure 1.7. Otto Piene's *Neon Medusa*, 1969, in operation. Collection Neuberger Museum of Art, Purchase College, State University of New York, gift of Leonore F. Rosenthal. Watch the video at https://youtu.be/lP8QLUGaupA.

Figure 1.10. Liz Larner's *Corner Basher*, 1988, in operation. Gaby and Wilhelm Schürmann. Watch the video at https://youtu.be/UkpyR7iLm5Q.

Courtesy of the artist.

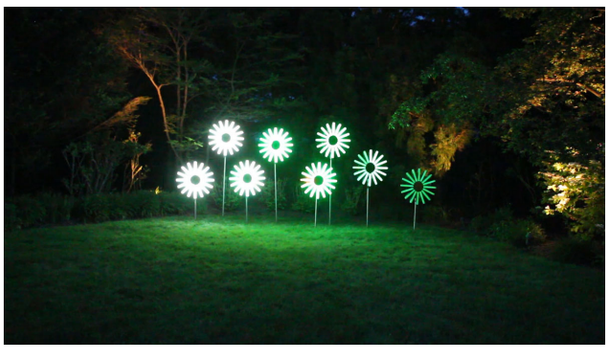

Figure 1.12. Leo Villareal's *Flowers 8*, 2005. Watch the video at https://youtu.be/Kpwfx8Zn0S4.

Courtesy of Donald R. Mullen Jr., with permission from the artist.

3. Fast and Furious

Figure 3.1. Chris Burden's *Metropolis II* (2010) in action. Watch the video at https://youtu.be/7vQkoFfU9gA.

4. Conserving Thomas Wilfred's *Lumia Suite*, *Opus 158*

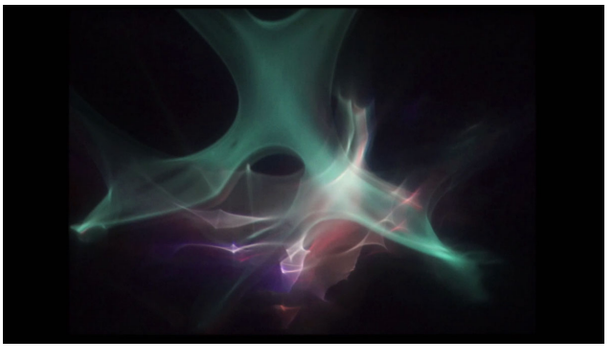

Figure 4.9. Yale University Art Gallery's video documentation of Wilfred's *Lumia Suite, Opus 158*. Museum of Modern Art, New York, Department of Painting and Sculpture, Museum Collection Files. Watch the video at https://youtu.be/h4PxDv_CFS4.

Video: Courtesy Yale University Art Gallery.

5. Cybernetic *Umbrella*

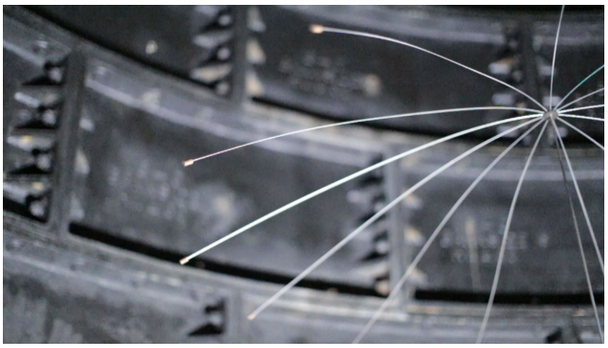

Figure 5.1. The central crown of *Umbrella*, 1971, by Wen-Ying Tsai, in action at Tate Modern's Tank Gallery, June 16, 2016–February 5, 2017. Watch the video at https://youtu.be/gj42ZITk7EM.
Courtesy Tsai Art and Science Foundation. Photo: © Tate, London 2016.

6. Moving with the Times

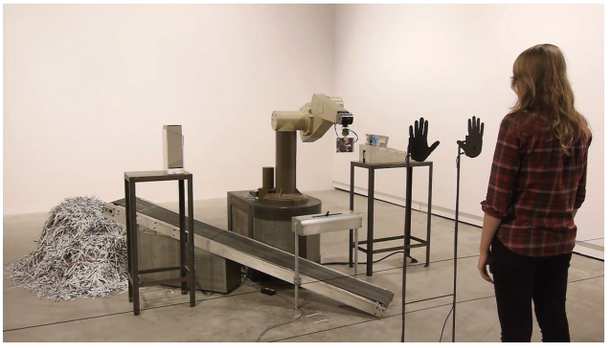

Figure 6.1. Max Dean's *As Yet Untitled*, 1992–95, on view in *Drone: The Automated Image* at VOX, Centre de l'Image Contemporaine, Montreal, September 7–October 19, 2013, during *Le Mois de la Photo à Montréal 2013*. Installation from the collection of the Art Gallery of Ontario. Watch the video at https://youtu.be/h5mMCqOLACo.
© 2017 Max Dean/Art Gallery of Ontario.

Figure 7.6. Detail of the operation of Takis's *Musical-M.013* producing sound, 2000. The Menil Collection, Houston, gift of the artist. Watch the video at https://youtu.be/OdKBY-9Xeos.

Figure 7.10. Operation of Takis's *Ballet Magnetique*, 1961, after conservation treatment. The Menil Collection, Houston. Watch the video at https://youtu.be/j86w750dsNU.

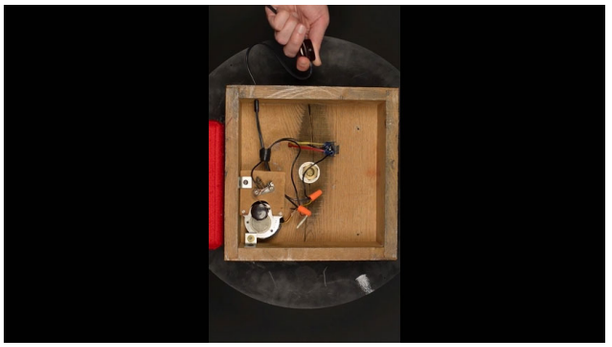

Figure 7.8. Detail of posttreatment mechanics on Takis's *Ballet Magnetique*, 1961. The Menil Collection, Houston. Watch the video at https://youtu.be/lBixeFhcJm8.

8. Preserving Performativity

Figure 8.2. Aleksandar Srnec adjusting his luminokinetic artwork at his exhibition in 1969. Museum of Contemporary Art, Zagreb. Watch the video at https://youtu.be/j5rhSkSZc3w.
Video: V. Petek.

Figure 8.6. Analogue projection of Aleksandar Srnec's *Luminoplastic 1*, 1965–67. Watch the video at https://youtu.be/bXS4nfmu5Tw.
Museum of Contemporary Art, Zagreb.

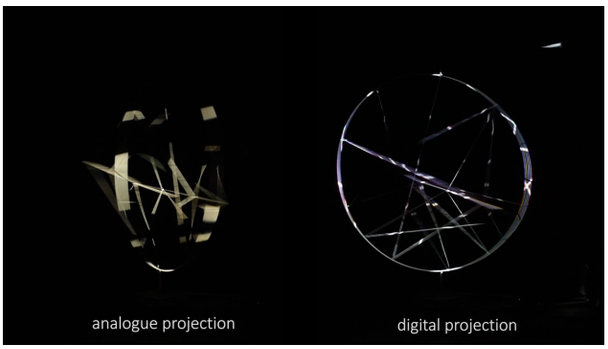

Figure 8.11. Comparison of the analogue and digital projections. Watch the video at https://youtu.be/EY3foRIJIFE.
Museum of Contemporary Art, Zagreb.

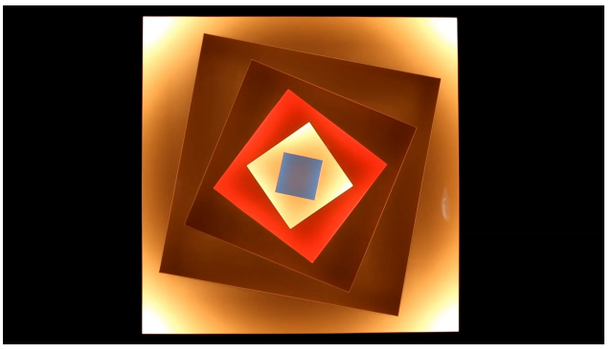

Figure 9.1. Gregorio Vardanega's *Espaces chromatiques carrées en spirale* (Chromatic Spaces Turning in a Spiral), 1968, Plexiglas, light bulbs, and motor; after treatment. The Museum of Fine Arts, Houston, museum purchase funded by the Latin Maecenas, 2010.173. Watch the video at https://youtu.be/zNr9YISTQfw.

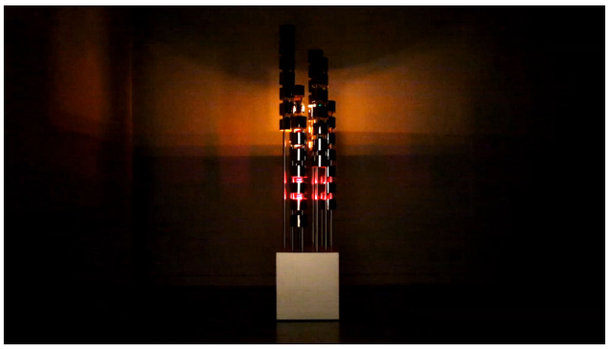

Figure 9.3. Gregorio Vardanega's *Couleurs sonores* (Sound Colors), 1963–79, metal, light bulbs, and electric motor; after treatment. The Museum of Fine Arts, Houston, gift of the estate of the artist and Sicardi Gallery, 2013.665.A-.G. Watch the video at https://youtu.be/PVJR2aAmdU4.

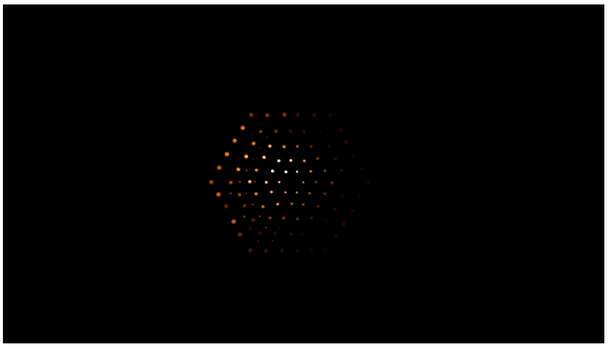

Figure 9.5. Horacio García Rossi's *Structure à lumière instable no. 29* (Unstable Light Structure No. 29), 1966, painted wood, Lucite rods, electric motor, and lights; after treatment. The Museum of Fine Arts, Houston, gift of Benbow and Jean Bullock, 2004.1618. Watch the video at https://youtu.be/E1HBHKpd46U.

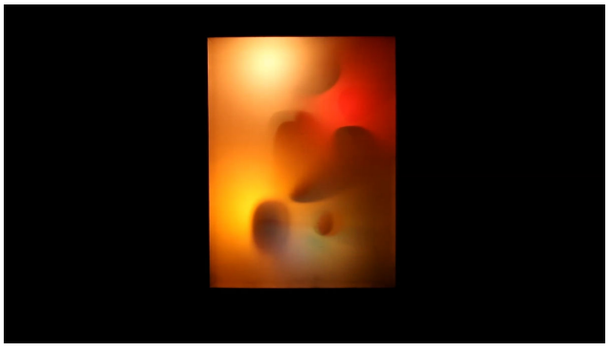

Figure 9.7. Abraham Palatnik's *Aparelho cinecromático* (Chromo-kinetic set), 1962, wooden box with plastic cover, electric motor, and colored light bulbs linked to a programmed electric circuit and cardboard paddles; after treatment. The Museum of Fine Arts, Houston, the Adolpho Leirner Collection of Brazilian Constructive Art, museum purchase funded by the Caroline Wiess Law Accessions Endowment Fund, 2007.21. Watch the video at https://youtu.be/wRws0HvLPB8.

15. “Pretty Good for the 21st Century”

Figure 15.2. Len Lye’s *A Flip and Two Twisters (Trilogy)*, 1977 footage. Watch the video at https://youtu.be/fgqht8Ui8dw.
Len Lye Foundation Collection, Govett-Brewster Art Gallery.

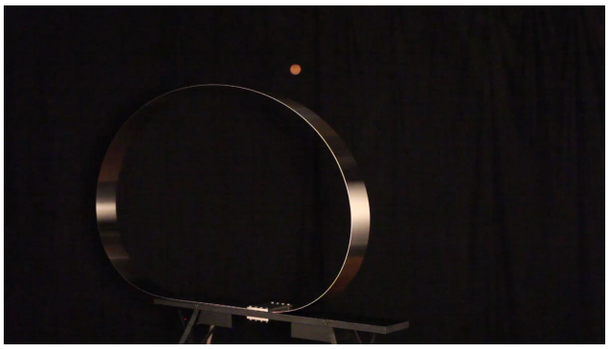

Figure 15.4. Len Lye’s *Loop*, ca. 1964, after its 2016 restoration. The Art Institute of Chicago, Barbara Neff Smith and Solomon Byron Smith Purchase Fund. Watch the video at https://youtu.be/zuY2-yNpJ-8.
© Len Lye Foundation Collection.

Figure 15.5. Len Lye’s *Five Fountains and a Firebush*, 2007. Govett-Brewster Art Gallery. Watch the video at https://youtu.be/t_Or2bTzcbg.
Courtesy of Govett-Brewster Art Gallery.

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