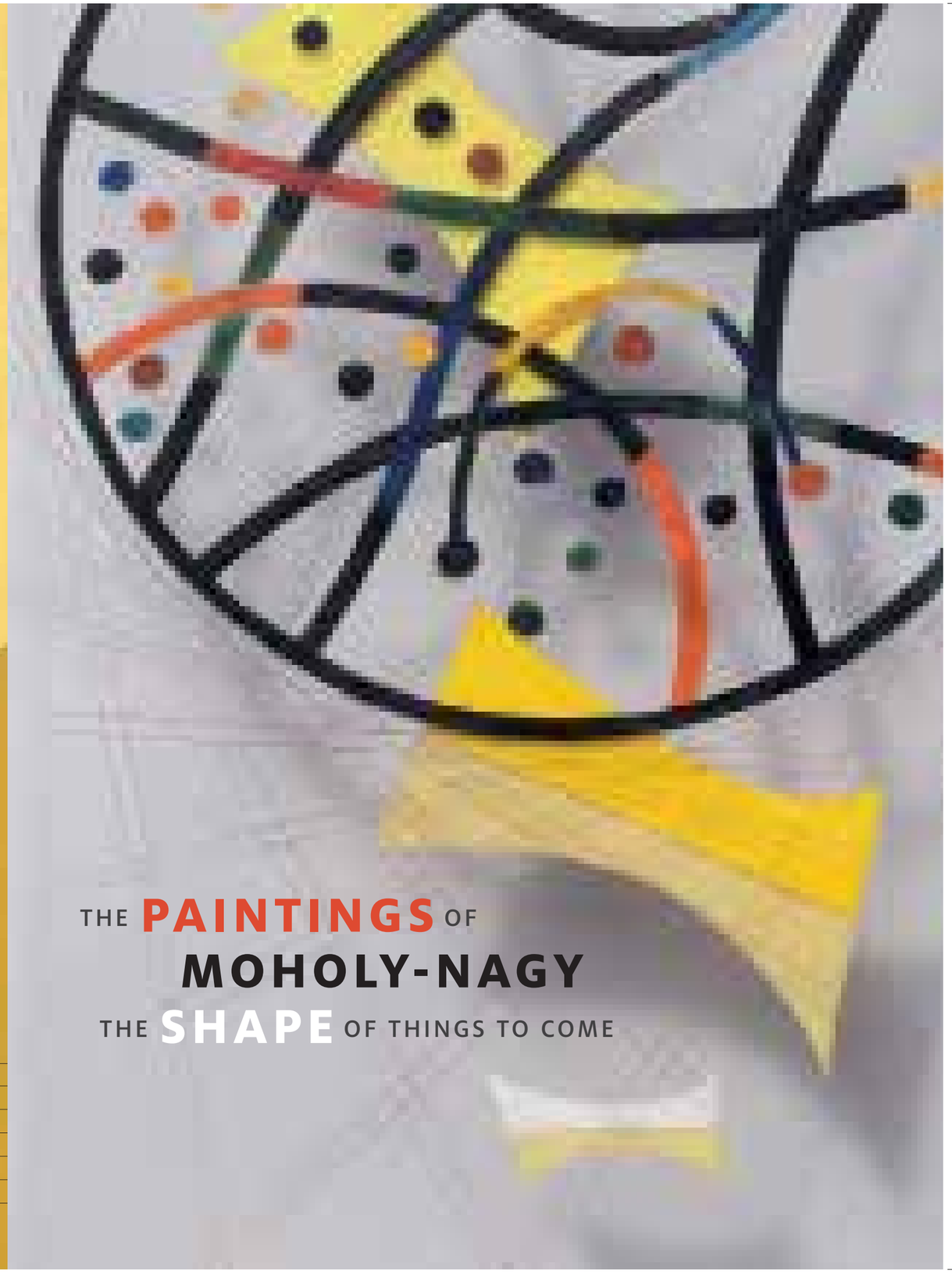
THE PAINTINGS OF MOHOLY-NAGY
THE SHAPE OF THINGS TO COME

Santa Barbara Museum of Art

Yale

ISBN 978-0-300-20997-6

Printed in China



THE PAINTINGS OF MOHOLY-NAGY

THE SHAPE OF THINGS TO COME

THE PAINTINGS OF MOHOLY-NAGY

THE SHAPE OF THINGS TO COME

THE PAINTINGS OF MOHOLY-NAGY

THE SHAPE OF THINGS TO COME

JOYCE TSAI

with contributions by LARRY J. FEINBERG,
EIK KAHNG, JAMES MERLE THOMAS
and FRIEDERIKE WAENTIG

SANTA BARBARA MUSEUM OF ART

Distributed by YALE UNIVERSITY PRESS,
New Haven and London

This book accompanies the exhibition *The Paintings of Moholy-Nagy: The Shape of Things to Come* presented at the Santa Barbara Museum of Art, Santa Barbara, California, from July 5 to September 27, 2015.

Published by
the Santa Barbara Museum of Art

Santa Barbara Museum of Art
1130 State Street
Santa Barbara, California 93101
www.sbmuseart.org

Distributed by
Yale University Press
P.O. Box 209040
302 Temple Street
New Haven, Connecticut
06520-9040
yalebooks.com/art

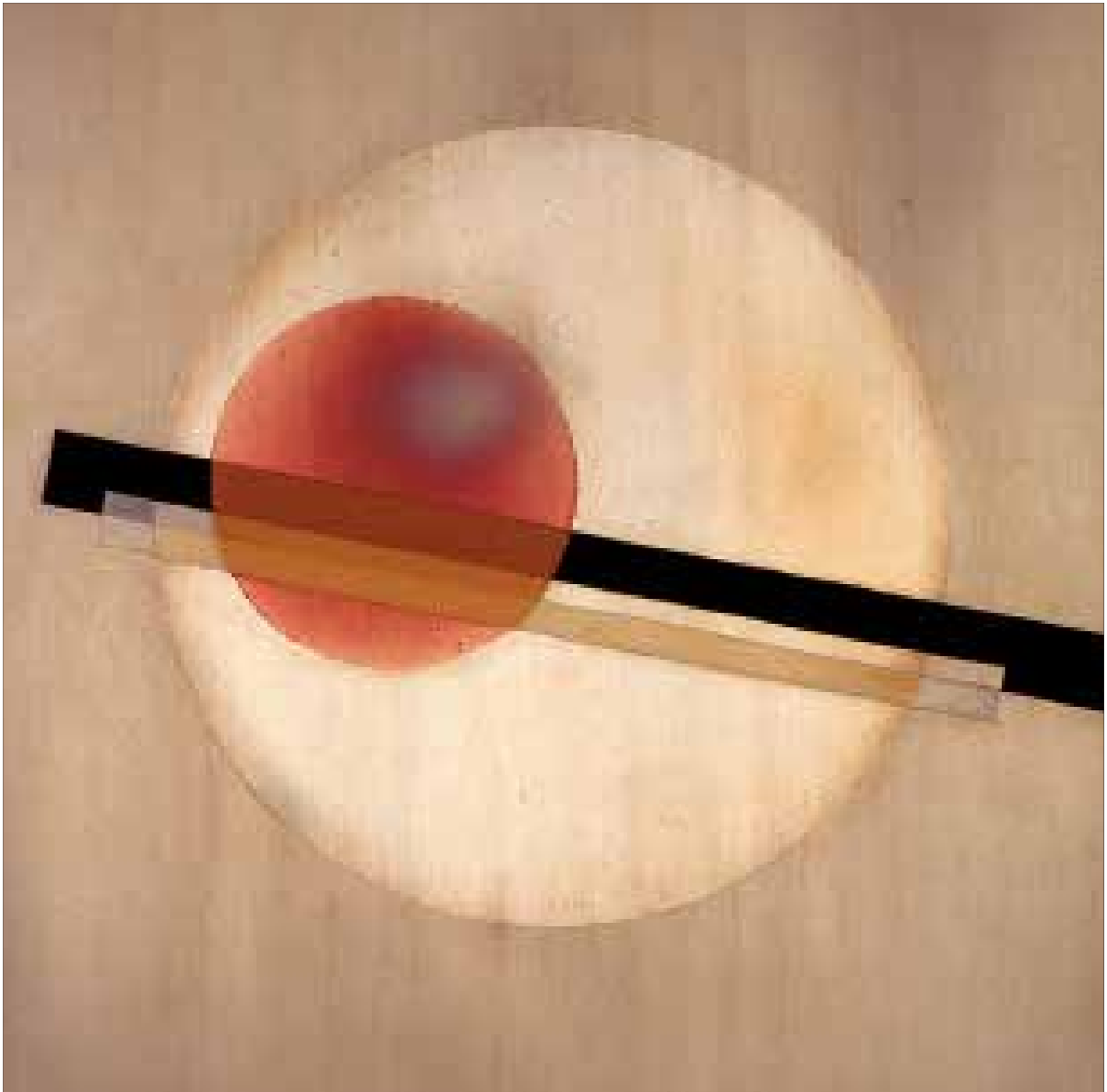
Produced by
Marquand Books, Inc., Seattle
www.marquandbooks.com

Designed by Margaret Bauer
Typeset in Milo and Milo Serif Pro and printed on Stora Enso matte artpaper
Proofread by Ted Gilley
Color management by iocolor, Seattle
Printed in China by Artron Art Group

Library of Congress Cataloging-in-Publication Data
The paintings of Moholy-Nagy : the shape of things to come / Joyce Tsai ; with essays by James Merle Thomas and Friederike Waentig.
pages cm
"This book accompanies the exhibition The Paintings of Moholy-Nagy: The Shape of Things to Come, presented at the Santa Barbara Museum of Art, Santa Barbara, California, from July 5 to September 27, 2015."
Includes bibliographical references.
ISBN 978-0-300-20997-6 (hardback)
1. Moholy-Nagy, László, 1895–1946—Exhibitions. I. Tsai, Joyce, 1977– Shape of things to come. II. Santa Barbara Museum of Art.
ND522.5.M59A4 2015
759.39—dc23 2014047923

Front Cover: László Moholy-Nagy, *Untitled* (Space Modulator) (pl. 30, detail), 1946; Back Cover: László Moholy-Nagy, *Z VII* (pl. 17, detail); Frontispiece: László Moholy-Nagy, *Leuk 5* (pl. 29, detail); Page 156: Unknown photographer, László Moholy-Nagy at a lecture, 1946, Estate of László Moholy-Nagy

CONTENTS



Above
László Moholy-Nagy,
AL 3 (detail), 1926.
See plate 12

DIRECTOR'S FOREWORD

This is the first major monographic presentation of the art of László Moholy-Nagy on the West Coast since the 1969 retrospective. That show, organized by the Museum of Contemporary Art, Chicago, and the Solomon R. Guggenheim Museum, traveled to the University Art Museum at Berkeley, the Seattle Art Museum, as well as the Santa Barbara Museum of Art. As we approach our 75th anniversary and look back at our exhibition history, our participation in that 1969 landmark retrospective only confirms what we, the current SBMA staff, have begun to recollect with sincere awe: even in its fledgling years, SBMA has participated in exhibitions of breadth, ambition, and sheer daring that might be surprising to those unaware of our early achievements. We are extremely proud, then, to be the organizers of this highly focused thesis exhibition — the first to dwell specifically on the centrality of painting in Moholy's artistic practice over the course of his career. This thesis, as advanced and eloquently explored by organizing guest curator Joyce Tsai in her extended essay, may come as something of a revelation, even to Moholy admirers. After all, Moholy is typically hailed as an innovator of the photogram (a type of cameraless photography, in which objects are placed directly onto light-sensitive paper) and one of the earliest instigators of a radical redefinition of art as a conceptual act rather than a handcrafted object.

Our exhibition catalog also features two additional essays, each of which contributes something new to the existing literature on Moholy. An overview by Friederike Waentig, with contributions by Tsai, offers a useful survey of the types of new painting supports — in addition to the traditional canvas or panel — that Moholy took from industrial contexts. The essay clarifies the often bewildering variety of names given to these modern materials by competing manufacturers and reveals Moholy's pioneering exploration of these new materials for painting. James Thomas's essay offers a nuanced reading of the overlapping concerns of Moholy and the later, American exponent of his visionary understanding of space, the artist Robert Irwin. As Thomas argues, far from remaining aesthetically removed from lived reality, both Moholy and Irwin entertained visions of functional applications for their designs, though they rarely achieved actual production for daily life.

Since it opened its doors in the summer of 1941, SBMA has consistently presented exhibitions of cutting-edge significance, both in terms of international modernism and with respect to emerging, regional artists. For example, under the leadership

of SBMA's first director, Donald Bear, we mounted solo exhibitions of the works of Ansel Adams, William Dole, Mark Rothko, and June Wayne, some of which were the first solo shows for artists who would later go on to national and international prominence. SBMA's next director and one of the first women directors of an American art museum, Ala Story, broadened programming to include an even more international flavor, staging one-man exhibitions of the art of Auguste Rodin and Oskar Kokoschka. The 1960s was a particularly rich decade for programming at the Museum, featuring not only the major 1969 Moholy exhibition, but also the first major retrospective of the art of David Park, as well as the important themed exhibition called *Serial Imagery*, which included works in series from Claude Monet through Kenneth Noland, Frank Stella, and Andy Warhol. The balance of programming between regional artists, those yet to be recognized, and more established, international modernist artists has been admirably maintained from the Museum's inception — something that we strive to continue today.

I want to commend SBMA assistant director and chief curator Eik Kahng for the ambitious projects she has undertaken in recent years, including exhibitions of Pablo Picasso's and Georges Braque's analytical Cubist works and the paintings of Delacroix, and for her perseverance in bringing this project to fruition. I would also like to thank the following individuals for their assistance in bringing this important show to our audience: Marcia and John Mike Cohen, Diane Cunningham, Ceil and Michael Pulitzer, Gregg Wilson and John Maienza, and anonymous donors. Special thanks as well to SBMA support group The Dead Artists Society, who continue to assist Dr. Kahng with the realization of programming of scholarly significance; the SBMA Women's Board; and The David Bermant Foundation.

Larry J. Feinberg

Robert and Merecedes Eichholz Director and CEO
Santa Barbara Museum of Art

LENDERS TO THE EXHIBITION

The J. Paul Getty Museum
Los Angeles, California

Richard Gray Gallery
New York, New York

Harvard Art Museums
Cambridge, Massachusetts

Historic New England
Boston, Massachusetts

McMaster Museum of Art
Hamilton, Ontario

Mills College Art Museum
Oakland, California

Estate of László Moholy-Nagy
Ann Arbor, Michigan

National Gallery of Art
Washington, D.C.

Norton Simon Museum
Pasadena, California

Saint Louis Art Museum
Saint Louis, Missouri

The Salgo Trust for Education
Port Washington, New York

Smith College Museum of Art
Northampton, Massachusetts

Smithsonian American Art Museum
Washington, D.C.

Snite Museum of Art
Notre Dame, Indiana

Yale University Art Gallery
New Haven, Connecticut

Above
Unknown photographer,
László Moholy-Nagy
painting in his studio,
ca. 1924. Estate of
László Moholy-Nagy

INTRODUCTION

"If I talked, would you listen, and if I painted again, would you look?"
He let go of me. Slowly he walked to the opposite side of the platform.
When I turned his face toward me I saw that he cried.
SIBYL MOHOLY-NAGY, 1950

Pale blinds drawn all day
Nothing to do, nothing to say
Blue, blue

I will sit right down,
Waiting for the gift of sound and vision
DAVID BOWIE, "SOUND AND VISION," FROM *LOW* (1977)

The death knell for painting in modernity has been rung repeatedly but never, it seems, with any lasting finality. Even László Moholy-Nagy, who, as the selection of objects featured in this exhibition amply demonstrates, continued to paint throughout his career, had a brief stint during which he put down the brush. We are told by Sibyl Moholy-Nagy in her loving depiction of her recently deceased husband that the decision to paint was fraught with emotion for Moholy, as the first epigraph to this brief introduction attests: "If I talked, would you listen, and if I painted again, would you look?"[1] Even if her recounting is likely marred by the work of nostalgia in its romanticism, Moholy clearly did retain a deep-seated emotional investment in painting. But the question, as it must have been for all artists functioning against the backdrop of political turmoil and the massive destruction of the world wars, must have felt nearly paralyzing. They are the same questions that later twentieth- and twenty-first-century artists must confront, even today: why paint, what to paint, and to what end? How can a mere painting enact the remaking of perception that can liberate the proletariat from centuries of oppression and remake the world?

In Moholy's case, as Joyce Tsai explains in her essay in this volume, painting provided a very functional alternative for an artistic mind that internalized visions so far ahead of existing technology. Painting, in other words, for Moholy was a visionary medium; the only means by which the artist could continue to explore the unattainable dreams he had for an art imagined as immaterial — what, one can plausibly argue, digital media

1. Sibyl Moholy-Nagy, *Moholy-Nagy: Experiment in Totality* (New York, 1950), 74.

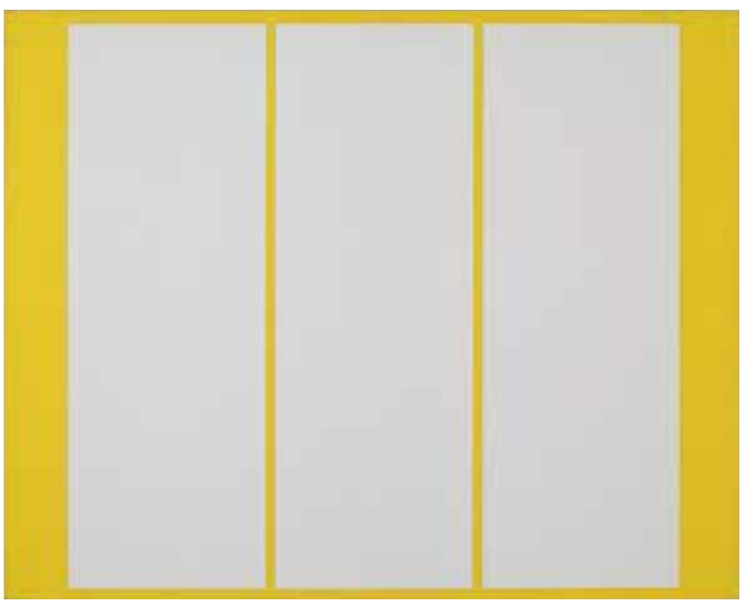
now presents. There is something deeply moving about Sibyl Moholy-Nagy's descriptions of Moholy's childlike pleasure in the cranking, clanking renditions of his beloved *Light Prop for an Electric Stage* (a kind of motorized light sculpture/machine composed of chromium, glass, wire, and rods),[2] all of which, we now know, amounted to an artistic failure of the most heroic variety, accessible today through its replica (made available to us in this exhibition through the generosity of the Harvard Art Museums). There is also something almost melancholic about the degree to which Moholy's most ambitious and innovative abstractions were later translated by his American progeny into the decorative language of those who could be described as Salon constructivists. In Southern California, this translation from the utopian ideals of the Bauhaus can be seen in the geometric gaiety of Karl Benjamin (1925–2012), Frederick Hammersley (1919–2009), or John McLaughlin (1898–1976; fig. 1). Indeed, the legacy of Moholy in the later twentieth century in Southern California is a story that has yet to be told and is too complex to treat in this brief introduction. In comparison with the lofty ideals of Moholy and the Bauhaus, American abstract painters really did lose their edge, at least with respect to the political radicalism of ambitious art between the world wars. The high idealism of Moholy's utopian project, in a Southern Californian idiom, is suddenly laced with a playfulness and giddy exuberance that is far removed from the solemnity of an early twentieth-century avant-garde agenda, motivated, as it was, by the tragedy of the systematic eradication of human life manifest in two world wars.

I want to pause for a moment to comment on the timeliness of our resurgent interest in the art of Moholy and the so-called death of painting that is normally associated with his legacy. One of the innovators of the photogram and an early experimenter with the possibilities presented by industrial design, he was also an inspirational precursor to the disassociation of maker, making, and meaning explored in later conceptual art and so startlingly metaphorized by his so-called telephone or dial-up pictures, which he "ordered" as if from a Sears & Roebuck catalogue. Moholy himself had a brief period, from 1928 to 1930, during which he forwent painting altogether, only to return to the relatively traditional medium once he realized the limitations that must necessarily attend his more ambitious excursions into elaborate light architecture, which, a century ago, required the industrial resources and capital only possible, and disturbingly so, at the behest of fascist regimes. But the death of painting has been a recurrent motif since the invention of photography, as famously recapitulated in a landmark essay by the critic Douglas Crimp published in *October* in 1981.[3] At this distance of some thirty-five years, it is now, perhaps, more descriptive to point to the death of criticism

2. Ibid., 64–67.

3. Douglas Crimp, "The End of Painting," *October* 16, Art World Follies (Spring, 1981): 69–86, reprinted in *On the Museum's Ruins* (Cambridge, Mass., 1993).

rather than the death of painting. As critics like Crimp have become further embedded in the Academy, so too have artists, weary of the theoretical straightjackets of post-structuralism, begun to ignore the polemics of *October* and its apostles. Indeed, the near irrelevance of art criticism is nowhere more apparent than in the explosive growth of the art market, partnered with the rabbitlike proliferation of art museums, whose white walls cry out to be filled by the elite. As it has turned out, despite Crimp's misgivings, the Museum was to become complicit, not with some lingering bourgeois sentimentality toward painting as the fictive expression of an ideology of individualism but with a ballooning market that unabashedly identifies art with commodity.



① John McLaughlin (American, 1898–1976), *#12*, 1965. Oil on canvas, 48 × 60 in. Santa Barbara Museum of Art, Gift of June Harwood in memory of Jules Langsner (1978.28.2)

Needless to say, painting, if it still needs to be personified, is still alive and well, and the defining stakes of its existence continue to morph. Recall, at its harshest, the prevailing cynicism toward painting in the 1980s, perhaps, best summed up so acidly by Gerhard Richter: "One must really be engaged in order to be a painter. Once obsessed by it, one eventually gets to the point where one thinks that humanity could be changed by painting. But when that passion deserts you, there is nothing else left to do. Because basically painting is pure idiocy."[4] That idiocy has now turned into pure capital.

Moholy's career, then, basically resumes the dominant themes of twentieth-century modernism but in their loftier forms, before the establishment of a neoliberal global capitalism as the driving force of art production and before alternative species of art making (earthworks, video, performance) were so prolific if not predominant. Moholy's active engagement with the new and the now, with photography, the newest technologies of color reproduction, and industrial materials, as this exhibition and catalog explore, applied constant pressure to his understanding of the role of painting in his practice. But, as has become clearer with time and distance, the presumed duel between painting and photography has not proved fatal to either; rather the interaction between the two has impelled a seemingly limitless redefinition of both, or, as the art of Richter so well embodies, a near inextricability between the two.

4. Quoted in Crimp, "The End of Painting," 73.

An historical reading of Moholy's art and especially his paintings helps us to recall the urgency of his historical moment. Technology, both as hopeful arbiter of things to come and enabler of the most vicious acts of genocide imaginable, was at the forefront of human endeavor and consciousness as it remains today. Now at the other side of the millennium, we can see its pernicious effects even more clearly, despite the delightful distractions that this digital age continues to pile on. The success or failure of Moholy's project hinges on our willingness to revisit his ethereal abstractions and homespun electric machines and recollect the Bauhaus ethos that impelled both: a utopian belief in the visual arts as the transformative means by which to remake the world and free us of nature's limitations and the brutishness of human behavior. Formed in the horror of war, Moholy's optimistic confidence in the future of art remains as inspirational today as it was before our immersion in this new era of sound and vision.

As always, this exhibition and catalog have been made possible only through the support and participation of the entire staff and board of trustees of the Santa Barbara Museum of Art. We would especially like to acknowledge Barbara Ben-Horin, Tressa Berman, Katrina Carl, Lynn Carlisle, John Coplin, Sandy Davis, Patsy Hicks, Alex Grabner, James Hutchinson, Phil Lord, Anne Mersmann, Tracy Owens, Joseph Price, Cherie Summers, and Mike Woxell. In particular, I want to thank SBMA director Larry J. Feinberg, who continues to encourage the origination of scholarly exhibitions and has forged a remarkable track record of achievement in this regard since his tenure began in 2008. I would also like to thank my curatorial colleagues Julie Joyce, Karen Sinsheimer, and Susan Tai for their endorsement of this project and for their intellectual contribution to its formation. This project could not have been better organized and managed, which I owe in large part to SBMA curatorial exhibition assistant Mac Kelly. The editorial skills of Charles Dibble have performed their usual magic, for which I am, as always, very grateful. Thanks, as well, to our team at Marquand Books: Melissa Duffes, Adrian Lucia, and Ed Marquand. A special shout-out to Margaret Bauer for the elegant design of this book: a worthy tribute to Moholy's graphic legacy. Last, I want to thank my dear friend and colleague Joyce Tsai, whose passionate understanding of her subject has resulted in this exhibition and accompanying volume.

This project would not have been possible without the steadfast support of Hattula Moholy-Nagy. Trained as an archaeologist, she has generously made her father's materials and art available to researchers, curators, and artists. She has continually fostered new approaches to interpreting his life and work. Oliver I.A. Botar, curator of the Salgo Trust

for Education and Moholy expert, deserves special thanks for making possible the inclusion of *Architektur I*. For their invaluable assistance in securing the loans for this exhibition, we would also like to thank Eileen Baral, Emily Beeny, Judith Brodie, Nancy Carlisle, Nicole Chalftant, Harry Cooper, Lamia Doumato, Jennifer Gross, Stephanie Hanor, Mazie M. Harris, Eleanor Harvey, Kelly Holbert, Simon Kelly, Leah Lehmbeck, Yuri Long, Charles R. Loving, Lynette Roth, and Carol Podedworny. Thanks, as well, to the Richard Gray Gallery, which represents the work of artist Jan Tichy, which we are pleased to include in our installation.

Joyce Tsai would also like to thank SBMA for its invitation to mount this exhibition on a topic that began as a dissertation, completed under the generous advisement of Michael Fried and Kathryn Tuma. She thanks Leah Dickerman, Jay Krueger, and Jeffrey Weiss for offering her the initial encouragement to explore Moholy's paintings. Her research for this project would not have been possible without the financial and intellectual support of the Center for Advanced Study in the Visual Arts at the National Gallery of Art; the Center for the Study of Modern Art at the Phillips Collection; and the University of Florida. She thanks Lynette Roth for her intellectual generosity and advice throughout the planning of this exhibition. To Graham Bader, Simon Baier, Julie Barten, Matthew Biro, Annie Bourneuf, Elizabeth Saari Browne, Gülru Çakmak, Francesca Casadio, Lynne Cooke, Carol Eliel, Brendan Fay, Gordon Hughes, Melissa Hyde, Ashley Jones, Jennie King, Megan Luke, Christopher Maines, Kate Markoski, Bibi Obler, Linda Parshall, Peter Parshall, Elizabeth Ross, Robin Schuldenfrei, Carol Stringari, Roger Taylor, Ralph Ubl, Leslie Ureña, Karole Vail, Matthew S. Witkovsky, and Andrés Zervigón, she expresses her gratitude for their assistance and support. She is indebted to her beloved late husband, Joshua Robert Gold (1971–2009), who helped shape the initial contours of this project, and her husband, Benjamin Mitchell DeVane, whose love has fostered its completion.

Eik Kahng

Assistant Director and Chief Curator
Santa Barbara Museum of Art

Joyce Tsai

THE **SHAPE** OF **THINGS** TO COME

Opposite

László Moholy-Nagy, *Z VI*, 1925. Oil on canvas, 37½ × 29¾ in. Harvard Art Museums/ Busch-Reisinger Museum, The Fredric Wertham Collection, Gift of his wife Hesketh (1987.78)

László Moholy-Nagy (1895–1946) achieved his renown and notoriety early. He was the youngest faculty member at the Bauhaus when he exhibited *Constructions in Enamel* at the Galerie der Sturm in 1924, pictures that were made at a sign factory and ordered, as the legend goes, by telephone (fig. 1).[1] In *Painting Photography Film*, a book published a year later by the Bauhaus as a part of a series, Moholy announced that in the face of ever more sophisticated technologies, painting in pigment would become an anachronism to be supplanted by the creation of optical effects through the use of artificial light.[2] Over the course of the 1920s, he became associated with "New Vision," a style of photography characterized by its use of aerial and low-angle perspectives intended to jar the viewer into seeing the world anew. By 1928, Moholy's commitment to photography, film, and electric-light design had led him famously to abandon painting altogether. In 1930, he made his *Light Prop for an Electric Stage*, a motorized, rotating light display machine heralded as one of the most important forerunners of kinetic, light, and machine art (pl. 14).[3]

Constructions in Enamel, *Light Prop*, and his contributions to photography and its theory are the projects most closely identified with Moholy's legacy. On the eve of his last retrospective in 1968–1969, for which the Santa Barbara Museum of Art served as a major venue, critics seized upon the prescience of his work. A critic with *Artforum* described the *Constructions in Enamel* as "almost a forecast of more recent approaches to utilizing industrial processes."[4] Moholy's work seemed to liberate art from the vicissitudes of the hand — of the artist's touch — and laid the groundwork for a new way of making predicated on the transmission of conceptual information. A reviewer for the *Los Angeles Times* contended that Moholy "foresaw the end of easel painting and the decline of a distinction between art and non-art."[5] In all these reviews, he was heralded as an artist who wholeheartedly embraced the machine age and whose work even presaged art in the age of cybernetics. Moholy's work appealed to a generation of artists and critics who sensed a resonance between his aspirations and theirs. Barbara Rose, writing in 1971 in a special *Artforum* issue on film, describes Moholy's motivation to abandon painting in terms that would apply just as much to her own contemporaries in the 1960s and '70s:

> The identification of the easel picture as dependent on capitalist economics and a system of patronage exploitative of both artist and public must be counted as among the strongest reasons for which artists turned their backs on painting during the period between the two world wars. The rejection of the hand as indicator of special talents separating the artist from the mass, and of personal style as

---

Parts of this essay were previously published in Anke Finger and Danielle Follette, *The Aesthetics of the Total Artwork: On Borders and Fragments* (Baltimore, 2011), and Jeffrey Saletnik and Robin Schuldenfrei, *Bauhaus Construct: Fashioning Identity, Discourse and Modernism* (London, 2009).

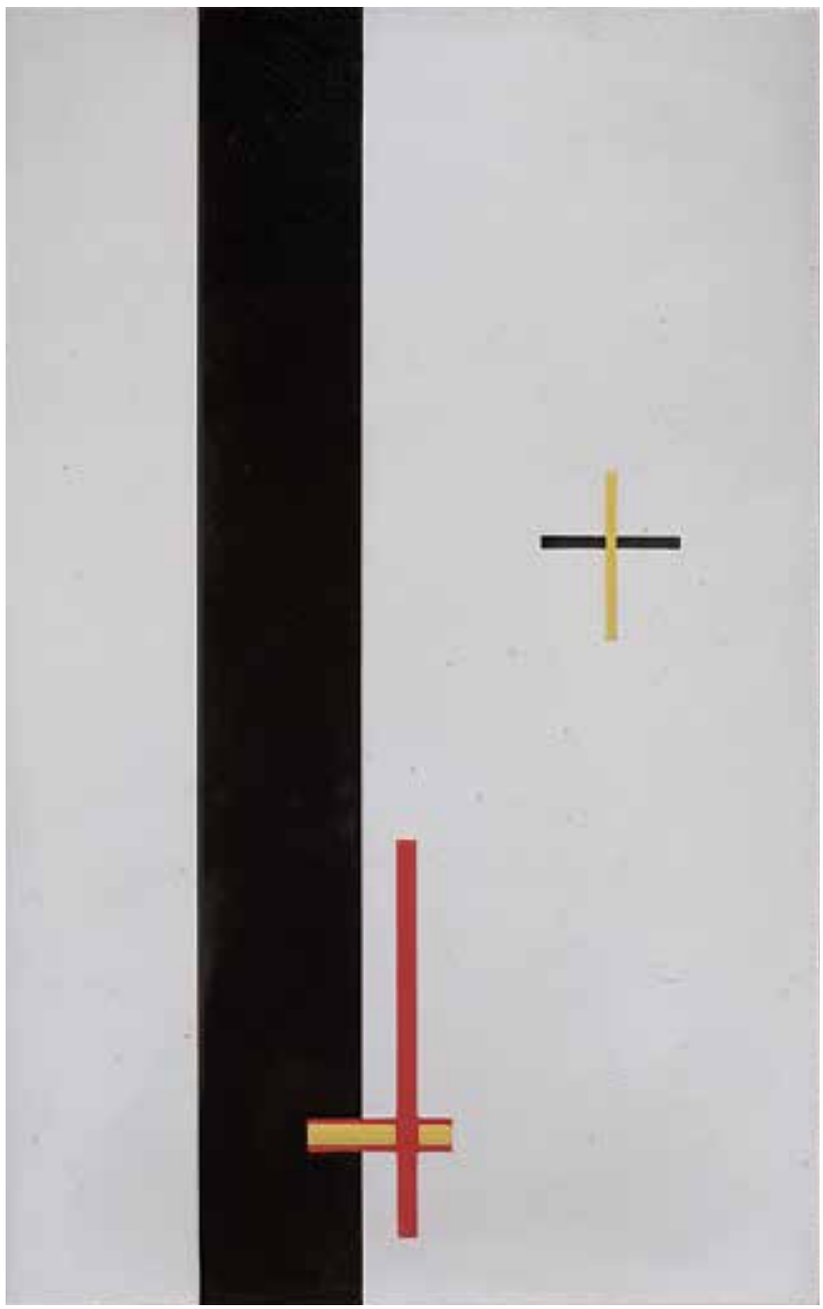
1. László Moholy-Nagy, "Emaille im Februar 1924," *Der Sturm Monatsbericht* 15, no. 1 (1924). The announcement suggested that such work might one day be ordered by phone but never claimed that the *Constructions in Enamel* ever were. Nonetheless, the fantasy of telephonic transmission circulated for decades as fact in part because of his own description of the works, origin in a text twenty years later. László Moholy-Nagy, "Abstract of an Artist," in *The New Vision*, trans. Daphne Hoffmann, 4th rev. ed. (New York, 1947), 79–80. Moholy-Nagy wrote "Abstract of an Artist" in English in 1944.

2. László Moholy-Nagy, *Malerei Fotografie Film* (Munich, 1925), 5, 37.

3. The invocation of Moholy's work as source and inspiration for machine, light, kinetic, and conceptual art in the 1960s and '70s are too numerous to list, but the most influential accounts include George Rickey, "Origins of Kinetic Art," *Studio International* 173, nos. 886–68 (February 1967): 65–71; Nan R. Piene, "Light Art," *Art in America* 55, no. 3 (May–June 1967): 24–48; and Barbara Rose, "Kinetic Solutions to Pictorial Problems: The Work of Man Ray and Moholy-Nagy," *Artforum* 10, no. 1 (September 1971): 68–73.

4. Whitney Halstead, "Chicago," *Artforum* 8, no. 1 (September 1969): 68.

5. "Art News," *Los Angeles Times*, 3 August 1969.



① László Moholy-Nagy, *Construction in Enamel 3*, 1923. Porcelain enamel on steel, 9½ × 6 in. The Museum of Modern Art, New York. Gift of Philip Johnson in memory of Sibyl Moholy-Nagy (92.1971)

the mark of an individualistic rather than a collectivist ethos, must also be counted as part of the impetus for the turn to film.[6]

In Rose's account, the rejection of painting was as much a political as an aesthetic decision. To reject painting was to reject a medium tied to an outdated economic and political system in the interest of exploring other means to foster a "collectivist ethos." The techno-utopianism that characterized so many of Moholy's projects of the 1920s was seen, then and now, as his most radical legacy.

What is far less often acknowledged is that within two years of his brief abandonment of painting in 1928, Moholy took up the brush once more and painted consistently until his death in 1947. If Moholy's technological experiments appeared to his critics as the most radical of his activities, his late paintings, by comparison, have been described as "conventional" or even "academic."[7] One anonymous British critic, writing in response to a solo show in London in the winter of 1936/37, remarked that "it is difficult to resist the impression that [these paintings] represent an attempt to assert the individuality of the artist as painter, in circumstances in which it is no longer relevant."[8] Moholy's return to painting in the 1930s and '40s has been seen by some, both then and now, as a retreat from his professed political and aesthetic commitments and as a betrayal of his most radical ideas.

Moholy was acutely sensitive to and anticipated such criticisms. Nonetheless, he considered painting to be a practice that was crucial to his art because of how profoundly circumstances had changed for the avant-garde in the 1930s and '40s. At the time of his exhibition in London, Moholy was living in England and working on multiple commercial commissions to support himself and his family. He had left Germany in the early 1930s, initially to pursue professional opportunities that were fast becoming scarce in Berlin, feeling the effects of the Great Depression. He would remain abroad as he grew ever more alarmed at Adolf Hitler's rise to power, moving from one station of exile to the next, from the Netherlands, to England, and finally settling in the United States in 1937.

Moholy believed that experimentation with film, photography, electric light, and other technologies held the greatest potential to serve as forces of modernization. However, from his own experience, Moholy discovered that these new media often required the expertise of specialists, enormous resources, and infrastructures of distribution that

6. Rose, "Kinetic Solutions to Pictorial Problems," 73.

7. Ibid. Roberta Smith, "On the Paths of Two Giants, Voyagers in Modernism," *New York Times*, 3 November 2006.

8. "Mr. Moholy-Nagy," *The Times* (London), 2 January 1937.

were difficult, if not impossible, for the lone artist to access under conditions of exile. Moholy's faith in the revolutionary potential of technological media and its ability to foster a progressive collectivist ethos was further shaken by the efficacy with which totalitarian regimes deployed print, film, radio, and spectacle to their own ends, using means they controlled.

Under such circumstances, Moholy's turn to painting was both highly pragmatic and quietly courageous. Unwilling to abandon his long-standing commitment to an art capable of shaping the future, Moholy transformed both the function of painting in his practice and its concept in his theory. Painting returned not as stodgy easel pictures but as an accessible technology of visualization. He painted not only on canvas but on new plastic materials and metallic alloys that were developed for use in the most advanced industries of his time. These late paintings served as speculative fields in which future avenues of aesthetic experimentation could be pursued.

For Moholy, painting had always been an important practical and theoretical touchstone whose meaning and significance shifted in response to changing conditions. At times, it was a freighted medium that had to be overcome; at others, a hidden practice undergirding his aesthetic and theoretical development. In his late paintings, it served as a surrogate field in which he explored the possibilities of as-yet inaccessible means.

A Painter in Times of Social Revolution

My conscience asks incessantly: is it right to become a painter in times of social revolution? May I claim for myself the privilege of art when all men are needed to solve the problems of sheer survival?[9] LÁSZLÓ MOHOLY-NAGY, DIARY ENTRY, 15 MAY 1919

Born in 1895, Moholy belonged to a generation of European avant-garde artists whose formative years were shaped by the experience of the First World War and the revolutionary tumult left in its wake. Already at the start of his career, Moholy had long grappled with how painting could be justified as an activity worth pursuing. Painting was not a neutral activity but had become fraught, contentious, and burdened both aesthetically and politically.

Moholy had not planned to be a visual artist. Before the war, he enrolled in the university to study law, though his passion was literature.[10] With the outbreak of the war, he enlisted in the Austro-Hungarian army in 1915 and fought in Galicia as part of an

9. Quoted in Oliver Botar, *Technical Detours: The Early Moholy-Nagy Reconsidered*, exh. cat., New York: Art Gallery of the Graduate Center, City University of New York (New York, 2006), 44. Oliver A.I. Botar, through his books, articles, and numerous curatorial projects, has provided the fullest and most important account of Moholy's early career. My own research is indebted to his meticulous archival and historical research.

10. Pamela J. Warner, "The Poems of László Moholy-Nagy: Catalyst for an Artistic Identity," in Belena S. Chapp, ed., *László Moholy-Nagy: From Budapest to Berlin, 1914–1923*, exh. cat., Newark, Del.: University Gallery (Newark, 1995), 27.

②

Unknown photographer, László Moholy-Nagy in military uniform, ca. 1915–18. Estate of László Moholy-Nagy

③

László Moholy-Nagy, *Self-Portrait*, ca. 1917–19. Black crayon on paper, 15 ¼ × 12 in. Estate of László Moholy-Nagy

artillery unit (fig. 2).[11] He began making little sketches of everyday life on the front, drawn quickly on hundreds of postcards. Put on medical leave in 1917 for a shattered left thumb, Moholy resumed his legal studies in Budapest but spent most of his free time pursuing his literary ambitions, eventually joining a number of artists, critics, and editors associated with leftist Hungarian Activist journals.[12]

Hungarian Activism started in direct homage to the German Socialist Expressionist journal *Die Aktion*, which was deeply anti-militarist in its political orientation. Centered around the journal *A Tett* (*The Action*) and later *Ma* (*Tomorrow*), both founded by Lajos Kassák (1887–1967), the movement sought to synthesize the spiritualist aspects of Expressionism with a futurist enthusiasm for technology and direct action in order to create a program to end warfare and usher in a new revolutionary age.[13] Moholy's turn to visual art with any seriousness coincided with his involvement with Activism. His own traumatic experience of the front prepared him to join this movement against the war and embrace its revolutionary vision. Beginning in November 1918, he began taking painting lessons offered for free by Róbert Berény, a prominent painter and former member of the Hungarian avant-garde group The Eight.[14] In Budapest, Moholy's paintings and sketches emulated styles favored by his teacher and other artists whom Moholy befriended or with whom he identified. Moholy was deeply impressed by the

11. Levente Nagy, "The Beginning of the Multi-faceted Career of László Moholy-Nagy," in Chapp, *László Moholy-Nagy: From Budapest to Berlin*, 22.

12. Oliver A.I. Botar, "From the Avant-Garde to 'Proletarian Art': The Emigré Hungarian Journals *Egység* and *Akasztott Ember*, 1922–23," *Art Journal* 52, no. 1 (1993): 34–45.

13. Lajos Kassák, "Program," *A Tett* (1916), trans., John Bátki, reprinted in Timothy O. Benson and Éva Forgács, eds., *Between Worlds: A Sourcebook of Central European Avant-Gardes, 1910–1930* (Cambridge, 2002), 160–61; Éva Forgács, "The Activists in Budapest," in Benson and Forgács, *Between Worlds*, 149.

14. Krisztina Passuth, "László Moholy-Nagy, the Painter: The Formative Years," in Iguchi Toshino, ed. *Moholy-Nagy: Laboratory of Vision*, exh. cat., Hayama: Museum of Modern Art (Kamakura and Hayama: 2011), 254–55.

④

László Moholy-Nagy, *Frachthof* (Freight Yard), ca. 1917–19. Black crayon on paper, 14½ × 21⅜ in. Estate of László Moholy-Nagy

⑤

László Moholy-Nagy, *Fabriklandschaft* (Factory Landscape), 1918. Oil on beaverboard, 39¾ × 48⅜ in. Estate of László Moholy-Nagy

art of Paul Cézanne, by the dark, moody power of Oskar Kokoschka's heavily worked paintings, and by the graphic economy of Rembrandt's etchings and drawings. His own work was characterized by a highly frenetic hand, energetically translating expressive brushwork into skeins of thick gestural crayon and charcoal marks engulfing the contours of his subjects with jittery auras like those found in Futurist paintings (fig. 3). Moholy drew a number of portraits but also demonstrated an early fascination with urban scenes. He executed a large sketch of a rail freight yard, attending closely to industrial elements — scaffolding, signals, signage — all arranged with an observed disarray (fig. 4). In 1918, he made some of his first paintings, emulating the Cubism he saw in reproduction. *Fabriklandschaft* (fig. 5) deploys such a technique, subjecting the landscape to a sharply angled structure reminiscent of Pablo Picasso's and George Braque's Horta paintings, but instead of Cézanne's palette, Moholy adopted highly saturated blues and ochres.

Moholy's early paintings were made in a heady revolutionary period. The Hungarian Soviet Republic came into being in March 1919 following the end of the First World War and the collapse of the Austro-Hungarian Empire. That spring, Moholy signed a manifesto with other Hungarian Activist artists demanding the creation of a "dictatorship of the revolutionary artists over the bourgeois artists" that would prepare for the emergence of a new "Communist Culture."[15] However, as his diary entry suggests, it was unclear to him, as it was to other young artists at the time, what it meant to be a revolutionary artist. Should the political artist work in a legible, accessible figuration to make

15. Botar, *Technical Detours*, 54.

pictures that pertain explicitly to the experience of the working class? Should the artist's subject matter affirm the experience of the proletariat or emphasize the squalor and poverty of the disaffected masses in order to promote revolutionary action? Should painting on canvas be pursued at all when so few would see a single picture, or should the artist focus on creating images for mass media? These questions were hotly contested, debated in artistic and political journals as well as in artists' congresses; as Moholy's diary entry suggests, they were questions that he posed of his own art as well.

The Hungarian Soviet Republic lasted all but six months. Its leaders fled from Budapest to Vienna along with many leftist intellectuals and artists including Moholy. After an unhappy winter in Vienna, Moholy left for Berlin in the early spring of 1920. Germany was in no less turmoil than his native Hungary, and the question of the relationship between art and politics was interrogated there with just as much passion. He arrived around the same time as the Kapp Putsch, a brief takeover of the fledgling German Republic by renegade military forces. In Dresden, an intense firefight outside the Zwinger Gallery claimed an unintended victim, when Peter Paul Rubens's *Bathsheba* was pierced by a stray bullet. In a newspaper editorial, Oskar Kokoschka, professor at the Dresden Academy, pleaded with workers and soldiers engaged in violent armed combat in the city to take their fighting elsewhere, away from museums and galleries in order to protect the treasures of human culture.[16] Kokoschka's editorial provoked Berlin Dadaists John Heartfield and George Grosz to respond with a scathing essay, "The Art Scab." Kokoschka's sentiments, they argued, revealed the perverse values of the ruling class, more concerned with the painted rump of Rubens's ladies than with the flesh-and-blood survival of the working class.[17] Art, under such circumstances, should be destroyed.

Even as he dismissed the solipsism of art for art's sake, Moholy's sense of the relationship of art to politics was a bit more cautious than the *tabula rasa* positions taken by the most radical artists and theorists. When Moholy arrived in Berlin early in 1920, he lamented to a close friend in Budapest that with the exception of Kokoschka, whom he deeply admired, "the Germans do not have one single decent painter." In the same letter, he dismissed the *Merzbilder* of Kurt Schwitters as nothing more than a failed Cubist experiment and called into question the avant-garde impulse to dispense with all artistic tradition.[18] However, his sense of Schwitters's achievement and even that of the Dadaists soon changed. Within a few brief months, Moholy began to emulate Schwitters's *Merz* assemblages while experimenting with montage techniques favored

16. Editorial quoted in George Grosz and John Heartfield, "Der Kunstlump," in *Der Gegner* no. 10–12 (1920): 53–55, translated as "The Art Scab," in *The Weimar Republic Sourcebook*, edited by Anton Kaes, Martin Jay, and Edward Dimendberg (Berkeley and Los Angeles, 1994), 483–86.

17. Ibid.

18. Moholy-Nagy to Iván Hevesy, 5 April 1920, in Krisztina Passuth, *Moholy-Nagy* (London, 1985), 360.

by the Berlin Dadaists. He made paintings, prints, and drawings that recall the look of the mechanical drawings found in the work of Raoul Hausmann, while integrating icons of the modern industrial age, including track signals, rail yards, radio towers, and transmission lines into his picture as ciphers laid across increasingly abstracted backgrounds.

Within a few short months, Moholy would attempt to integrate the various strains to which he had been exposed in a suite of new paintings published in the September 1921 issue of the Hungarian journal *Ma* and concurrently in its sister publication, *Horizont*. Accompanying the illustrations was Ernö Kállai's introduction, which heralded Moholy's new paintings as the "organic unification" of the "antipodes of cubism and dada." Kállai maintained that Moholy's work synthesized the anarchic energies of Dada with Cubism's attention to form. Moholy's new paintings articulated and affirmed the possibilities of the "metropolis and modern technology." Kállai explained, Moholy had become a "master builder," an artist who demonstrated the "constructive" potential of his age.[19]

⑥
László Moholy-Nagy, *Nickel Construction*, 1921. Nickel-plated iron, welded, 14⅛ × 6⅞ × 9⅜ in. The Museum of Modern Art, New York, Gift of Mrs. Sibyl Moholy-Nagy (17.1956)

In early 1922, Moholy had his first exhibition at Herwarth Walden's Galerie der Sturm in Berlin. It included some of these abstract paintings as well as his new sculptures, which extended his architectonic turn into three dimensions. Among the work singled out for praise was his *Nickel Construction*, which comprised a ribbon of highly polished nickel, set twirling in an ascending diagonal, terminating atop a rigidly upright metal bracket (fig. 6). It makes use of materials that explicitly evoke modern industry, its highly polished chromed surface glimmering with factory newness. The exhibition was a sensation. The architect and critic Ludwig Hilbersheimer wrote that Moholy's work demonstrated "his constructive ambition," expressing an "impersonal collective vision of our technological civilization, of industrialization."[20] The journal *Veščˇ-Objet-Gegenstand*, started by El Lissitzky and Ilya Ehrenburg in 1922 as a means to disseminate Soviet Constructivism to an international audience, celebrated his show.

19. Peter Màtyàs [Ernö Kállai], "Moholy-Nagy," *Horizont* 2 (1921): unpaginated.

20. Ludwig Hilberseimer, "Bildende Kunst," *Sozialistische Monatsheft*, 28 no. 4 (6 March 1922): 242–43.

In an article that appeared in the May issue of the journal, El Lisstizky wrote, "Moholy-Nagy has prevailed over German Expressionism and is striving to achieve an organized approach."[21] The show helped secure Moholy's place as an artist who could represent the Constructivist position in the West.

Moholy's work was embraced by artists and critics who defined Constructivism as a new revolutionary ethos, not merely a stylistic designator for hard-edged geometrical abstraction. Constructivism provided Moholy with a theoretical framework and aesthetic logic that allowed him to describe his task as an artist and his work in wholly different terms. Against those who hoped to protect easel painting as an inherently valuable cultural reserve, an expression of genius meant to be enjoyed in a mode of quiet contemplation, Constructivism demanded that painting, along with all creative activity, be treated as an organizational feat. Forms and colors were arranged within set limits, be they three-dimensional or flat, in order to maximize their capacity to "modernize" the viewer. Put differently, the aim of abstract art was to exemplify and inculcate a modern perspective and in so doing, to inaugurate the arrival of a new human subject responsive to the industrial age. Abstraction was pursued not as a style but as a project intended to examine structures and forms that might help bring new ways of seeing, commensurate with the scientific rationality and technical precision demanded by the age. Working in oil and canvas would serve as one of many means to formulate structures to activate and modernize the viewer.

The year 1922 proved decisive to Moholy's practice and theory. He formulated the core of much of what he would pursue during the rest of his career in an eloquent refutation of the anti-art position published in a newly founded avant-garde journal, *Akasztott Ember*. Its inaugural issue announced its radical orientation. The journal published a translation of Grosz and Heartfield's "The Art Scab" along with a manifesto by the editor, Sándor Barta, that demanded that art serve as the vehicle for promoting revolutionary aims.[22] Moholy wrote a response to this first issue that affirmed his commitment to the political cause while refusing to make art the handmaiden of propaganda. Taking his cue from the language of Constructivism, Moholy argued that an artist who seeks to contribute to class struggle must address an increasingly international public not bound by national borders, language, or cultural sensibility. To "influence the maximum number of people," artists cannot merely repackage political dogma with their art but instead must work to retrain human "channels of intuition," understood as the perceptual paths through which mankind apprehends the world.[23] For Moholy, the

21. *Veščˇ-Objet-Gegenstand* 3 (1922): 14, quoted in Sophie Lissitzky-Küppers, *El Lissitzky: Life, Letters, Texts* (London, 1968): 341–42.

22. Botar, "From the Avant-Garde to 'Proletarian Art.'"

23. Ibid., 38–43.

⑦
László Moholy-Nagy, *Architektur 1* (reverse and front), 1922. Oil and metallic oil pigment and graphite on fine linen fabric, 25 11/16 × 21 13/16 in. Salgo Trust for Education, New York. See plate 1.

most effective means of reaching the masses was by reconfiguring the senses to enable a new perception of historical and political conditions. According to this logic, human beings must first learn to perceive relationships within a work of art and become attuned to the ways in which subtle shifts in color, form, and space might fundamentally alter the balance of a composition. In this process, the newfound ability to discern formal relationships might expose the mutability of other kinds of relationships in the world — political, economic, and social.

When Moholy arrived in Berlin, he was making pictures that figured the industrial world, populating fields that were becoming ever more abstract with standardized numbers and letters along with bits of grating and scaffolding. However, he quickly abandoned this strategy with his embrace of the Constructivist ethos. The distance he traveled between these two very different approaches is exemplified on the two sides of a single painting. In 1999, paintings conservator Carol Stringari removed the whitewash from

the reverse of *Architektur I* (1922) to reveal a composition executed late in 1920 or early 1921 (fig. 7).[24] The hidden painting reflected Moholy's early attempts to synthesize the avant-garde currents to which he was exposed. By contrast, the verso represented his daring willingness to leave figuration behind and trust the capacity of abstract forms to evince the modernity of his vision. Here, a floating green band weaves above and beneath the elements it intersects, the diagonal orientation of the structure propelled forward by the brilliance of a luminous arc. That curve is held as if by the tension produced at the perpendicular edges of the painting's support. The architecture evoked does not refer to imagined buildings or future cities; instead, this painting offers a blueprint for the reconfiguration of our vision, a vantage point lifted from the ground, made dynamic, even aerial. The art and theory Moholy produced in 1922 maintained that art could transform the world to shape the future by habituating the viewer to new, modern modes of perception. These precepts were foundational to his later work.

Bauhaus: Art and Technology

In the spring of 1923, Walter Gropius appointed Moholy to the faculty at the Bauhaus in Weimar. Moholy arrived at a particularly tumultuous moment in the school's history. The right-wing opposition party of the parliament of Thuringia sought to cut state funding for the Bauhaus.[25] Critics of the school saw it as a financial drain at a time when rampant inflation and political turmoil threatened state coffers. They argued that the artistic dabbling of its students and teachers failed to serve the needs of industry or to contribute to the economy of the state that supported it. In response to these pressures, Gropius would announce the school's new mission in a lecture titled "Art and Technology: A New Unity," delivered in August 1923.[26] Moholy was hired to help Gropius fulfill that program in part because of his reputation as a Constructivist.

These challenges were very much at the forefront of Moholy's mind when he had his exhibition at the Galerie der Sturm in February 1924. There, he exhibited his *Constructions in Enamel*, works that would later be better known as his *Telephone Pictures*. Moholy took this opportunity to advertise how his art embraced new industrial manufacturing techniques. His explanatory text for the *Constructions in Enamel* published in the gallery's newsletter stated:

In this age of industrial production and technical exactness we also strive to produce works of art with total precision. Among the new works that I am exhibiting this February at the Sturm Gallery

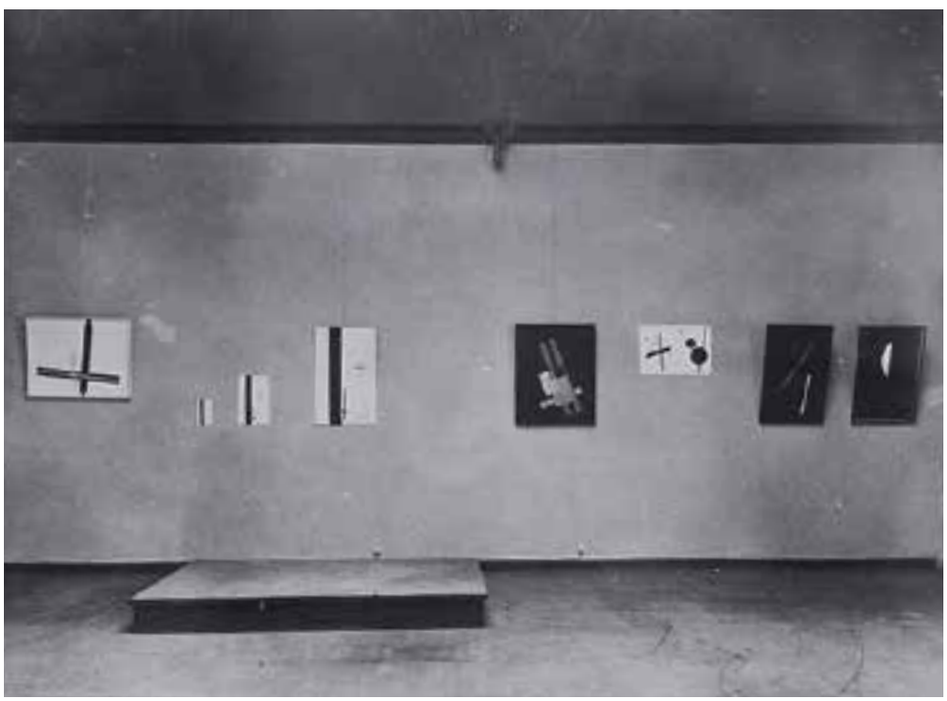
24. Botar, *Technical Detours*, 116–17.

25. Gillian Naylor, *The Bauhaus Reassessed* (London, 1985), 60.

26. Walter Gropius, "Kunst und Technik: Eine neue Einheit," 15 August 1923, quoted in Barry Bergdoll and Leah Dickerman, eds., *Bauhaus 1913–1933: Workshops for Modernity*, exh. cat., New York: Museum of Modern Art (New York, 2009), 19.

is a series of enamel pictures that were manufactured by machine. To be sure, this manner of manufacturing pictures only comes into play for works created with a will to precise and impersonal technique. One can have works of this sort manufactured on demand on the basis of the Ostwald color charts and a scaled grid. One can therefore even order them by telephone.[27]

In many respects, this last speculative detail remains what many identify exclusively with this series of works. However, their theoretical importance goes far beyond the fantasy of an art by telephone. Photographs of the exhibition show that the *Constructions in Enamel* were installed in a series ascending in size from left to right, explicitly reproduced in a ratio of 2:1. The anchored lower edge and the proportional distance separating each picture heightened the sense of a mechanical rhythm at work, as if illustrating the ordered printing of these pictures along an assembly line (fig. 8). Seeing these panels together on the wall also invites the viewer to scan between them and to attend to how differences in scale affect the otherwise identical structures. This comparative approach extends beyond the three pictures. The exhibition at the Galerie der Sturm explicitly linked his machine-made pictures and his paintings on canvas.



(8) *below*

László Moholy-Nagy, *Constructions in Enamel* as installed at the Sturm Galerie, Berlin, February 1922. Estate of László Moholy-Nagy

(9) *opposite*

László Moholy-Nagy, Untitled, ca. 1920–23. Woodcut, 8 × 7⅜ in. Estate of László Moholy-Nagy

(10) *opposite*

László Moholy-Nagy, Untitled, 1922. Linocut, 11½ × 8¾ in. Estate of László Moholy-Nagy

27. László Moholy-Nagy, "Emaille im Februar 1924," *Der Sturm* 15, Monatsbericht (February 1924): 1, quoted in Bergdoll and Dickerman, *Bauhaus 1913–1933*, 130, nos. 143–45 (Brigid Doherty).

Moholy's ambition, to make an art commensurate with "this age of industrial production and technical exactness," depended upon painting as a key testing ground to formulate structures that would warrant reproduction in the first place.

Constructions in Enamel, when seen in conjunction with his paintings, reveal how powerful an experimental approach predicated on repeating or subtly varying parameters can be. It was a strategy Moholy used extensively, especially in his turn toward abstract painting, deploying repetition systematically to generate and test sets of compositional structures. He disciplined his hand, converting it from a vehicle of expression into a tool capable of organizing a structure whose precision might be gauged only by iteratively trained eyes. The industrial production of the *Constructions in Enamel* automated what he sought to achieve in many works across media by controlling color, surface, and scale.

Moholy executed several paintings upon carefully prepared, white grounds that feature elements locked together in perpendicular central structures made as if in preparation for his *Constructions in Enamel*. Some pictures secure the central complex to a perpendicularly laid-out grid of the painting's edge while others float it within the framed confines of the painting. *K1* (1922), painted prior to his appointment at the Bauhaus, features red, yellow, and gray bars bound into crosses (pl. 5). Their sharp angles suggest the use of architectural drafting tools to lay out the form assembled to float against the pristine white ground. In this and other paintings from the period, it emulates the texture of machine finished surfaces through the even and precise application of paint. Another canvas, *Composition* (1923), offers a restrained study of black, brown and gray, producing translucent effects by the subtle modulation of value (pl. 6). Executed in a similar palette that nonetheless produces the illusion of projected light and crystalline planes, the painting makes use of strategies he explored in his lithographs. In a different vein, Moholy showed how effective textural contrasts can be in producing effects of translucency in the black and white graphic work of his woodcuts, linocuts, and lithographs by subtly altering the state of a single plate between printings (figs. 9, 10, pl. 8). Moholy's approach, working across media, coincided with his experiments with photograms — cameraless photographs he began to make in the early 1920s. Moholy conjured ghostly images by setting objects on photosensitive paper and exposing the ensemble to light. The resulting images reverse our experience of dark and light: the exposed areas became deeply opaque, while areas masked by objects appear white, incandescent against

the black ground. These photograms were unique, but could be photographed and enlarged, or their values reversed in positive prints. These became yet another generator of effects, ready to be transferred into other media as well (pls. 9, 21).

By working across media, Moholy trained his hand and eye in this steady, deliberative, and disciplined process. He sought to internalize the "will to precise and impersonal technique," to embody the key determinant of work consonant with industrial manufacture. In so doing, the art he produced was to serve as forms and structures usable in modernizing the sensibilities of his viewers. The exhibition, showing his paintings in concert with the *Constructions in Enamel*, polemically asserted the objective validity and transmissibility of Moholy's aesthetic.

The same year he exhibited *Constructions in Enamel*, Moholy completed the manuscript for *Painting Photography Film*, which made the stakes of his painting and the purpose of manufactured pictures explicit. In a chapter titled "Domestic Pinakothek," Moholy argues that everyone should have a collection of pictures, not to be hung as décor but kept like books or albums brought out to be studied. The analogy to print is important for we are to imagine works like the *Constructions in Enamel* as objects to be used in inculcating a new literacy, made to be "read" time and again, arranged on a table, propped up against the wall or otherwise reordered so that the viewer might learn to better analyze how structure, color relations, and scale shape the perception of different visual elements. In a footnote to the chapter, Moholy enumerated the names of new industrial materials — plastics and new metallic alloys — as potential supports for manufactured pictures. "Turbonit, Triolin, Torlit, etc. etc.," he argues, "are much more appropriate than canvas or wood panel for the production of precisely executed pictures. I have no doubt that these, or similar new materials, will soon dominate easel painting, and we should also expect new, surprising effects produced through its use."[28]

The materials Moholy invoked not only sounded futuristic but were developed for the fields of electrotechnics, aviation, and building construction, some of which were in use at the Bauhaus as well.[29] Serving in the capacity of the head of the metal workshop, Moholy worked with students to develop projects that might attract industry funding. He worked to bring the school closer to lighting manufacturers Kandem and Osram, as well as Junkers, the airplane factory located near the school in Dessau.[30] These materials advertised Bauhaus expertise in the domain of new

28. László Moholy-Nagy, *Malerei Fotografie Film* (Munich, 1925), 19 (author's translation).

29. Monika Markgraf, ed., *Archäologie der Moderne/Archaeology of Modernism*, Edition Bauhaus 22 (Dessau, 2006), 163.

30. Mauro F. Guillén, *The Taylorized Beauty of the Mechanical: Scientific Management and the Rise of Modernist Architecture* (Princeton, 2006), 58.

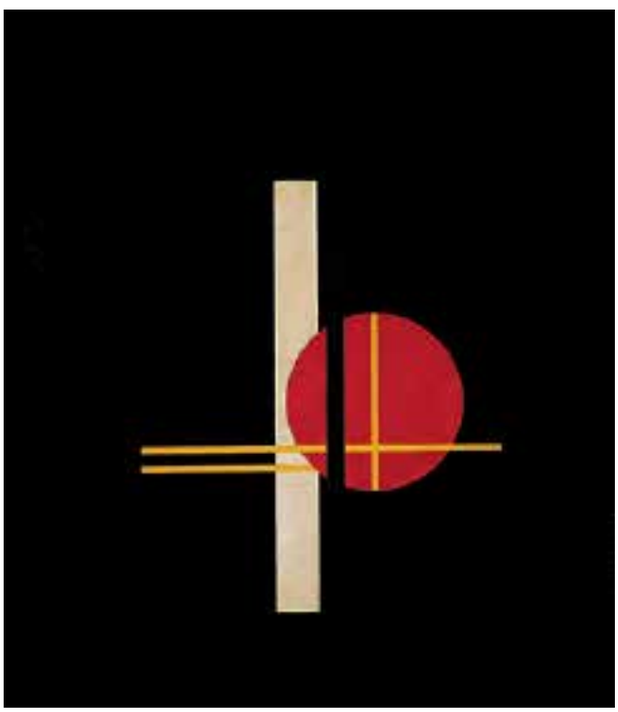
(11)
Installation view of Moholy exhibition at the Galerie Neue Kunst Fides, Dresden, 1926. Estate of László Moholy-Nagy

materials, a point Moholy was as eager to promote to prospective industrial collaborators as to students and lay readers.

Moholy embedded painting within an array of practices across media deployed to investigate compositions and color effects that relate specifically to the new materials he named in "Domestic Pinakothek." One of the key visual characteristics of plastics developed for use in industrial settings (for instance, as highly resistant electrical insulation and sheeting) was their dark opacity. In anticipation of making pictures that could be produced upon such a ground, he made a suite of intimately related dark ground pictures on paper, canvas, and panel (fig. 11). He experimented with collage to piece together compositional strategies using cut-out shapes pasted upon black wove paper (pls. 2, 4). He also made use of tissue-thin carbon paper, exploiting its ready-made velvety black texture as the ground for *Q* (1922/23), which explores different intensities and gradations of black elements, painted, pasted, and drawn in watercolor, ink, and pencil (pl. 3). In *QXX* (1923) he painted the same form (the red circle with cross) on a panel sanded and prepared to resemble the slightly matte opaque surface of

synthetic plastic materials. Here he experimented with different layering techniques to buoy the vibrancy of the colors against the dark ground (fig. 12).

The structural and coloristic strategies developed in his paintings and experiments in more traditional materials were also sometimes transferred to his paintings on plastic and even metallic supports. In an untitled painting from 1925 that remained in the collection of Walter Gropius until his death, Moholy adapted an often repeated composition and painted it on a black, opaque plastic sheet (see p. 143). Its polished support suspends a square and intersecting bars executed in white, gray, and light pink oil paints. In another work titled *AL3* (1926), executed against a textured aluminum surface, Moholy used a combination of oil and industrial paints — applied in part by hand, in part with a spray machine (pl. 13). Aluminum was relatively new, lightweight, and associated with aircraft manufacture, an industry highly visible with the presence of Junkers in close proximity to Bauhaus Dessau. Moholy was quick to advertise his active experimentation with these and other industrial materials in the second revised edition of *Painting Photography Film* as well as in *New Vision*, both published at the end of the 1920s.



Even as he painted on new supports, Moholy continued to paint on canvas but did so with a hand that was careful, self-effacing in its application, and mimicked the effects he achieved in his work with plastic, enamel, and metal. *Z VI* (1925) from the Busch-Reisinger Museum is exemplary in that respect (pl. 10). It incorporates a number of compositional elements developed several years earlier. The precisely wrought skeins of black lines projecting vertically at the left recall a number of Moholy's paintings in which expanses of color are pinned behind receding lattices. A black plane at left anchors the painting, a feature that appears especially prominently in pictures produced just as he began exploring abstract compositions in the early 1920s. The fields of color are applied carefully, evenly, and thinly across the canvas, subtly differentiated at times through the discrete application of varnish. Two discs of white levitate atop adjoining planes and are executed in thicker paint that mimics the hard, glossy surface

(12) *opposite*

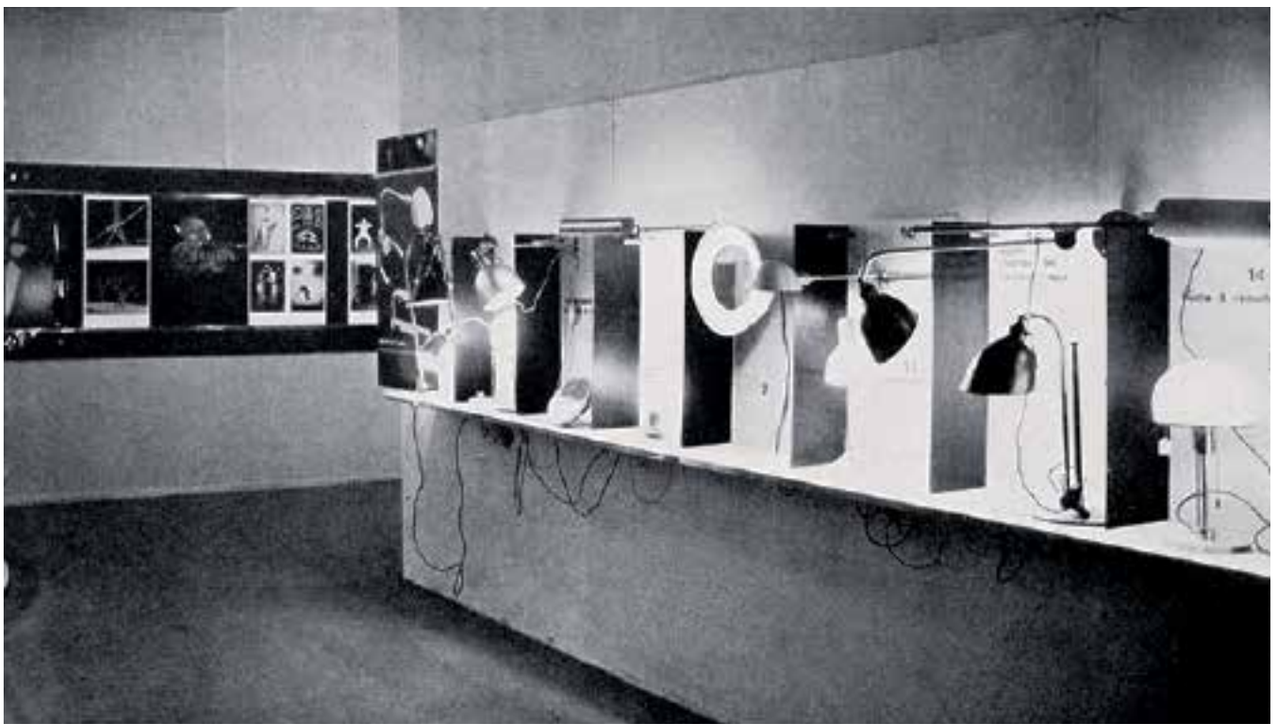
László Moholy-Nagy, *QXX*, 1923. Oil on wood, 31⅛ × 27⅛ in. Von der Heydt-Museum, Wuppertal

(13) *right*

László Moholy-Nagy, *A19*, 1927. Oil on canvas, 32⅝ × 38⅞ in. Estate of László Moholy-Nagy

of enamel (see p. 16). Upon closer inspection, the circles themselves are not whole but are cleaved through, as if resulting from the interaction between the surfaces beneath them and their own internal brilliance. The discs oscillate between announcing their brittle, opaque materiality and functioning within the picture like two spots of immaterial, concentrated pure light.

Beyond mimicking the new materials of industry, the paintings from the mid-1920s attempt to generate the illusory effect of light and the interplay of transparent and translucent planes, giving the viewer a glimpse of a floating, luminous world (fig. 13). But over the course of the 1920s, Moholy grew dissatisfied with limitations of his hand-made paintings, which could only spin the fiction of luminosity in pigment. He postulated in theory that painting would give way to the medium of the future: electric light displays. Painting, for Moholy in the mid-1920s, served as an anticipatory practice, a field of training to prepare his hand and eye to produce potentially for industry



(14)
View of lighting display at the Werkbund Exhibition in Paris (1930) as published in *Die Form: Zeitschrift für gestaltende Arbeit* 5, no. 11/12 (1930): 291

and in pursuit of future experiments with light. In 1928, he felt that the time for preparation had come to an end. He stopped painting altogether and turned his attentions instead to developing novel technologies that would enable artists to manipulate light as a creative medium.[31]

Light Prop for an Electric Stage

Moholy resigned from the Bauhaus in 1928 and stopped painting in part because he wanted to devote his energies to activities that went beyond painting's static frame. He curated photography exhibitions, worked as photography editor for the influential avant-garde journal *i.10*, and designed sets for opera and political theater in Berlin that integrated film projections and new materials such as chromed metals and colorful plastic panels. For the 1930 Paris Werkbund exhibition at the Salon des Artistes Décorateurs, Moholy designed exhibits showcasing modern German light technology, featuring a number of the works that had been developed at the Bauhaus (fig. 14).

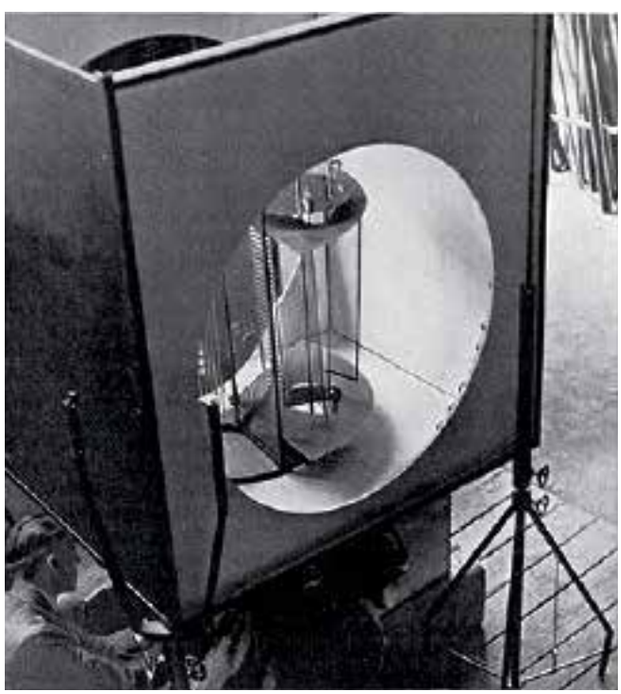
31. Several of Moholy-Nagy's publications allude to this development, beginning with the 1925 edition of *Malerei Fotografie Film*, in which he discusses the potential of new technologies to shift the exploration of color effects to the manipulation of pure color itself. Further underscoring a progressive development toward the manipulation of pure light as a medium is the title of the first section of the book: "Von der Pigementmalerei bis zum reflektorischen geworfenen Lichtspiel." *Malerei Fotografie Film* (1925), 6–7.

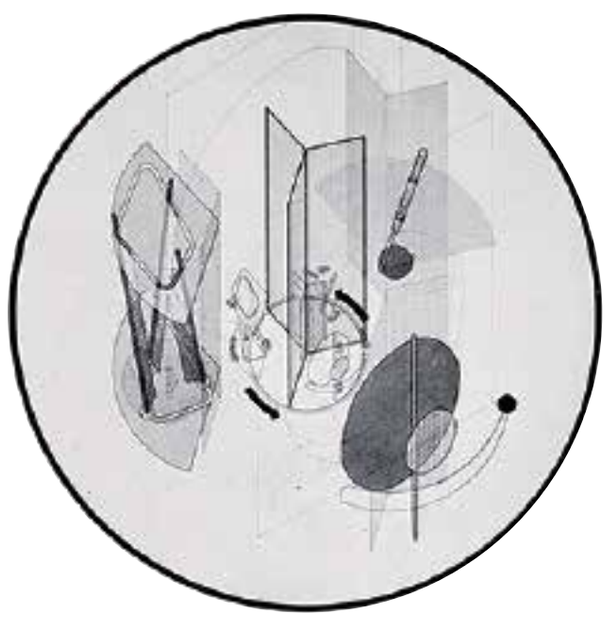
Moholy took the occasion to unveil his most ambitious project, his *Light Prop for an Electric Stage* (fig.15). It was a prototype built with funding and technical support from the theater lighting division of AEG, one of Germany's largest industrial conglomerates. With this financial support, Moholy employed an architect to design the machine and a mechanic to build it. *Light Prop* modeled the unification of art, technology, and industry. It made concrete what Moholy had long advocated: an art that would move beyond the strictures of what he called "pigment painting" and arrive at the creation of "electric, reflective light displays."[32]

Light Prop was a mechanism assembled out of metallic, glass, and plastic components enclosed within a box with two circular openings. Multicolored bulbs lined the perimeter of the opening. Moholy's article for the Werkbund journal *Die Form* described the aims of the prototype (fig. 16). Moholy's text presented detailed technical diagrams of its mechanisms. In addition, he also published what he called the "switchboard"—a program to sequence the lighting of each of the seventy electric bulbs integrated into the work (fig. 17). The rotating machine was meant to reflect and refract the light, flashing

(15)
Lichtrequisit einer elektrischen Bühne, 1922/30, as published in *Die Form: Zeitschrift für gestaltende Arbeit* 5, no. 11/12 (1930): 297

(16)
Lichtrequisit einer elektrischen Bühne, 1922/30, as published in *Die Form: Zeitschrift für gestaltende Arbeit* 5, no. 11/12 (1930): 298





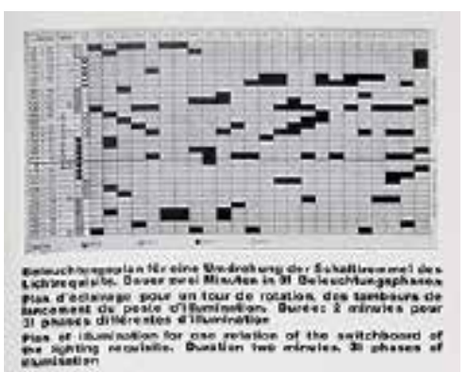
32. Ibid.

(17) *below*

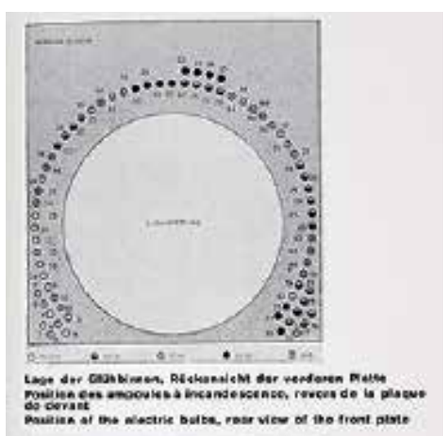
Lichtrequisit einer elektrischen Bühne, 1922/30, as published in *Die Form: Zeitschrift für gestaltende Arbeit* 5, no. 11/12 (1930): 299

in rhythm to create a dancing display for the new electrified stage. In his descriptive text, he wrote that *Light Prop* might be used in public spectacles, exposing an audience, perhaps even a mass audience, to new, captivating, and transformative effects about which he had long theorized. He mused that there might one day even be light plays that could be transmitted by radio, these visual effects reaching individual viewers in their homes.[33] Moholy's ambitions for this work were immense, but the prototype was extremely fragile. The creaky gears of *Light Prop* got stuck, parts dislodged, and its motor failed upon multiple occasions even during that inaugural exhibition.[34] Nonetheless, Moholy held out high hopes for the machine and hoped to gain additional support for research and development. Shortly after the Deutscher Werkbund exhibition, he corresponded with Alexander Dorner about mounting an exhibition featuring *Light Prop* in what Moholy called the *Space of the Present*, conceived as a pendant to El Lissitzky's *Abstract Cabinet* in Hanover.[35] Immediately after the Paris exhibition, Moholy made a film of his machine in action entitled *Lightplay: Black White Grey.* Using a sequence of tightly composed shots, superimpositions and reversals, the film transformed the temperamental machine into an elegant generator of special effects.

Light Prop was introduced at a particularly inopportune time. Not only was it completed at the start of the Great Depression; the technologies it used could not keep pace with the scope of the ambition he held out for the machine. *Space of the Present* was scrapped for lack of funds. No one came forward to fund the production of *Light Prop.* Even his *Lightplay*, his film of the machine, was dismissed by the film critic Siegfried Kracauer for its "mere meaningless prettiness."[36] Moholy's *Light Prop* represented his most



Beleuchtungsplan für eine Umdrehung der Schaltwalze des Lichtrequisits. Dauer zwei Minuten in 31 Beleuchtungsphasen
Plan d'éclairage pour un tour de rotation des tambours de branchement du poste d'illumination. Durée: 2 minutes pour 31 phases différentes d'illumination
Plan of illumination for one revolution of the switchboard of the lighting requisite. Duration two minutes. 31 phases of illumination



Lage der Glühbirnen, Rückansicht der vorderen Platte
Position des ampoules à incandescence, revers de la plaque de devant
Position of the electric bulbs, rear view of the front plate

33. L. Moholy-Nagy, "Lichtrequisit einer elektrischen Bühne," *Die Form: Zeitschrift für gestaltende Arbeit* 5, nos. 11/12 (1930): 297–99.

34. The original *Light Prop* is in the collection of the Busch-Reisinger Museum of the Harvard Art Museums, Cambridge, Mass. For an account of its inherent design flaws, see Memorandum from Arthur Beal to Miss Mongan, 20 May 1969, in object file for László Moholy-Nagy, *Light Prop for an Electric Stage* (*Light-Space Modulator*), Harvard Art Museums, Busch-Reisinger Museum, Cambridge, Mass. (acc. no. BR 56.5).

35. See correspondence on the "Raum der Gegenwart" in the Alexander Dorner Papers, Sprengel Museum, Hanover.

36. Siegfried Kracauer, "Einige Filme," *Frankfurter Zeitung,* 19 March 1932. On Moholy-Nagy's experiment in film, see also Jan Stahli, *Filmische Sinneserweiterung: László Moholy-Nagys Filmwerk und Theorie* (Marburg, 2006).

concerted attempt to work with technical experts. The project sought to create entirely new conditions for the theater that would allow passive viewers to become active participants in immersive environments. These works, however, were met even by the most sophisticated viewers with little more than amusement, a "curious play of colored lights."[37] Moholy's faith in technology might have appeared unfettered at the end of the 1920s, but it became clear that conditions had shifted profoundly by the start of the 1930s. The frustrated hopes of *Light Prop* and his experience working in economic, turned political exile made clear that new technologies required enormous capital investments and technical expertise. Such resources were rarely accessible to the lone artist. The simplest film project required camera, film, editing equipment, and if it had any hopes to be shown, some access to means of distribution. As Moholy came to recognize, the production and exhibition requirements of painting were far more modest. Despite his many commercial projects, Moholy began to paint once more and pursued opportunities to exhibit his new work. However, he quickly discovered resistance to his new paintings. He had become so closely associated with photography and light that by 1934 one newspaper sent a photography reporter to review an exhibition of his paintings in Utrecht.[38] It became amply clear to Moholy that for both his proponents and critics, painting's place in his artistic project had to be justified.

In 1934, Moholy was invited to mount a major retrospective in Brno. He welcomed the opportunity to describe more fully the ways his many different practices might be seen as intimately enmeshed. The invitation came from František Kalivoda, a young Czech architect, film enthusiast, and editor of several avant-garde journals with whom Moholy had worked in the hopes of showing his films in Brno the year prior. Kalivoda was planning to launch an ambitious new journal that showcased avant-garde engagement with new media.[39] He called it *telehor,* the Hungarian name Dénes Mihály gave to his invention of a wireless image-transmission technology, more familiar to us now as television. The title speaks to its technological orientation.[40] Its first, and, as it would turn out, the only issue was given over entirely to Moholy's art.

Kalivoda's description of Moholy's work and of the central importance he assigned to the investigation of light published in that volume echoes the arguments Moholy had made in his theoretical writings throughout the 1920s.[41] Yet Moholy's introductory text, an open letter to the editor, published in *telehor,* begins not with an elucidation of the importance of light and new technology, but rather with a justification of his return to painting (pl. 17). Moholy writes:

37. René Chavance, "La section allemand," *Les échos d'art* 59 (June 1930): unpaginated.

38. László Moholy-Nagy to Sibyl Moholy-Nagy, 9 October 1934, Sibyl Moholy-Nagy Papers, Archives of American Art, Smithsonian Institution, Washington, D.C.

39. In 2013, Lars Müller Publishers produced a superb color reprint of *telehor* with a detailed commentary volume complete with additional translations of the text in Spanish, Russian, Chinese, and Hungarian. Their editorial notes a historical and archival reconstruction of *telehor*'s publication. Klemens Gruber and Oliver A.I. Botar, "Melancholy for the Future," in Klemens Gruber, and Oliver A.I. Botar, eds., *telehor, l. moholy-nagy, Kommentarband/Commentary and Translations* (Zurich, 2013) 11–19.

40. Fr. Kalivoda, "Postscript," trans. F.D. Klingender, *telehor* 1, no. 1–2 (1936): 45.

41. László Moholy-Nagy, "Lichtrequisit Einer Elektrischen Bühne," *Die Form: Zeitschrift für Gestaltende Arbeit* 5, nos. 11–12 (1930): 297.

Dear Kalivoda,

You are surprised that I am again arranging a growing number of exhibitions of both my earlier and more recent work. It is true that for a number of years I had ceased to exhibit, or even to paint. I felt that it was senseless to employ means that I could only regard as out of date and insufficient for the new requirements of art at a time when new technical media were still waiting to be explored.

Later in the same text, he remarks:

You are acquainted with my light requisits [*sic*] and my "lightplay black-white-gray." It took a great deal of work to assemble all this material, and yet it was only a very modest beginning, an almost negligible step forward. Nor was I able fully to carry out my experiments even within this limited sphere. You have every right to ask why I gave in [*warum ich die waffen strekte*], why I am painting and exhibiting pictures, after once having recognized what were the real tasks confronting the "painter" of today.[42]

The question Moholy attempts to answer throughout his text with almost obsessive repetition is this: Why paint if he felt that it was "senseless to employ an obsolete medium"?[43]

Moholy admitted that his abandonment of painting and his focus on projects like *Light Prop* at the end of the 1920s amounted to little more than "a very modest beginning, an almost negligible step forward." In this vein, he writes:

It is an irrefutable fact that the material dependence of the artist on capital, industry, and working equipment presents an insurmountable obstacle today to the successful creation of a true architecture of light.… While possession of a few brushes and tubes of color enables the painter in his studio to be a sovereign creator, the designer of light displays is only too often the slave of technical and other material factors, a mere pawn in the hands of chance patrons.…[44]

Moholy offers a sober description of the limitations that technologically mediated art — vulnerable to compromises of all kinds, not merely pragmatic and economic — poses by virtue of its technical and capital requirements.

telehor was finally published in 1936, and Moholy's remarks would appear all the more prescient that year. Albert Speer, Hitler's architect, would pull off one of the most spectacular light displays imaginable. For the Nazi rallies that year in Nuremburg, Speer created cathedrals of light by requisitioning more than a hundred anti-aircraft searchlights

42. L. Moholy-Nagy, "Dear Kalivoda," trans. F.D. Kingender, *telehor* 1: 1–2 (1936): 30.

43. Ibid.

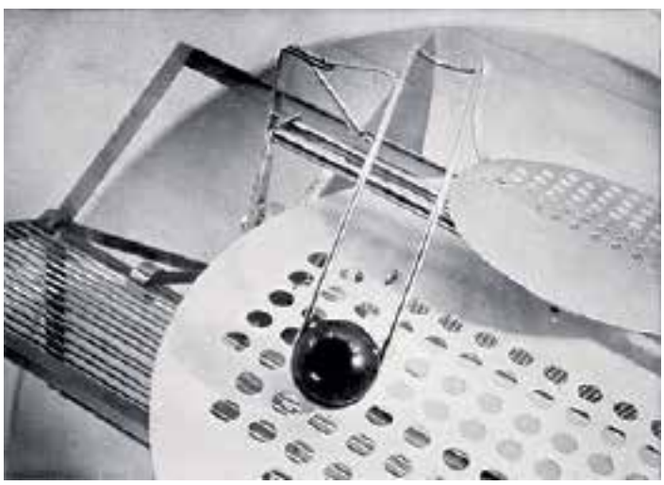
44. Ibid., 31.

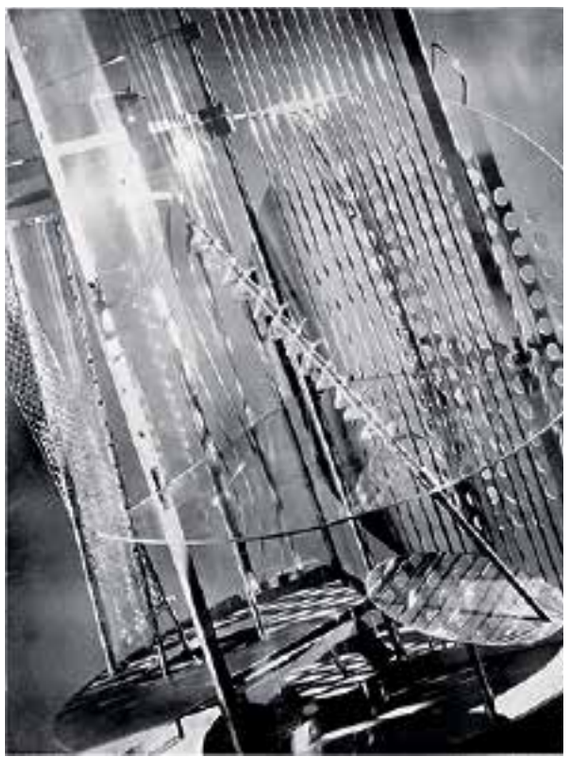
(18)
Heinrich Hoffman, *Nuremberg Rallies, Gruppenb* (Lichtdom von Albert Speer). Bayerische Staatsbibliothek/Hoffmann Archiv

directly from the Luftwaffe. Perception was manipulated by technology — but not toward the ends for which Moholy had long hoped (fig. 18).[45] This is one of the most dramatic illustrations of the infrastructure required to corral new technologies to serve as the foundation of a new, luminous medium, executed on a grand scale.

For Moholy, the manipulation of artificial light embodied by *Light Prop* had once represented the culmination of his artistic project. Kalivoda recognized it as one of the most important works in Moholy's oeuvre. Five pages in the publication are devoted to reproductions of its plans, several photographs, and film stills (fig. 19a, b). His practical experience with these projects, however, pointed to how many factors were out of his control, making it difficult, if not impossible, for him to explore these technologies directly. Despite the melancholy tone of his letter, despite the frustrations he encountered, Moholy remained committed to the continued exploration of new media by proxy, by returning to brush and paint, the modest tools still readily available to him as an artist, working in exile.

45. Joyce Tsai, "Excavating Surface," in Jeffrey Saletnik and Robin Schuldenfrei, *Bauhaus Construct: Fashioning Identity, Discourse and Modernism* (London, 2009), 151–56.





(19) *above*

a + b: László Moholy-Nagy and František Kalivoda, *telehor,* issue 1–2 (1936): 82, 83

(20) *opposite*

Color reproduction of László Moholy-Nagy, *Construction AL 6* in László Moholy-Nagy and František Kalivoda, *telehor,* issue 1–2 (1936): 68

telehor featured a number of color plates illustrating recent paintings Moholy executed on canvas, aluminum, and plastic that take up some of the effects he sought to secure with his light machine. *AL 6* features an aluminum plate with five identically sized die-cut holes, secured with brackets to a painted wooden plank. The holes in the painting provide areas where real shadows are cast, where light qualities shift with the changes in the surrounding environment (fig. 20). And although the painting cannot move, Moholy activated the polished metal surface through the application of patiently engraved lines and circles that catch and reflect light at different angles, glinting at a viewer as he moves. Far from avoiding facture, this painting, even within the limitations of the color photographic reproduction, manages to convey contrasts between the metallic surface and daubed, thickly stippled areas of paint.[46]

With the single exception of a yellow and red schematic rendering of *Light Prop*, all the color illustrations in the volume were of his paintings. The colorful illustrations are

46. Ibid., 155.

ebullient, hardly hinting at the despondent tone of his letter to Kalivoda, and indeed visually argue for the capacity of painting to advance the artistic project Moholy had long assigned to other technologies. This claim is made all the more explicit with the journal's cover. It features a painting on canvas as its representative image. Put differently, *telehor*, a journal whose very name signals a far-seeing, a projection into an as-yet unknown future, is paradoxically illustrated with a color reproduction of a painting.

Titled *Z VII*, the painting was a curious choice for the cover, in part because the canvas itself had been damaged prior to its reproduction (pl. 16). The original painting was torn; Moholy roughly patched the torn painting and applied thick layers of paint to one area of the canvas. To balance the bulge, Moholy overlaid large expanses of the painting with quick-drying, glossy enamel paints. Unlike other paintings from the 1920s that sought to suppress the traces of obvious brushwork, *Z VII* calls attention to the presence of the artist's hand. Against an opaque, glossy gray parallelogram, Moholy introduced a field of hand-applied daubs of blue paint, rough dots spread across an unevenly distributed penciled grid. The new coat of colors, clothing the original composition's scaffolding, undermines the illusion of luminosity and transparency so palpable in Moholy's work of the 1920s. The dark grays and the vivid reds solidify the central complex of geometrical elements, making them cohere, figure-like, against the lighter ground of creamy and mustard yellows.[47]

Moholy had exhibited his work extensively in the 1930s, working in exile, shipping his works across Europe between Switzerland, the Netherlands, Czechoslovakia, France, and England. Paintings are vulnerable to damage brought about in transit, at exhibition, or even in the studio. We know from Moholy's correspondence and accounts by his wife Sibyl that he repaired his own work during his lifetime and especially during this period in exile.[48] In this case, however, Moholy entirely repainted the surface with a new palette and textures. He treated this damaged painting as a lively terrain to be explored anew and not a pristine surface to be restored to an earlier state. Not only did he alter the original palette; he also made use of enamel paints, staples of the housepainter, to quickly and opaquely cover large expanses of canvas, imparting an industrial, hard, and glossy sheen to those planes. While he subjected his canvas to new techniques and materials, he also used it as a field to experiment with the capacity of color photographic reproduction.[49]

As is true of any reproduction, the painting that appears on the cover of *telehor* differs significantly from the original (pl. 17). In some ways, the very limitations of color photography and color print reproduction flatten the work's flaws and render the repaired, repainted surface warm and luminous. Moholy's act of reproducing this painting in color is pointed, for it recovers one of his paintings, transforms its obdurate, damaged surface into luminous fields of color. Color photographic reproduction was quite new at the time. Moholy had only begun to explore its possibilities while working in commercial publishing in the Netherlands in 1933 (pl. 18). *telehor* allowed him to use painting as

47. Ibid.,143.

48. Sibyl Moholy-Nagy to Lucia Moholy, 15 November 1947. Bauhaus Archiv, Berlin.

49. Joyce Tsai, Jay Krueger, and Christopher Maines, "'Transparency and Light, Structure and Substance': Enamel Paints in László Moholy-Nagy's *Z VII* (1926)," *Journal of the American Institute of Conservation* 52, no. 4 (2013): 236–45.

a way to test the capabilities of this nascent medium. In the course of its transformation into color photograph and then color print, it modeled how painting might guide the development of the future technologies.[50]

Moholy advanced his claims about the relationship between color film and painting more explicitly that same year in an essay titled "Paths to the Unleashed Color Camera."[51] Moholy opens the essay by enumerating the many limitations of color photography, including the impediments posed not only by the complexity of its chemistry and costs but also by the expectation that it be used exclusively to reproduce the objects and colors of nature.[52] It was a problem he knew well.[53] "Paths to the Unleashed Color Camera" argued that the technology of color photography must go beyond "recording," which simply reinforced existing visual relations.[54] Instead, it must "divorce" itself from "naturalistic-illusionistic meaning" in order to explore "colored form in light," something best explored through painting, for it represents the most advanced domain in which these questions have been developed "as an expressive medium."[55] In the 1920s, Moholy had once argued that photography and the photogram would be the tools that would break people of their habits of seeing, but in the 1930s, he argued that the conventions that plague color photography could be broken only by attending more closely to the lessons learned in abstract painting. This short article included a description of how Moholy's most recent paintings would put the color camera on a new path. In one work, according to the artist's account, he painted

> the front and back of a transparent material. Adjacent to the colored surfaces there is a perforation. This admits unfiltered light, so that in addition to the pigmentary effect of the painted spaces we have a direct material effect derived from the light striking though upon the background. Thus a kind of spatial kinetics also begins to play its part. When the picture is secured at a certain distance from its background, we have effects of light and shade which appear to move as the spectator walks past the picture.[56]

Space Modulator Experiment AL 5 (fig. 21), Moholy's three-part composition, completed in 1935, comprises a wooden base, a perforated aluminum panel, and a translucent plastic disc. Overlaid with delicate black rays, the disc is secured with three metal pins to the polished aluminum panel, covered with a web of red rays emanating from unseen sources. Three die-cut circles corresponding to textured painted rounds on the metal surface offer glimpses of the wooden support beneath. The hole near the center of the composition reveals a roughly painted matrix of red, yellow, and blue. In two places, the red rays on the aluminum extend onto the painted wooden ground.

---

50. Tsai, "Excavating Surface," 157–58.

51. Jeannine Fiedler, "Moholy-Nagy's Color Camera Works: A Pioneer of Color Photography," in Jeannine Fiedler, ed., *Color in Transparency: Photographic Experiments in Color, 1934–1946*, exh. cat., Berlin: Bauhaus Archiv (Göttingen, 2006), 20.

52. László Moholy-Nagy, "A felszabadult szín-fényképezés felé," *Korunk* 12 (1936), 1014–17, translated and republished as "Paths to the Unleashed Color Camera," in *László Moholy-Nagy: Color in Transparency*, 35–88.

53. László Moholy-Nagy to Sibyl Moholy-Nagy, November 1933, Sibyl Moholy-Nagy Papers, Archives of American Art, Smithsonian Institution, Washington, D.C.

54. Moholy-Nagy, "Paths to the Unleashed Color Camera," 36; and L. Moholy-Nagy, "Produktion-Reproduktion, *de Stijl* 5, no. 7 (July 1922): 98–101.

55. Moholy-Nagy, "Paths to the Unleashed Color Camera," 37.

56. Ibid.

(21)
László Moholy-Nagy,
Space Modulator Experiment, AL 5, 1931–35.
Aluminum and Rhodoid,
33⅞ × 27⅞ in.
Private collection

This work features lines engraved upon the plastic and metal surfaces, elements most clearly seen when the viewer shifts position. Our shift in position alerts us to how light filters differently through the plastic disc, and how cast shadows change the way painted passages register. As Moholy's own description suggests, the work was intended to stimulate a kinetic perception of space, color, and light by encouraging our

movement in relation to it. Like many other paintings on plastic and metal supports that he executed in the 1930s and '40s, *AL 5* stands at the interstices of diverse artistic practices: it integrates techniques and materials drawn from printmaking, painting, and sculpture while alluding to problems that Moholy believed color photography should come to explore. It does so also by transferring part of the kinetic task he had once assigned to *Light Prop* from the machine to the viewer.

Moholy's engagement with *Light Prop* continued in works produced during the last decade of his career in Chicago. In 1942, he used a pair of identically sized red and yellow Formica panels as a support (pls. 26, 27). Formica became pervasive in mid-century interiors, favored for the range of intensely saturated colors in which it could be produced and the durability of its surface. Moholy makes use of the bright intensity of the ground and introduces a cascade of overlapping painted sheets on the brilliant yellow surface, each curved as if resisting the downward pull of gravitational force. On the red panel, Moholy painted a composition of black stripes, circular openings, and angled rods zig-zagging through the complex of shapes. The surface is highly worked, dappled light suggested by means of stiff, dry daubs of paint. A color reproduction of the red Formica painting appears in the artist's posthumously published book, *Vision in Motion*.[57] Although the book is divided into different media — including painting, photography, film, and architecture — the work appears in a section on color film and photography, where it is captioned "Color variation of part IV of the motion picture 'Light Display: black and white and grey' (Scenario pp. 288, 289)."[58] With creative captioning and inventive categorization, a painting comes to stand in for a color film that does not yet exist. Painting not only sets color photography on a new path, as Moholy suggested in the 1930s; in this instance, painting and color photography become mutually inflecting conceptual and practical equivalents in Moholy's theory and practice at the end of the artist's career.

Chicago: Pragmatic Solutions and "Free Art Problems"

Moholy came to the United States in 1937, leaving Europe to head the New Bauhaus, founded that year in Chicago. He received a telegram from Norma K. Stahl, a designer and a senior officer in the Association of Arts and Industry in Illinois, asking that he consider leading a new school of design to start in the fall of that year. The school was modeled after its namesake in Dessau. Conceived by a group of designers and businessmen, its focus was to foster the integration of science and technology in art

57. László Moholy-Nagy, *Vision in Motion*, 2nd ed. (Chicago, 1969), 172.

58. Ibid.

pedagogy with the aim of training students to design for industry.[59] The trustees of the New Bauhaus initially had turned to Walter Gropius to lead the school; Gropius recommended Moholy for the post.[60]

The invitation came just as Moholy was anxiously observing events unfolding in Germany from the relative safety of London. He had briefly returned to Berlin in the summer of 1936, hired by a British agency to film the Olympics. On the day of his arrival, he was greeted by a former Bauhaus student of his in full SS uniform. Moholy stayed only two days, leaving in considerable distress without having shot any footage.[61] Aware of the increasingly dire situation in Europe, Moholy was grateful for the telegram inviting him to return to teaching and to promote the model of art education he and his colleagues at the Bauhaus had developed. Furthermore, Moholy held out hope that within this pedagogical setting and vested industrial support, the infrastructure might exist to allow him to experiment with new technologies once more.

Moholy's transition to his new post was not easy. The New Bauhaus folded less than a year after it opened due to internal politics and financial insolvency. Within months of the first semester, Moholy was engaged in an unsuccessful campaign to secure funds for the school's survival. The Association of Arts and Industry withheld part of the salaries promised, and Moholy found himself in Chicago without a school to house the faculty that he had recruited, in many cases from Europe. However, he quickly rallied support and reorganized. In early 1939, he gathered the resources to start a new institution, the School of Design, later renamed Institute of Design. He secured financial backing from the Container Corporation of America and embarked on intensive fundraising campaigns to secure the school's future.[62]

These were hardly auspicious beginnings, but the school survived its early challenges. However, within just a few short years, it faced another ordeal, confronted by the demands of war once the United States joined the effort in 1941. Moholy contended with material shortages and with dwindling enrollments because of the draft. As director, he strategically recast the school's mission to make explicit the ways art education could contribute to the design demands of the "war industry." Working with the Office of Civilian Defense, he offered courses on the development of new camouflage patterns.[63] His students took up wartime challenges and redesigned helmets and proposed portable runways for temporary airfields.[64] Moholy adapted his ideas for a holistic approach to the education of man developed in *New Vision* for an integrated program to

59. *The New Bauhaus: American School of Design*, promotional brochure (Chicago, 1937), 3.

60. Engelbrecht, *Mentor to Modernism*, 548–49.

61. Sibyl Moholy-Nagy, *Experiment in Totality*, 1st ed. (New York, 1950), 132.

62. Engelbrecht, *Mentor to Modernism*, chap. 5.

63. In a letter to Robert Jay Wolff, Moholy describes the urgency of teaching principles of camouflage to soldiers as a part of military training. "It was officially stated that one of the reasons for our first Tunisian reverses was the lack of camouflage discipline. I have been preaching for a long time the necessity for young students to take pre-induction courses in the principles of camouflage. We have here the facilities and have made the research, but we are not heeded." László Moholy-Nagy to R.J. Wolff, 17 March 1943, Robert Jay Wolff Papers, Archives of American Art, Smithsonian Institution, Washington, D.C.

64. Robin Schuldenfrei, "Assimilating Unease: Moholy-Nagy and the Wartime/Postwar Bauhaus in Chicago," in Robin Schuldenfrei, ed., *Atomic Dwelling: Anxiety, Domesticity, and Postwar Architecture* (Oxford and New York, 2012), 87–126.

rehabilitate wounded soldiers.[65] He actively promoted the school's activities to the Air Force, especially experiments in friction-welding plastic for use on windshield repairs on the battlefield.[66] There is no question that Moholy supported the war effort, but he also struggled to justify the continued existence of an art school under such conditions.

In a 1943 letter to the architectural historian Nicolaus Pevsner, describing his activities as director of the School of Design, Moholy wrote that the program "is set up for designers and architects with the integration of art, science and technology in mind. I am convinced that a balanced education in intellectual and emotional matters is the main requirement, which means that all our students have time to work on free art problems and not just on scientific and technological matters. For practical reasons, however, we officially emphasize at present more the scientific and technological approach, as with our meager budget situation we constantly have to prove with practical products that we are worthy of support."[67] Moholy's school showcased a range of projects that sought to demonstrate the practicality of design for industry. One of the few projects that stoked private interest — the design and manufacture of wooden springs — received funding from a mattress producer.[68]

Moholy had always been a highly pragmatic artist, administrator, and designer ready to play the role of visionary prepared to marry art with technology. The works of the 1920s reveal the extent to which he saw his art as paving the way to new avenues of industrial production, how technological projects like *Light Prop* were initially conceived as prototypes for future manufactured displays. However, by 1943, in his remarks to Pevsner, Moholy critiqued a conception of design limited exclusively to its commercial value or scientific applications. He argued that there had to be space in which creative problems could be pursued independently of considerations of their utility and application, the need to provide students with the time and resources to explore what he called "free art problems." For himself, Moholy pursued those "free art problems" at home and in his paintings.

Moholy considered himself first and foremost a painter in his late career even if, as his daughter recalls, that activity was pursued not in the artist's studio but in his living room, painting at night when he returned from work.[69] His paintings from his late career differed markedly from the work he produced in the 1920s, employing an astonishing and inventive range of media and techniques that took on loose and cursive forms. In the 1930s and '40s, Moholy worked extensively with clear plastic materials,

65. László Moholy-Nagy, "New Approach to Rehabilitation of the Handicapped," manuscript included with a letter to Robert Jay Wolff, 31 May 1944, Robert Jay Wolff Papers, Archives of American Art, Smithsonian Institution, Washington, D.C.

66. László Moholy-Nagy to Dr. Walter B. Kirner, National Defense Research Committee, 7 January 1944, Robert Jay Wolff Papers, Archives of American Art, Washington, D.C.

67. László Moholy-Nagy to Nikolaus Pevsner, 18 March 1943, Bauhaus Archiv, Berlin.

68. Schuldenfrei, "Assimilating Unease," 96.

69. Hattula Moholy-Nagy, "A Visionary with Great Creative Energy," in *The Art of Light*, 241.

and in the United States he would come to favor Plexiglas. Plexiglas was unique not only because it was synthetic; no other man-made material rivaled its clarity in comparison with glass. *Untitled (Space Modulator)* (1946) was executed on a sheet of clear Plexiglas (pl. 29), abraded in order to improve oil paint adhesion. He experimented with a number of techniques, often drawn from the toolkit of the printmaker, scuffing and scoring discrete areas before building up planes of color. He painted both sides of the sheet, sometimes wiping away painted areas to leave behind a web of color that would remain caught in the scratched areas.

Plexiglas could also be manipulated with the gentle, gradual application of heat. Too much heat too fast and the material might stress, crack, or bubble. The treatment of this thermoplastic required a tempered approach — focused, careful, and patient. It allowed him to warp forms that cut neatly across ideal Cartesian planes and create a new sense of space. *Space Modulator with Highlights* (1942) holds colorful shapes suspended upon an undulating topography, riding the polished, clear surface (fig. 22). The painted Plexiglas sheet was warmed, often in the oven at home. His daughters watched him shape these futuristic pictures by hand. In *CH XI (39)*, a painting that used the most conventional of materials, oil and canvas, Moholy treated the gessoed surface with techniques he developed for his plastic pictures (pl. 24). His vibrant forms took up looser, more organic curves, their surfaces textured and tooled by hand. Moholy's idiom would no longer be the geometrical abstraction nor the machine aesthetic with which he has so often been identified.

Moholy had long described a shift in the trajectory of his art from painting in pigment to the exploration of light itself as the basis of an artistic medium.[70] This narrative of progressive technological dissolution of material support toward the creation of powerful, projected light, color, and shadow effects remained a constant leitmotif in his writings. However, the language he used in his work with light took on painting as its practical and theoretical model, describing such activities in the mid-1930s as "light painting." His Kodachrome slides, made throughout his time in Chicago, often exemplify this idea through their painterly aesthetic.[71]

Moholy produced a number of Kodachrome slides in his late career that were not shown as a corpus during his lifetime (fig. 23 a, b). He used a range of light filters to apply washes of color to abstract studies, paying close attention to how overlapping hues interacted with one another and with the surfaces upon which they were

70. Moholy-Nagy, *Malerei Fotografie Film*, 7.

71. László Moholy-Nagy, "Light Painting" in *Circle: International Survey of Constructive Art*, ed. J.L. Martin et al. (London, 1937), 245.

(22)

László Moholy-Nagy, *Space Modulator with Highlights*, 1942. Plexiglas, paint, and wood, 17 × 11 1⁄16 × 6 5⁄16 in. Rhode Island School of Design, Providence, Gift of Mr. and Mrs. John Gilbert Dean

projected. He made nocturnal photographs taken on the street. Simply by using a long exposure, light emanating from passing traffic, streetlamps, or garish neon is transmuted into brilliant tendrils of color and feathery ribbons painted by the gestures caught on film with the camera cradled by hand, reanimated with the light projected through the slide.

(23)

a: László Moholy-Nagy, [*Color Study*], ca. 1939–46. Kodachrome slide. Estate of László Moholy-Nagy

b: László Moholy-Nagy, [*Traffic Lights*], ca. 1934–46. Kodachrome slide. Estate of László Moholy-Nagy

What characterized so much of Moholy's art from the 1920s was the desire to make art train the eye and hand to habituate themselves to the demands of a new industrial modernity. Technology and industry offered the standard toward which he aspired and in pursuit of which he once attempted to eviscerate every last trace of his hand. However, what Moholy arrived upon in the art of his late career was a desire to alter our relationship to technology. Painting returns as a way to make photography, film, new metallic alloys, and even plastics accommodate his own hand. His touch becomes a humanizing force in a technological age.

Coda: The Shape of Things to Come

The title of this book draws on Moholy's involvement in *Things to Come*, a highly successful science fiction film (based on a book by H.G. Wells) that opened in theaters in 1936. Alexander Korda, a fellow Hungarian émigré in London, invited Moholy to contribute special-effects sequences. Moholy had at his disposal the use of the film studio, a filming assistant, set materials including clear plastic, glass, and metal sheets and rods. His task was to create futuristic effects and to produce a sequence that would envision what architectural shape the future might take.[72]

Moholy was never credited for his work, and the special effects he produced for the film were barely used. A few scant seconds of his contributions were integrated in a section that shows how the world would be rebuilt in the aftermath of a cataclysmic world war, with new machines and materials. He made a kinetic contraption comprising mercury-filled tubes that whirled against a mirrored backing and ghostly figures caught behind textured glass. Left on the editing floor were Moholy's images of the future cities, whose crystalline and curved, floating forms are captured in photographic still shots (pl. 19; figs. 24 a–b, 25).

These special effects, however, found an afterlife in Moholy's late work. Upon his appointment as director of the New Bauhaus in 1937, he designed a brochure advertising the new school that used as its front and back covers photographic stills of his unused set designs for *Things to Come* (pl. 20). The forms he produced for the film populate his late paintings, translated from black and white into color. The effects of these shapes are only intensified when executed on Plexiglas sheets. These works were often called *Space Modulators*, a name that has an undeniably futuristic, science-fiction feel, as if these paintings served as some bit of equipment for outer space (pls. 26, 27). *Things*

72. Christopher Frayling, *Things to Come* (London, 1995), 72–73.

(24)
a + b: László Moholy-Nagy. Set designs for *Things to Come*, 1935. Silver gelatin prints. Estate of László Moholy-Nagy

to Come served as a source for many of his paintings, including those executed in the last year of his life. A black-and-white photographic still of a metallic orb is transformed into a painting of a colorful globe levitating upon an abstract background (figs. 25, 26). Another painting frames multispoked, colorfully tipped figures reminiscent of pieces out of a box of jacks that recall the film's science fiction future–oriented aesthetic (pl. 28). The former was titled *Nuclear II* (1946), the second of two paintings that bear a title that refers to the atomic bombs dropped on Hiroshima and Nagasaki in 1945. The latter was named *Leuk 5* (1946), made as Moholy knew that he was dying of leukemia.[73]

It is hard to approach this late work, especially the paintings he made in the brief few months between the end of the war and his death in 1946, without ascribing their significance to these two events. His titles invoke the relationship explicitly, even as the paintings themselves refuse to give in to horror and fear but instead open up views of a world to come that is colorful, even cheerfully so. Their optimism comes even

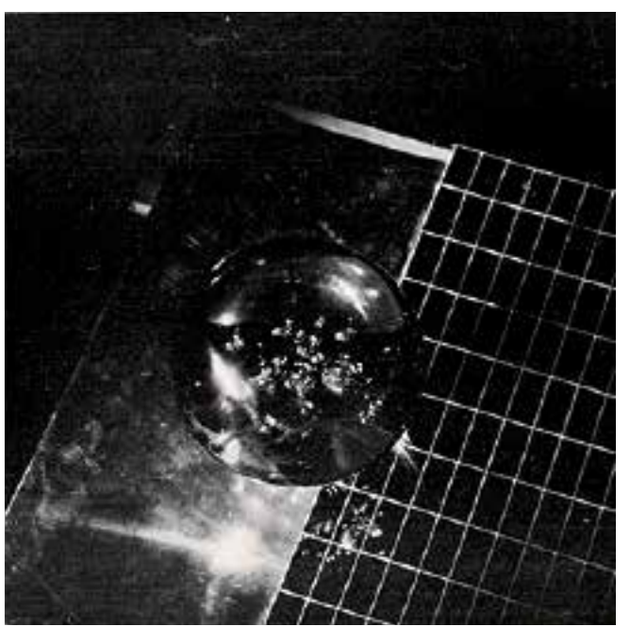
73. Moholy was diagnosed with leukemia in winter 1945. Hattula Moholy-Nagy, "A Visionary with Great Creative Energy," in Rubio, *The Art of Light*, 242.

as he witnessed the limitless ability of scientific knowledge to destroy the world and its limited capacity to treat his leukemia. But the titles, so seemingly overdetermined in this historical moment, also hold keys to open a wholly different reading of the pictures. *Nuclear II* is at once center and seed, executed with a number of different sectors all contained within its clear globe, as if containing the potential features of a world to come. *Leuk 5* refers, on the one hand, obviously and explicitly, to leukemia. On the other hand, the title also derives from the Greek λευκός, which means white, light, and bright. It is the sense of the second that the painting invokes with its luminous colors, playful forms, and open rendering of space, shuttling between micro- and macro-scopic perspectives, and orbits both atomic and cosmic.

Moholy's desire to engage with the newest materials, the tools, and the means in his early career was tied to his belief that he might be able to acquire the expertise to speed the process of modernization. His art was intended to promote what he called a new "hygiene of the optical," capable of instilling new visual habits that would prepare the viewer to benefit from the latest discoveries in science and industry. In the 1930s, a time of economic duress and political persecution, Moholy could not but recognize that technology in and of itself could offer little, if any, salvation. In response to his

(25)

László Moholy-Nagy. Set designs for *Things to Come* (detail), 1935. Silver gelatin prints. Estate of László Moholy-Nagy



(26)

László Moholy-Nagy, *Nuclear II*, 1946. Oil on canvas, 49¾ × 49¾ in. Milwaukee Museum of Art, Gift of Kenneth Parker (M1970.110)

historical circumstances, Moholy turned to painting as a more accessible, achievable technology that still allowed him to accomplish his aims.

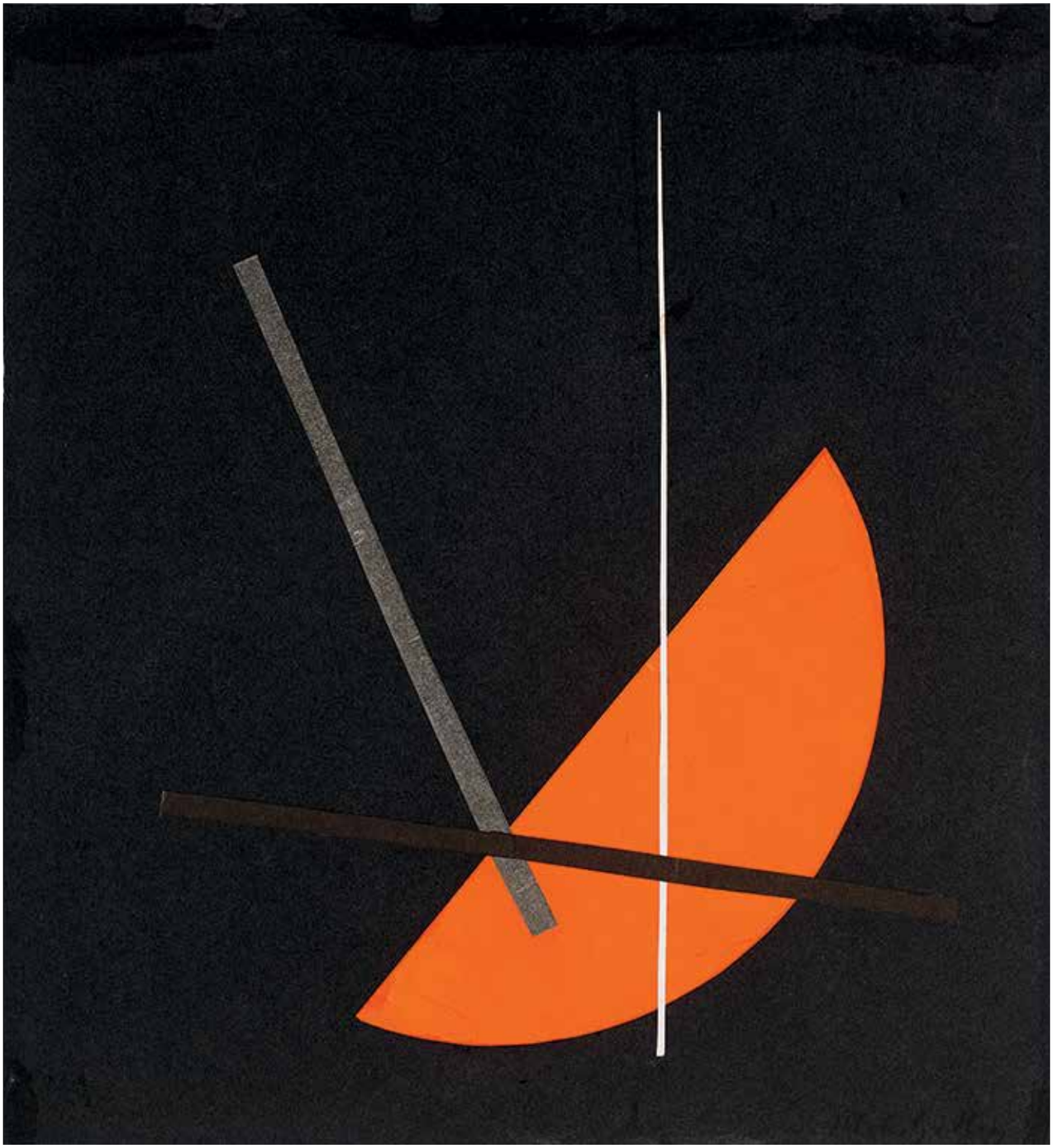
The artist, Moholy writes in his last, posthumously published book, has an ethical responsibility to respond to the challenges of his time.[74] Increasingly, in the last two decades of his life, he argued in his writings that artists have nothing to fear from technology, as his own willingness to engage the most advanced materials in his artistic practice certainly exemplified. However, he also warned against a purely utilitarian approach to science and technology. Moholy took materials and tools from military, commercial, or industrial sources and used them against the grain. His paintings imagined new ways that these products of human ingenuity could be used to serve ends that were not centered on warfare or profit but directed to engender the shape of things to come. Moholy began his artistic career by asking how a painter could justify his activities in a time of revolution; he answered his younger self in his late paintings, made during a time of unprecedented global, political, and economic turmoil. Painting could still suggest the contours of an optimistic future, even if that future remained out of reach, for now.

74. Moholy-Nagy, *Vision in Motion*, 30.

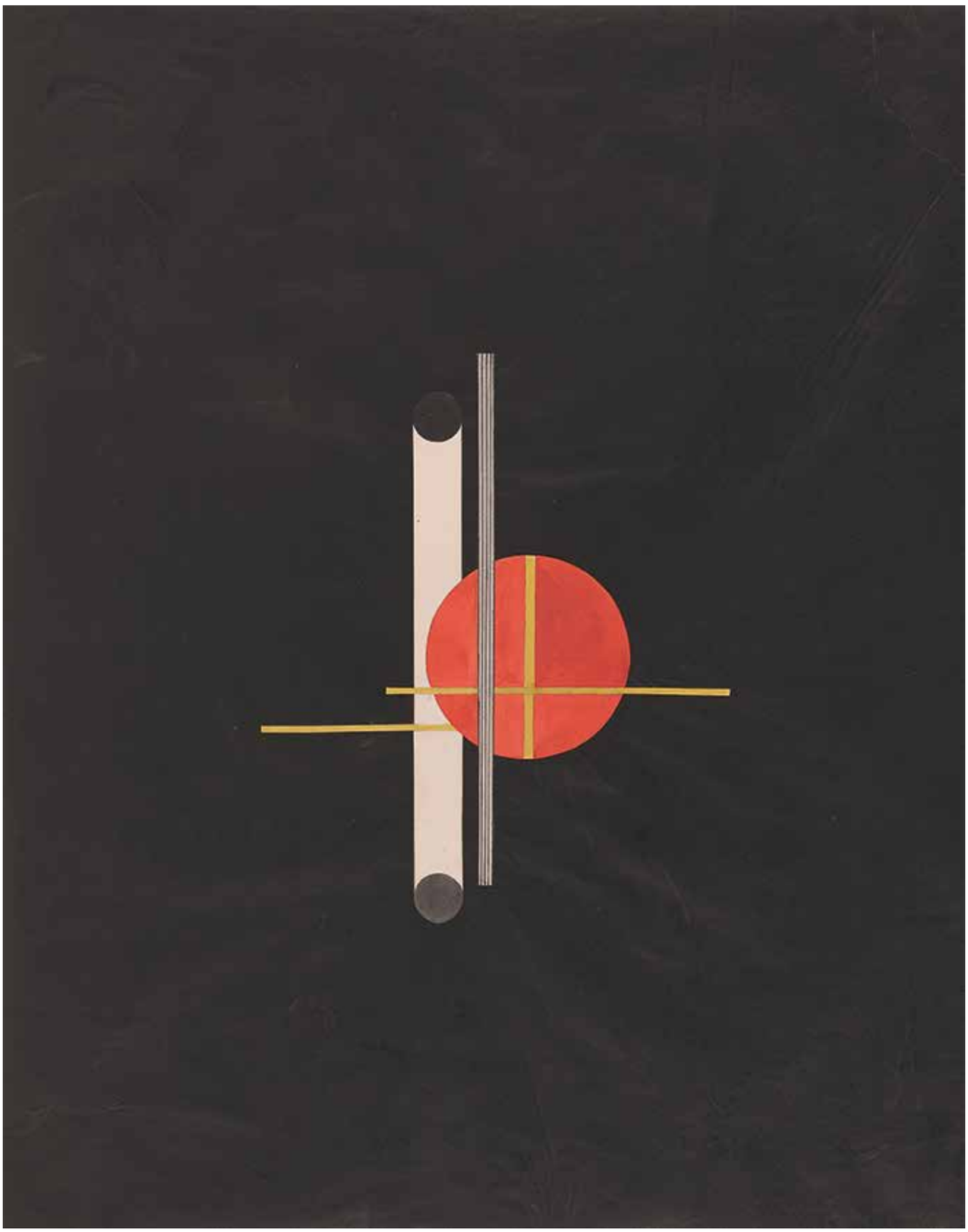
PLATES

1 ***Architektur 1*** 1922, Oil on canvas, 25 11/16 × 21 13/16 in., The Salgo Trust for Education

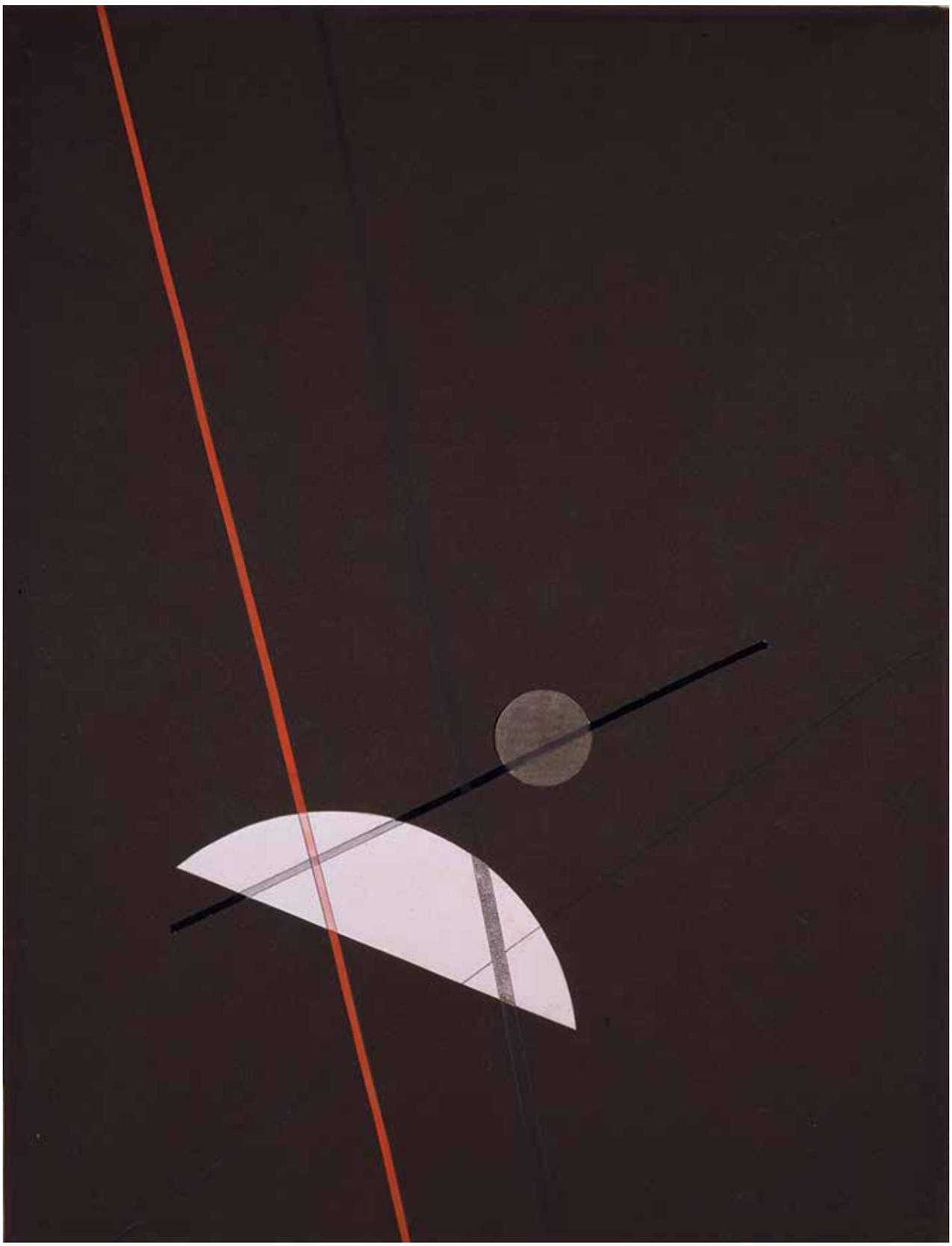
2 ***Composition*** ca. 1922–23, Paper collage on paper, 12 × 11 in., Santa Barbara Museum of Art

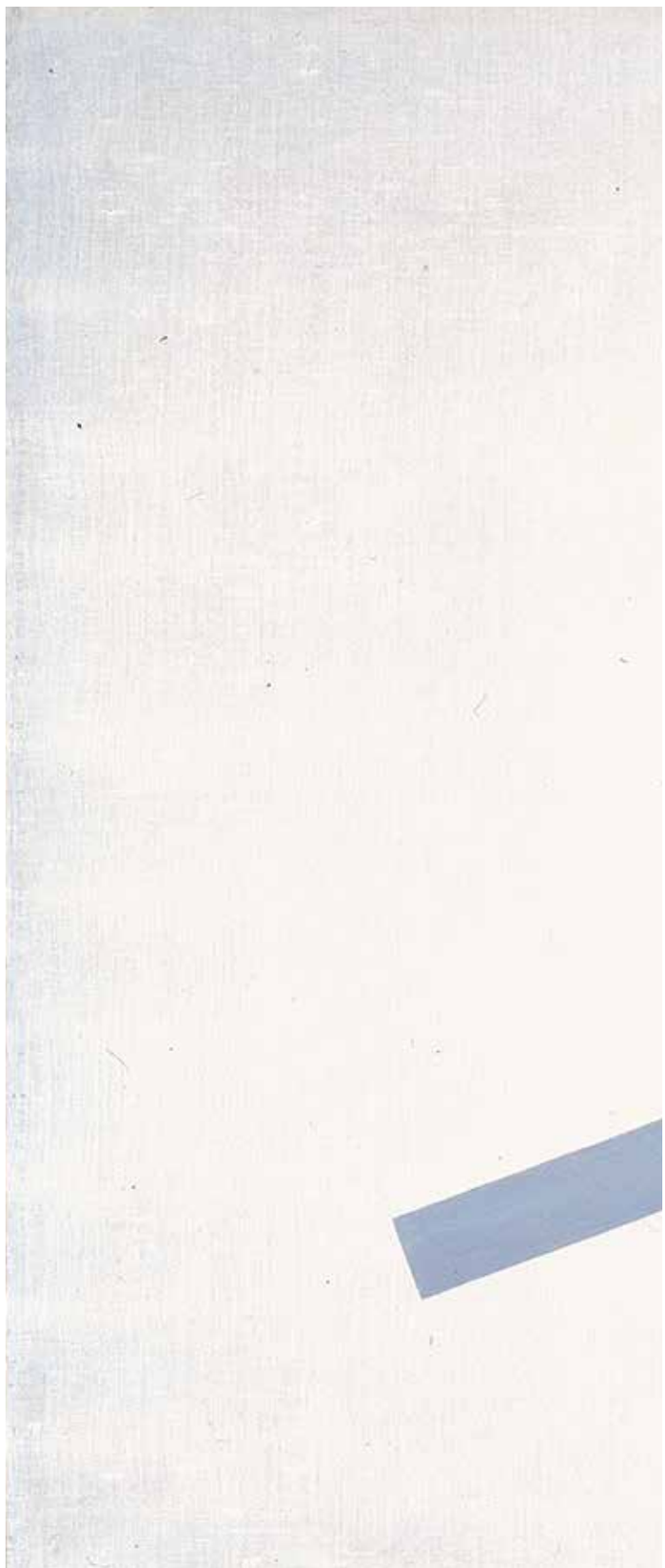


3 ***Q*** 1922/1923, Collage with watercolor and pen and black ink over graphite on carbon paper, 23 3/16 × 18 1/4 in., National Gallery of Art

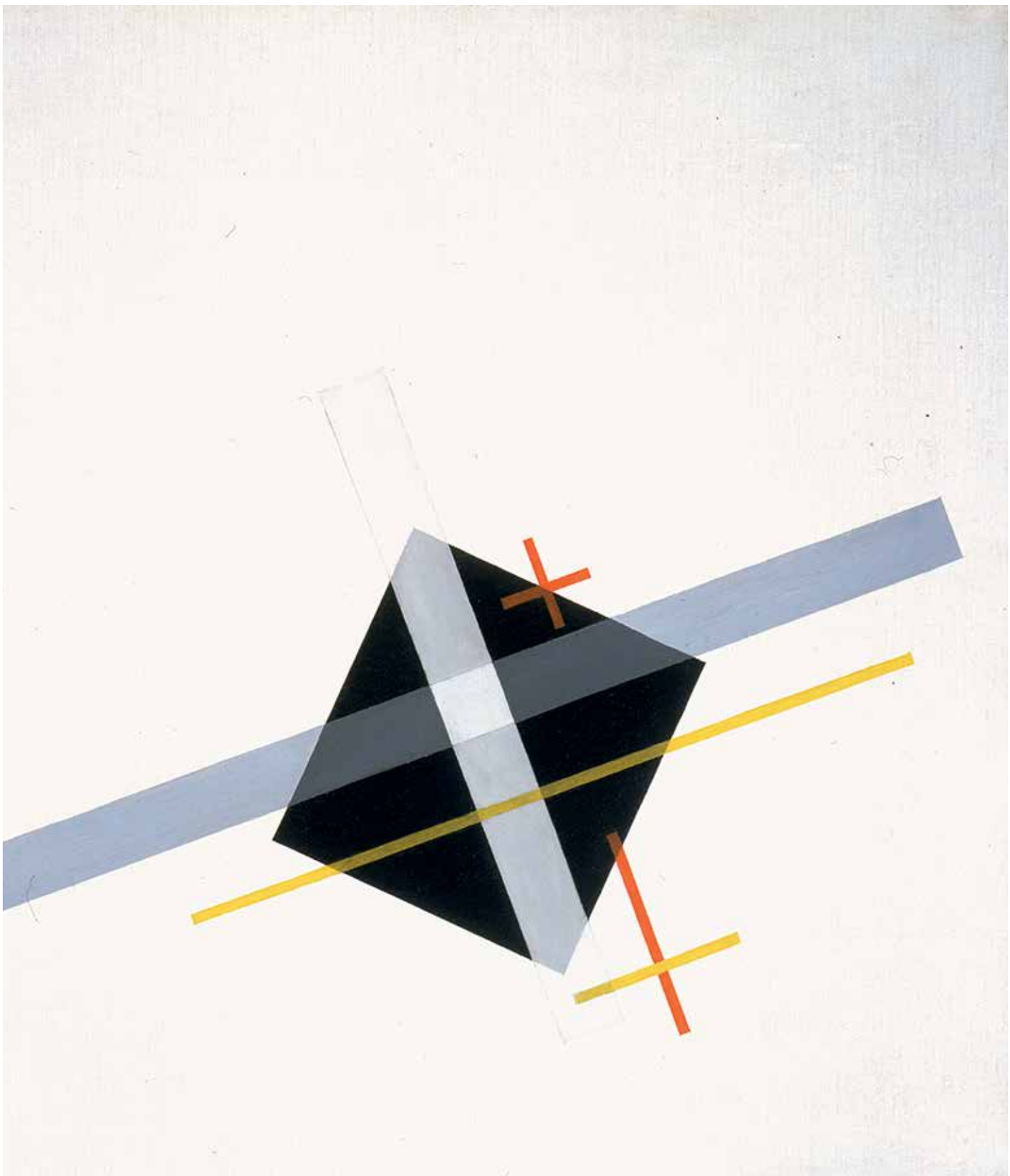


4 **Untitled** 1922–23, Gouache, watercolor, pencil, charcoal, and pasted paper on black wove paper, 25¾ × 19½ in., Norton Simon Museum

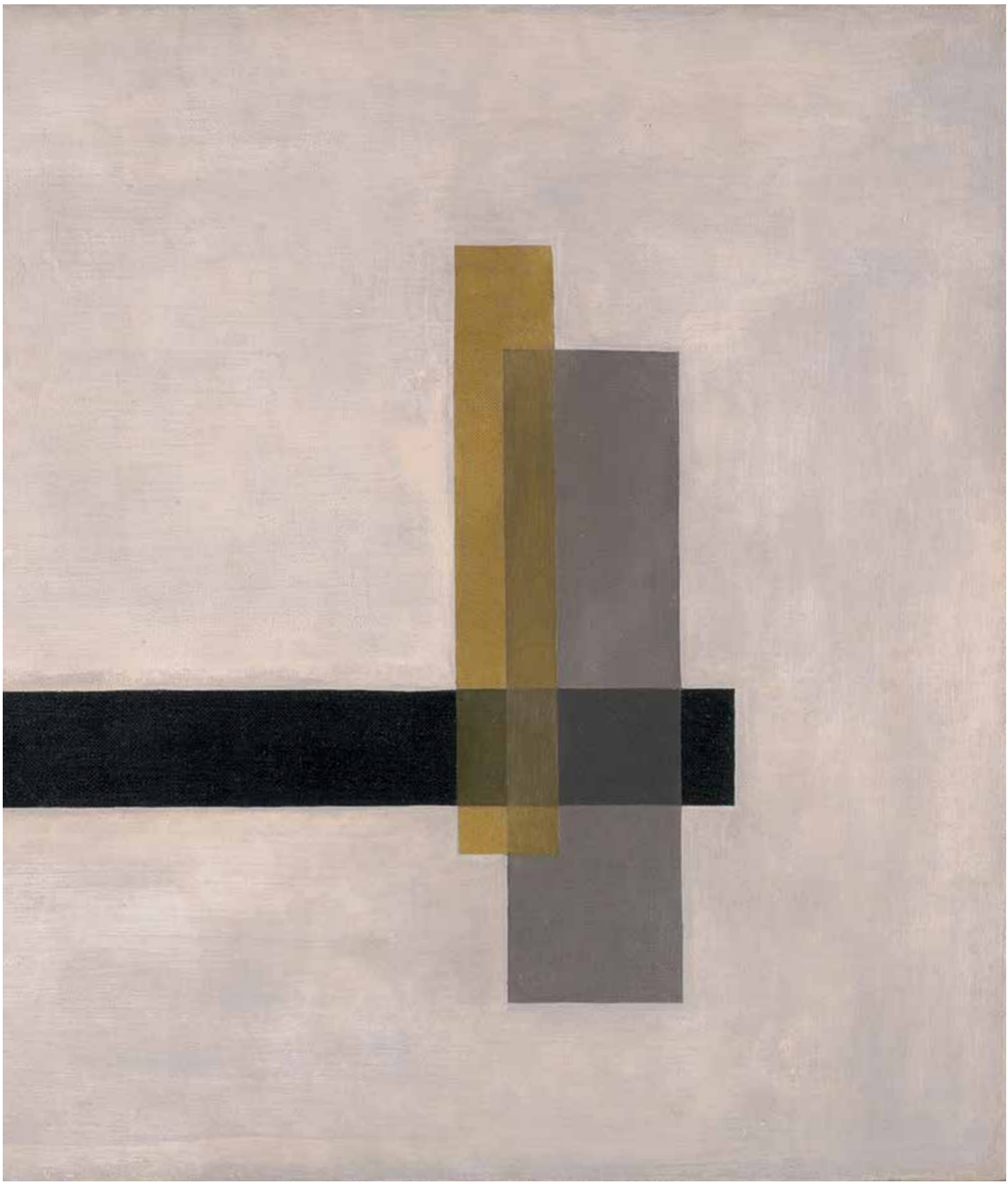




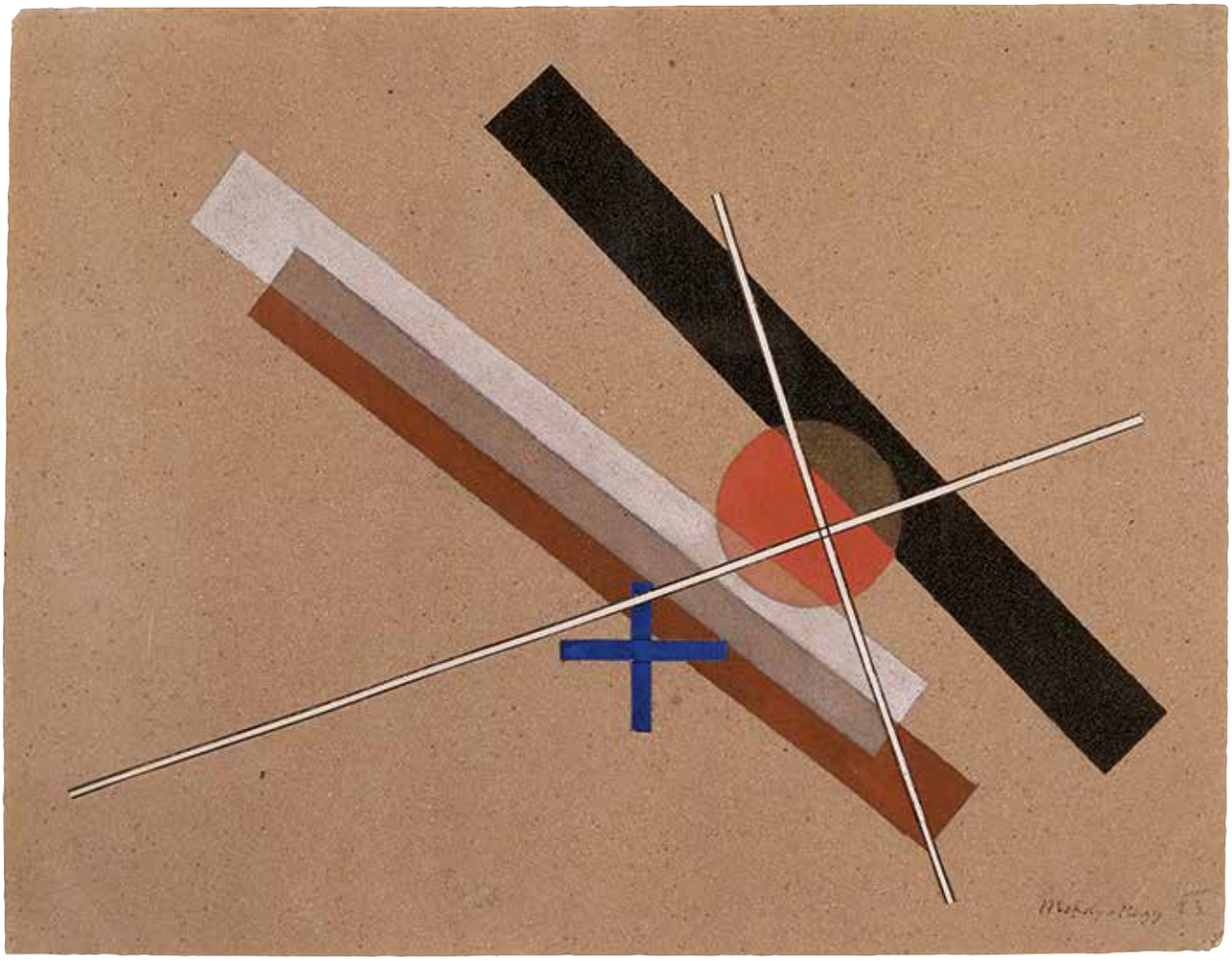
5 ***K 1*** 1922, Oil on canvas, 30 × 37½ in., Smith College Museum of Art



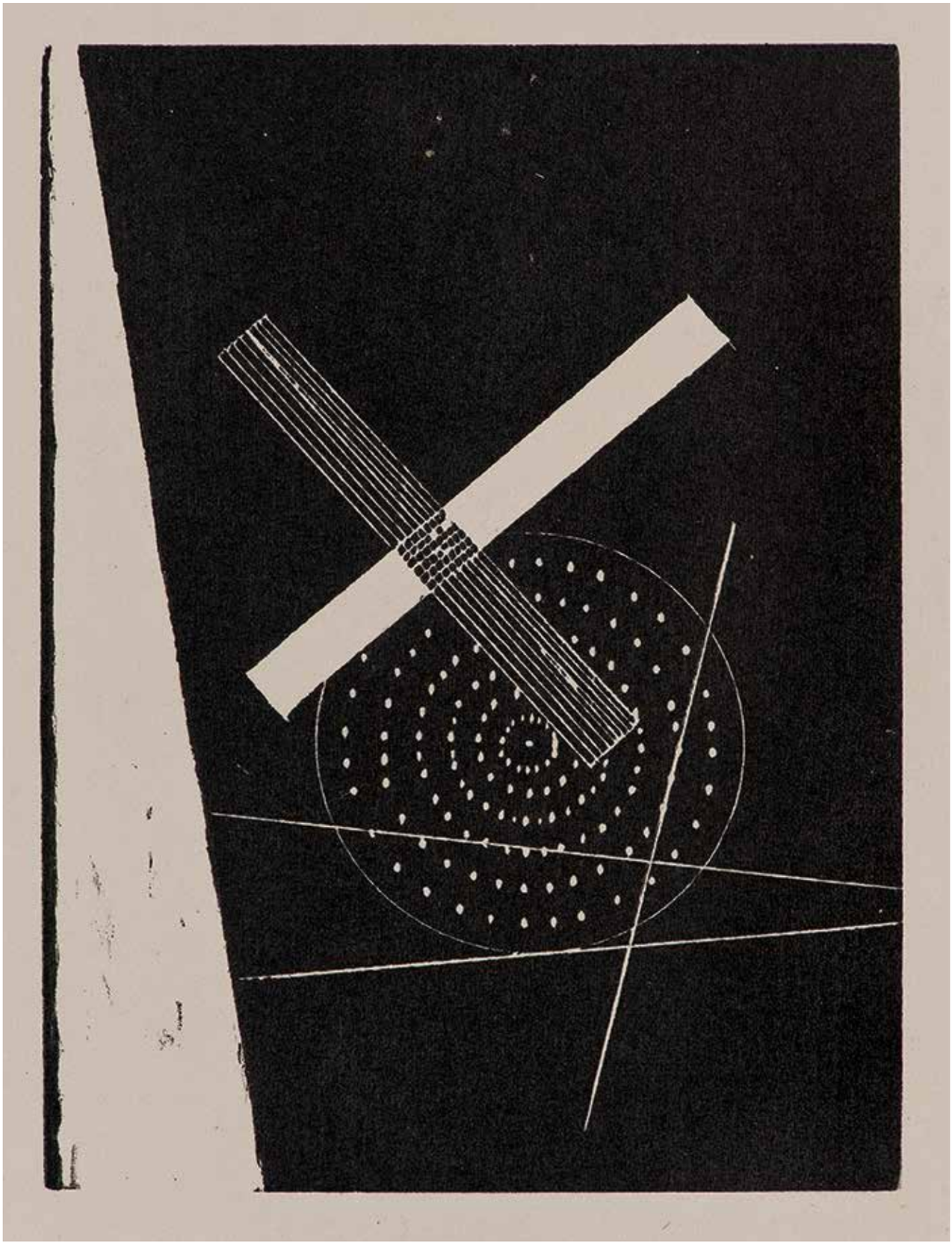
6 ***Composition*** 1923, Oil on canvas, 22¼ × 25 in., Snite Museum of Art, University of Notre Dame



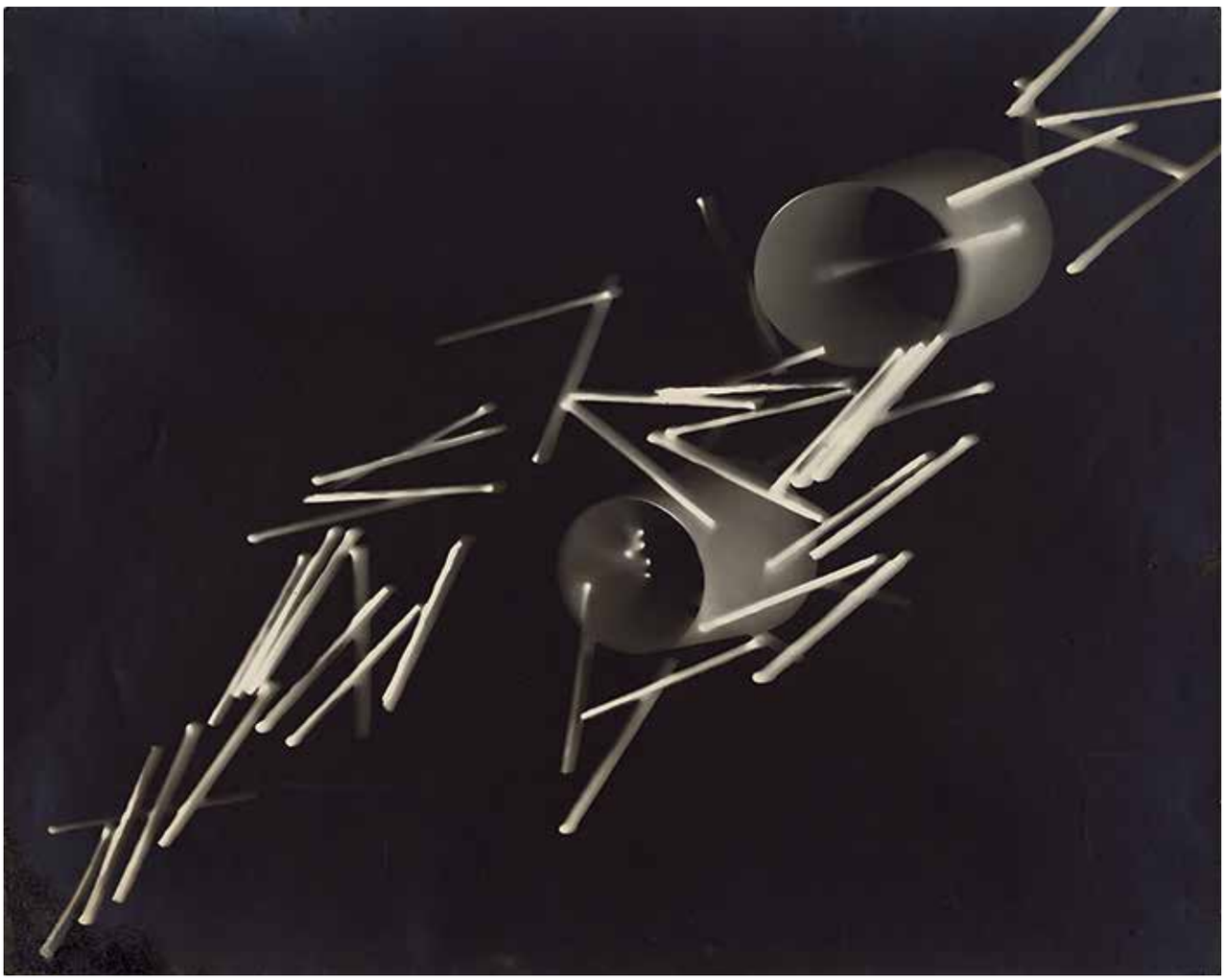
7 ***G. SMIRG*** 1923, Watercolor and collage on sandpaper, 9 × 11 11⁄16 in., Saint Louis Art Museum



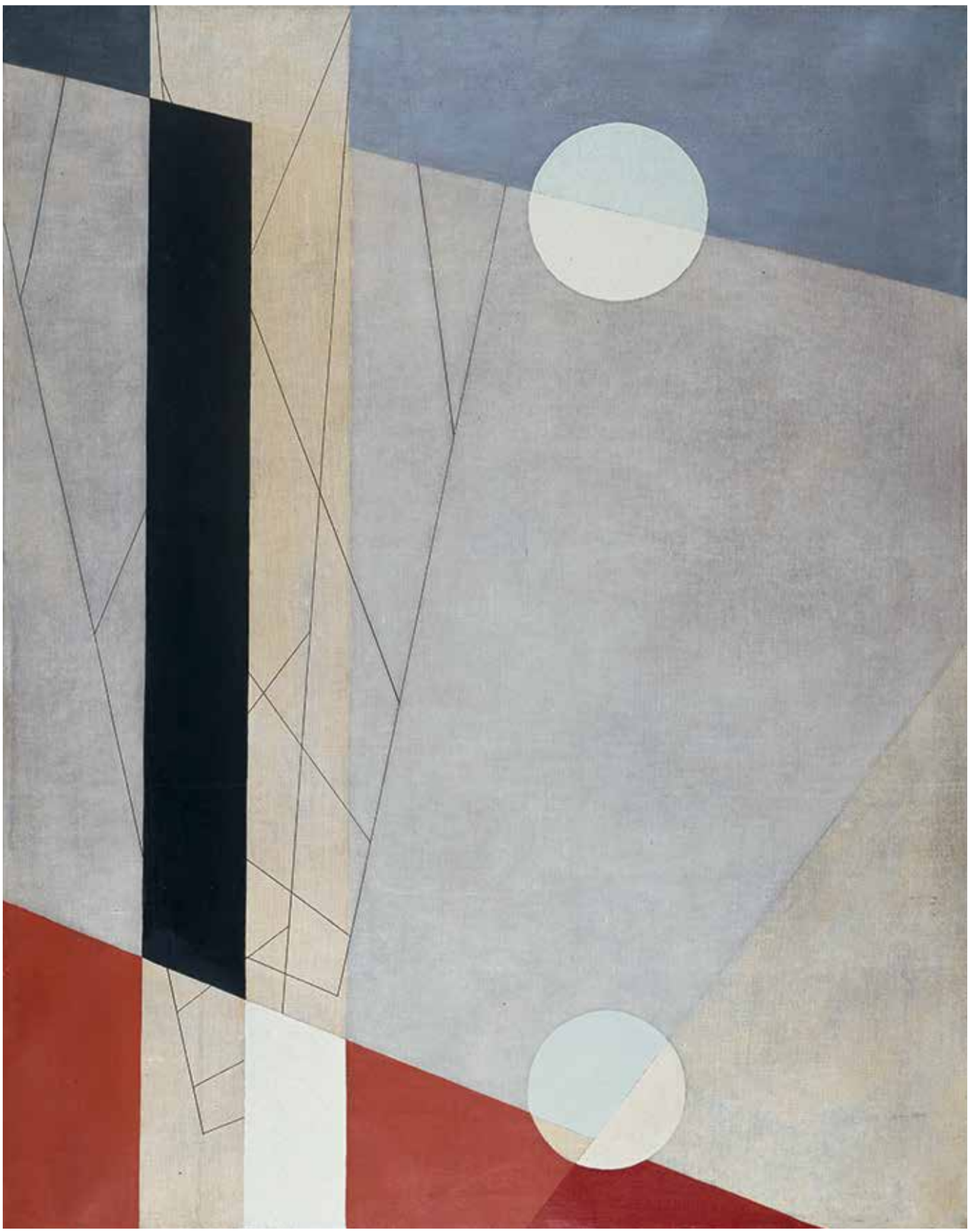
8 **Untitled** ca. 1924, Linoleum cut, 10 ¾ × 8 in., Santa Barbara Museum of Art



9 ***Photogram*** ca. 1924, Gelatin silver print, 9 7/16 × 11 3/4 in., The J. Paul Getty Museum

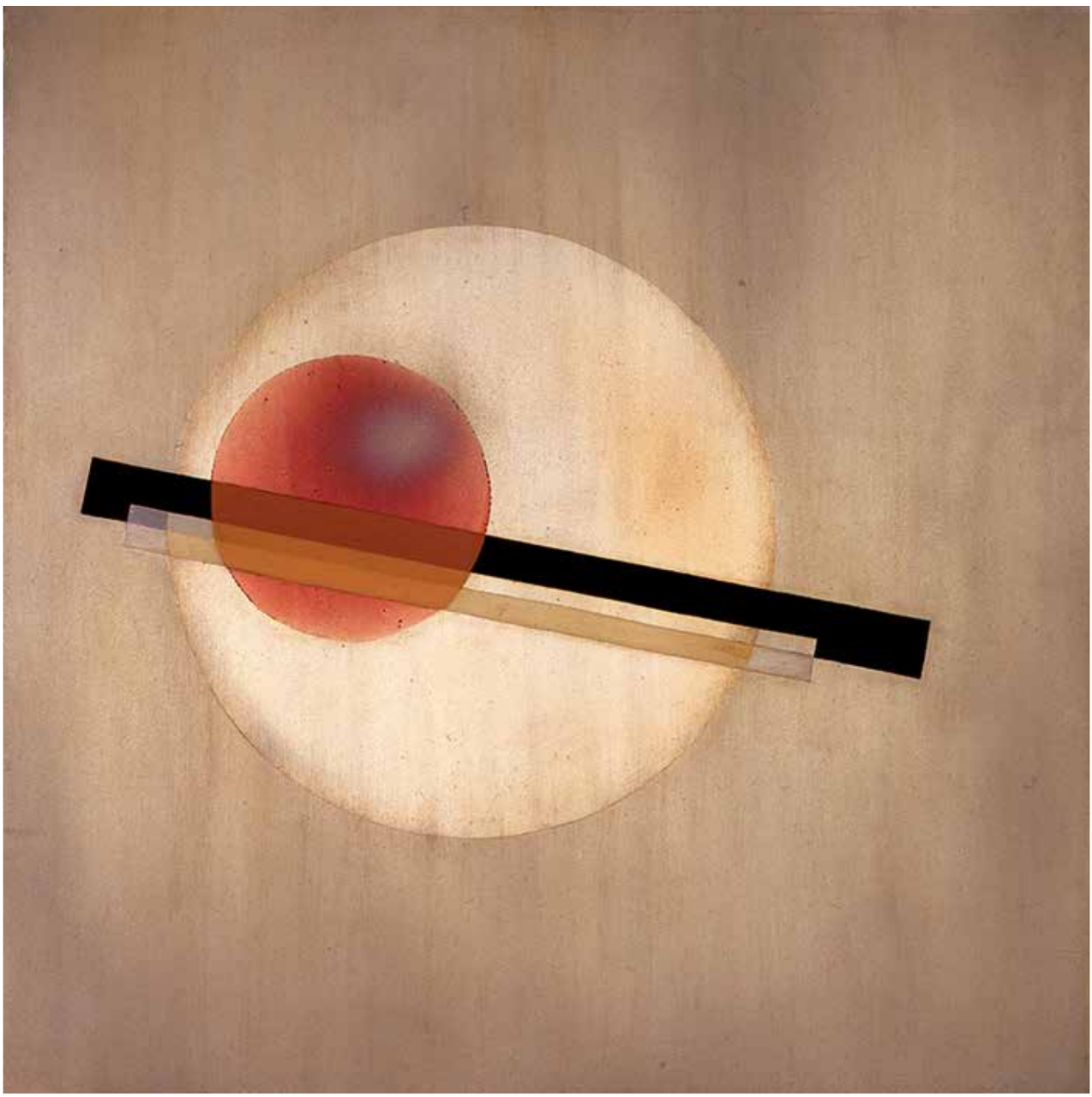


10 ***Z VI*** 1925, Oil on canvas, 37½ × 29¾ in., Harvard Art Museums/Busch-Reisinger Museum



11 ***Planes Cutting Planes*** 1926, Watercolor and graphite on paper, 19½ × 13⅝ in., Yale University Art Gallery

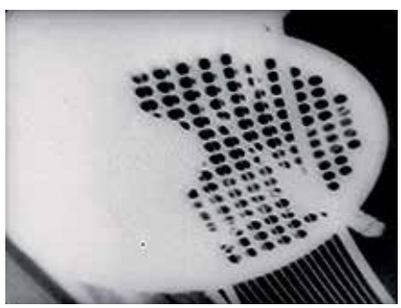
12 ***AL 3*** 1926, Oil, industrial paints, and pencil on aluminum, 15¾ × 15¾ in., Norton Simon Museum

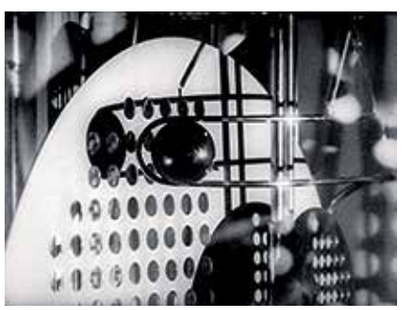


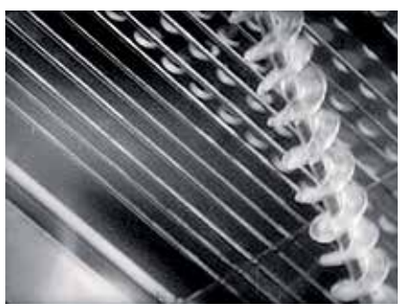
13 ***TRB 1*** 1928, Oil on plastic, 10 ⅜ × 15 ¾ in., Estate of László Moholy-Nagy

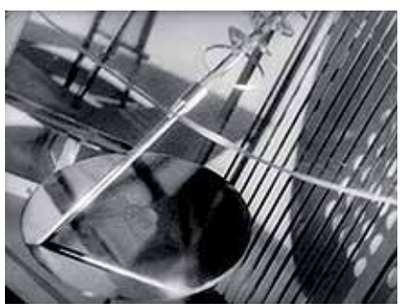
14 ***Light Prop for an Electric Stage*** 1929–30, Exhibition replica, constructed in 2006 through the courtesy of Hattula Moholy-Nagy, Metal, plastics, glass, paint, and wood, with electric motor, 59 7/16 × 27 9/16 × 27 9/16 in., Harvard Art Museums/Busch-Reisinger Museum

15 ***A Lightplay: Black White Gray*** 1930, DVD, Estate of László Moholy-Nagy





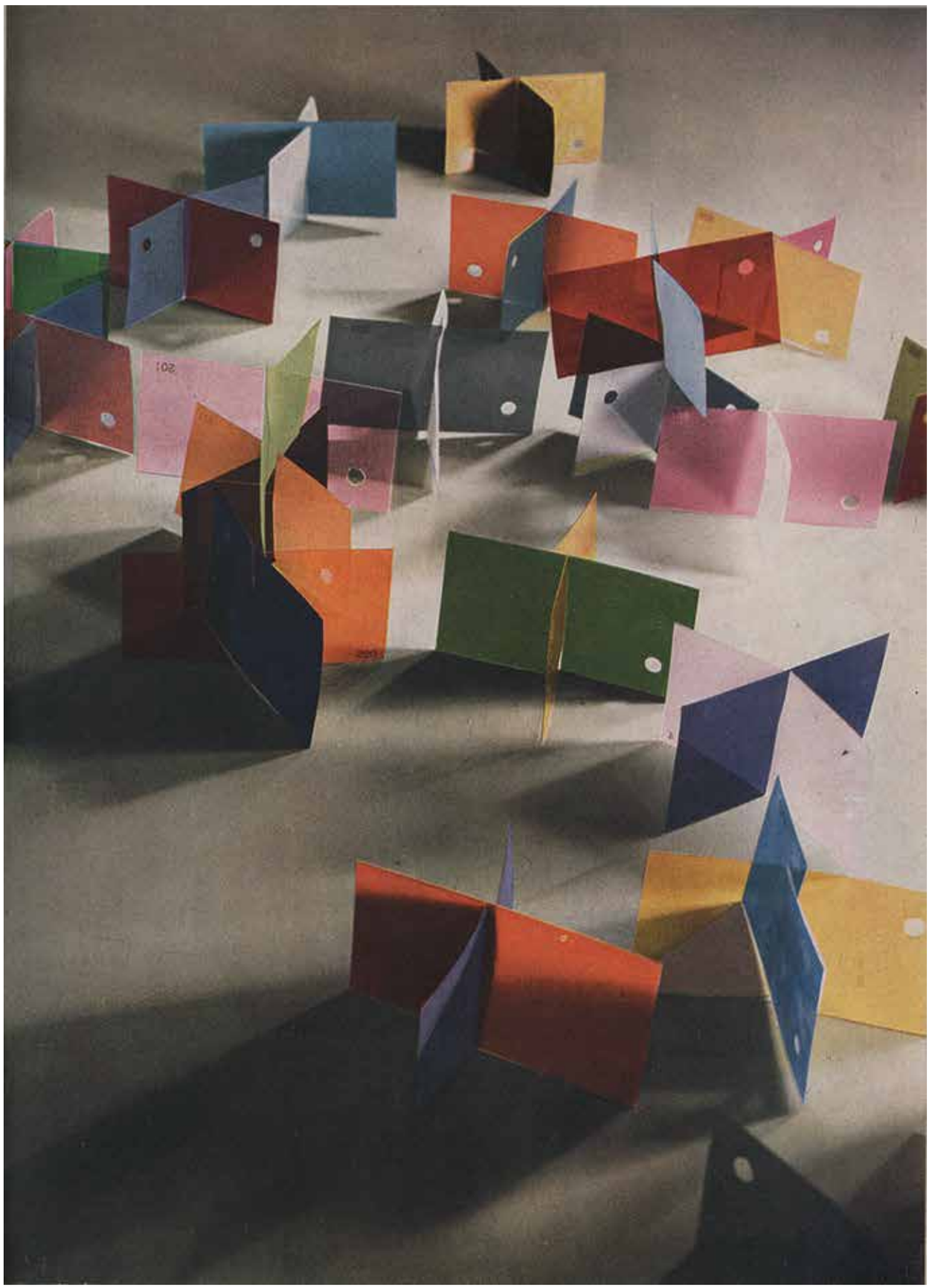


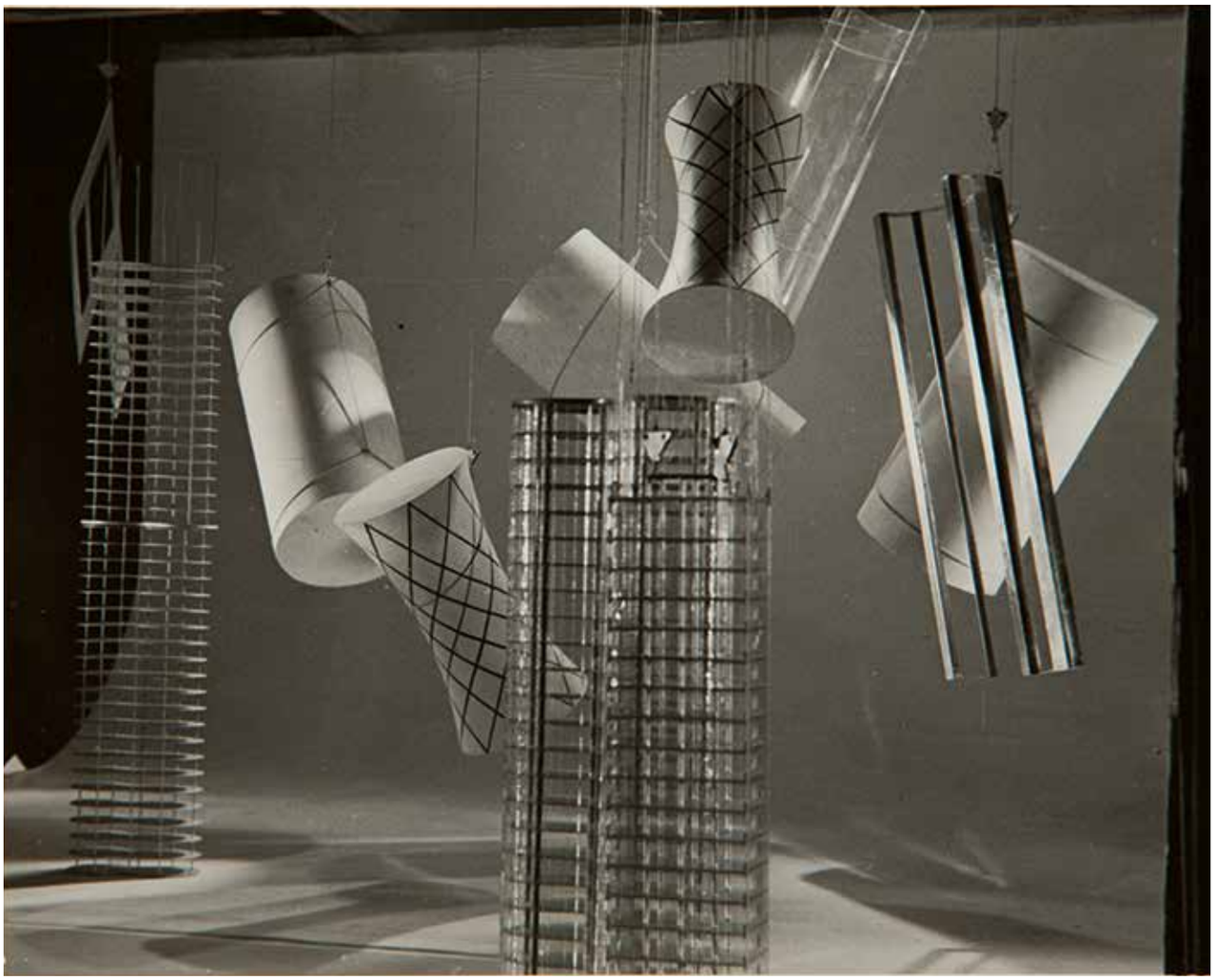


16 ***Z VII*** 1926, Oil on canvas, 37½ × 30 in., National Gallery of Art

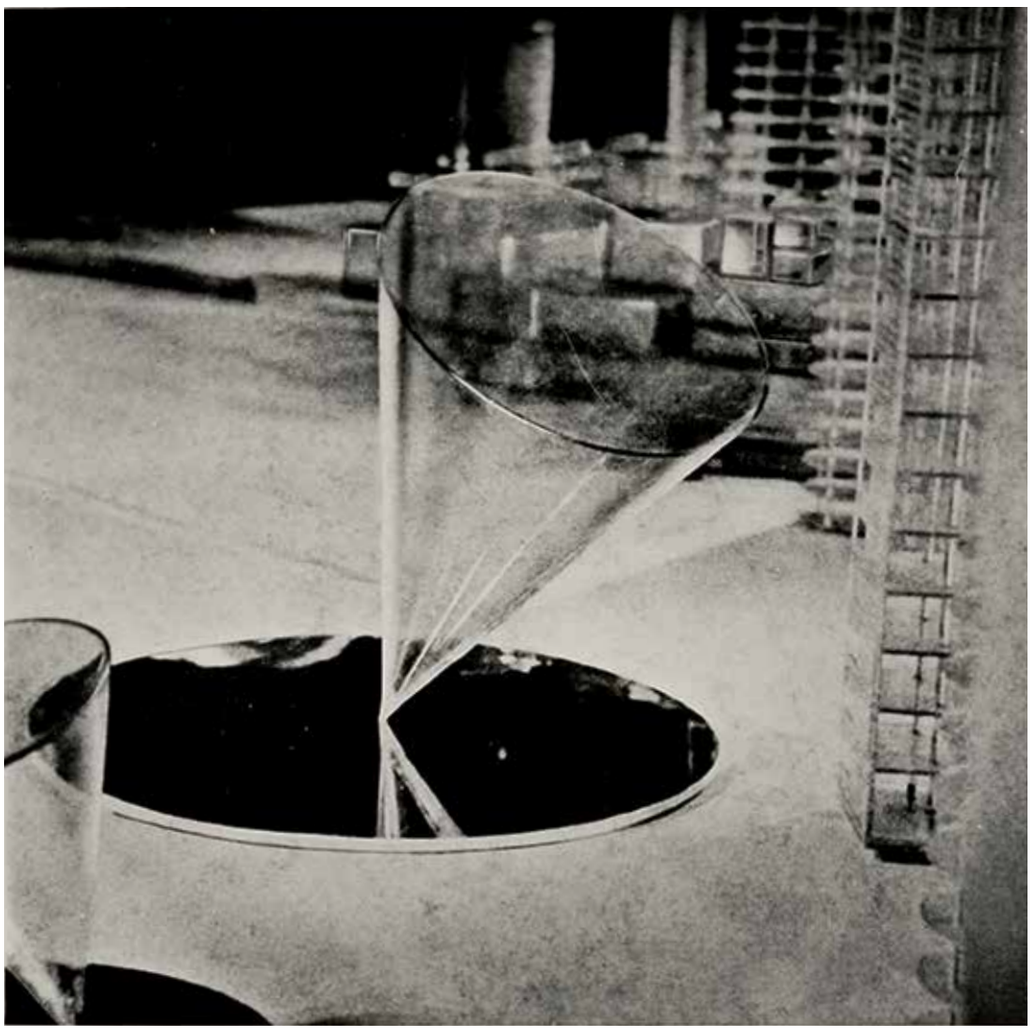
17 László Moholy-Nagy and František Kalivoda ***telehor*** issue 1–2 (1936), Color offset print, 11⅝ × 8¼ in., National Gallery of Art Library

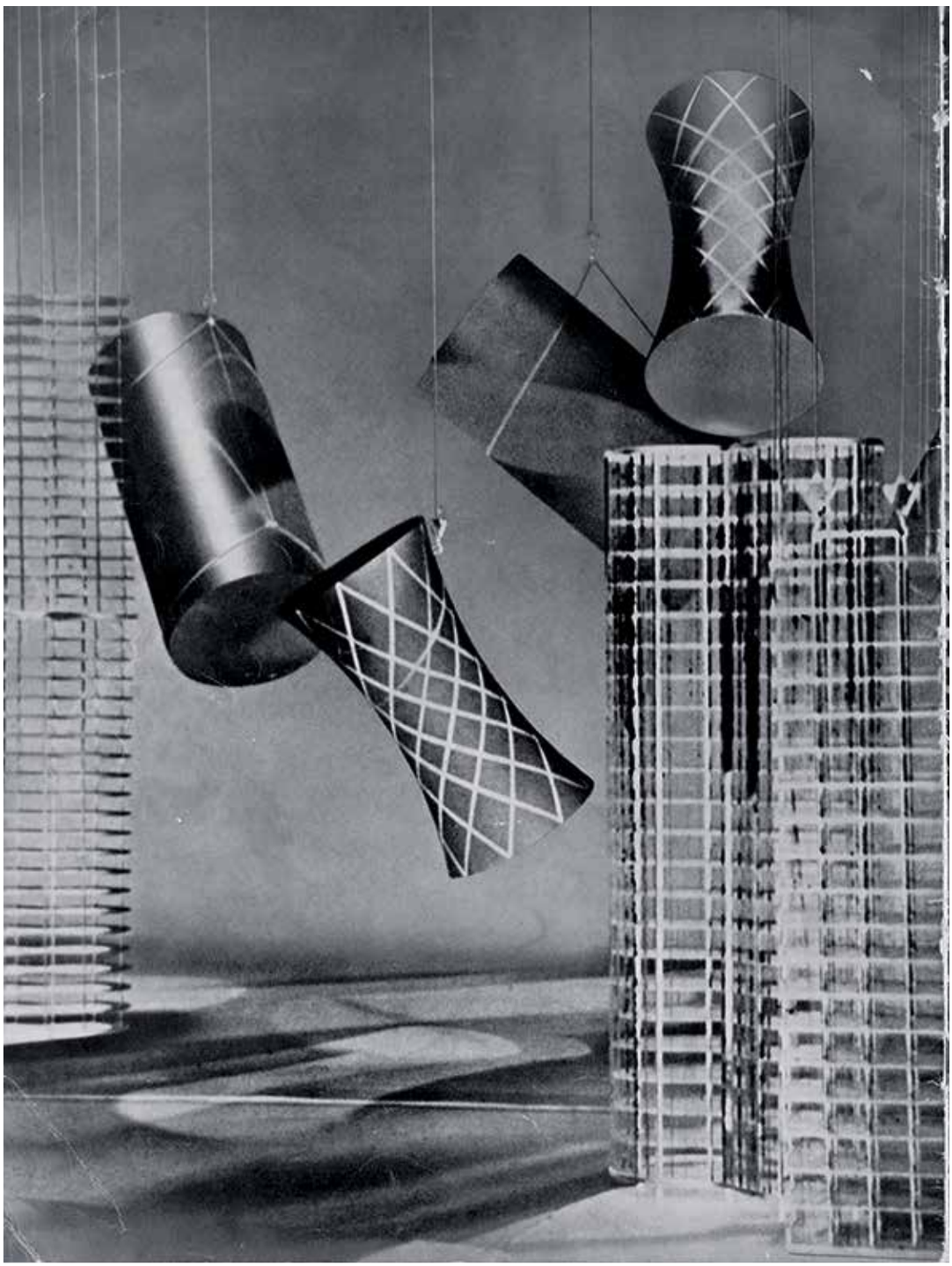
18 ***Dufay Color Photograph (Light Filtering)*** 1935, from *Vision in Motion*, 1st ed. (Chicago: Paul Theobald & Co, 1947), 11 × 8 in., Santa Barbara Museum of Art



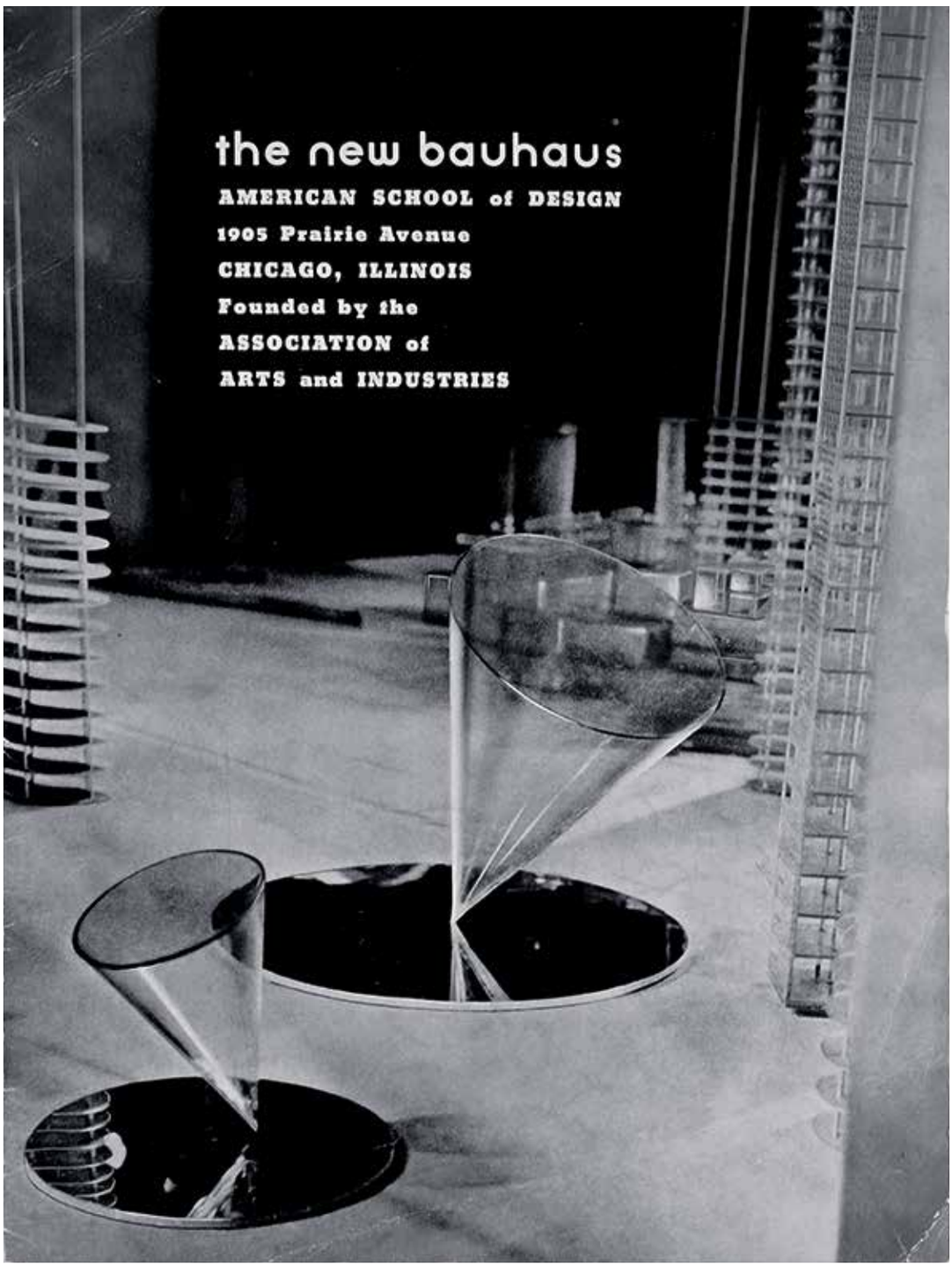


19 **Set designs for *Things to Come*** 1936, Gelatin silver prints, Estate of László Moholy-Nagy

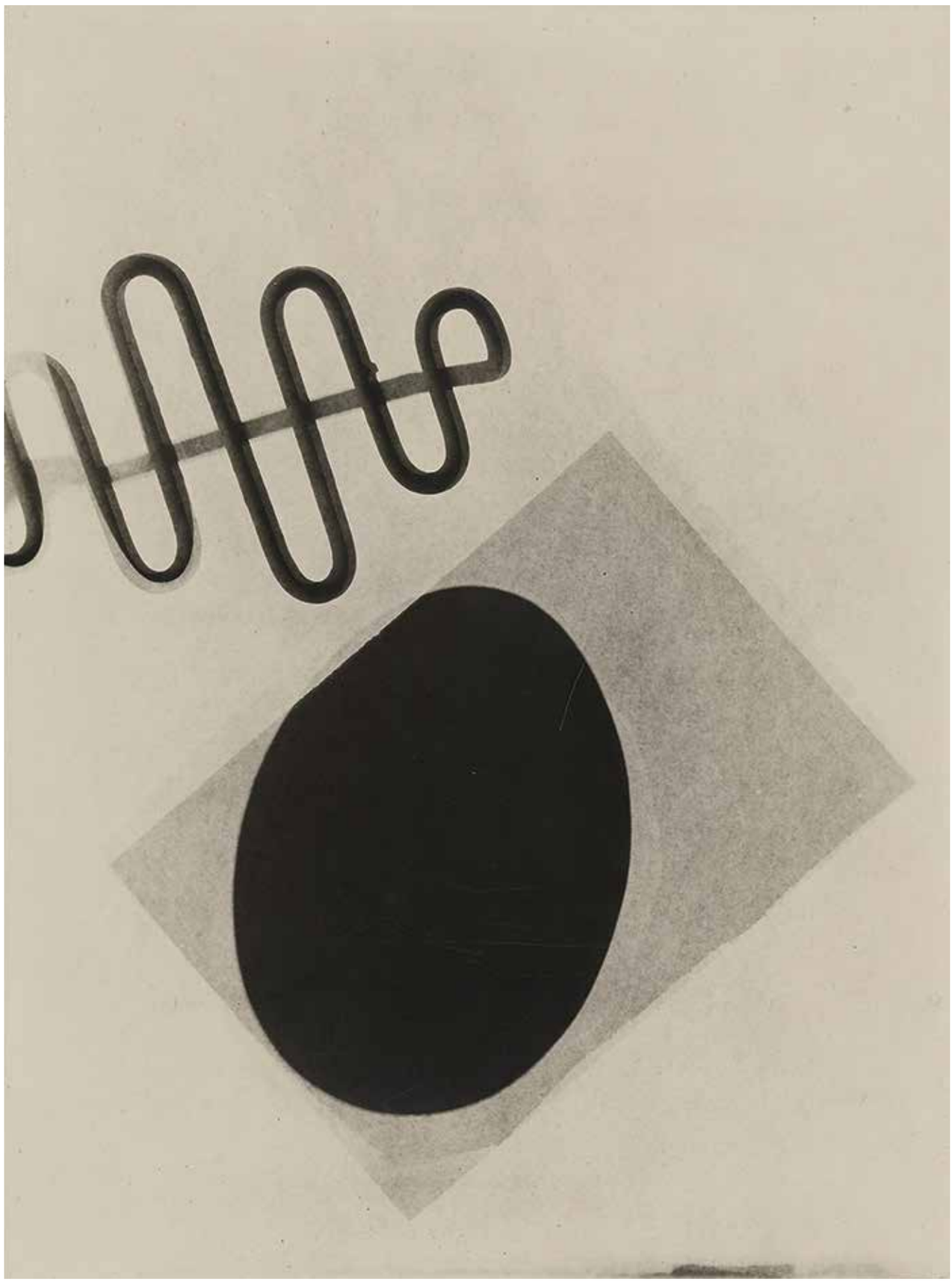




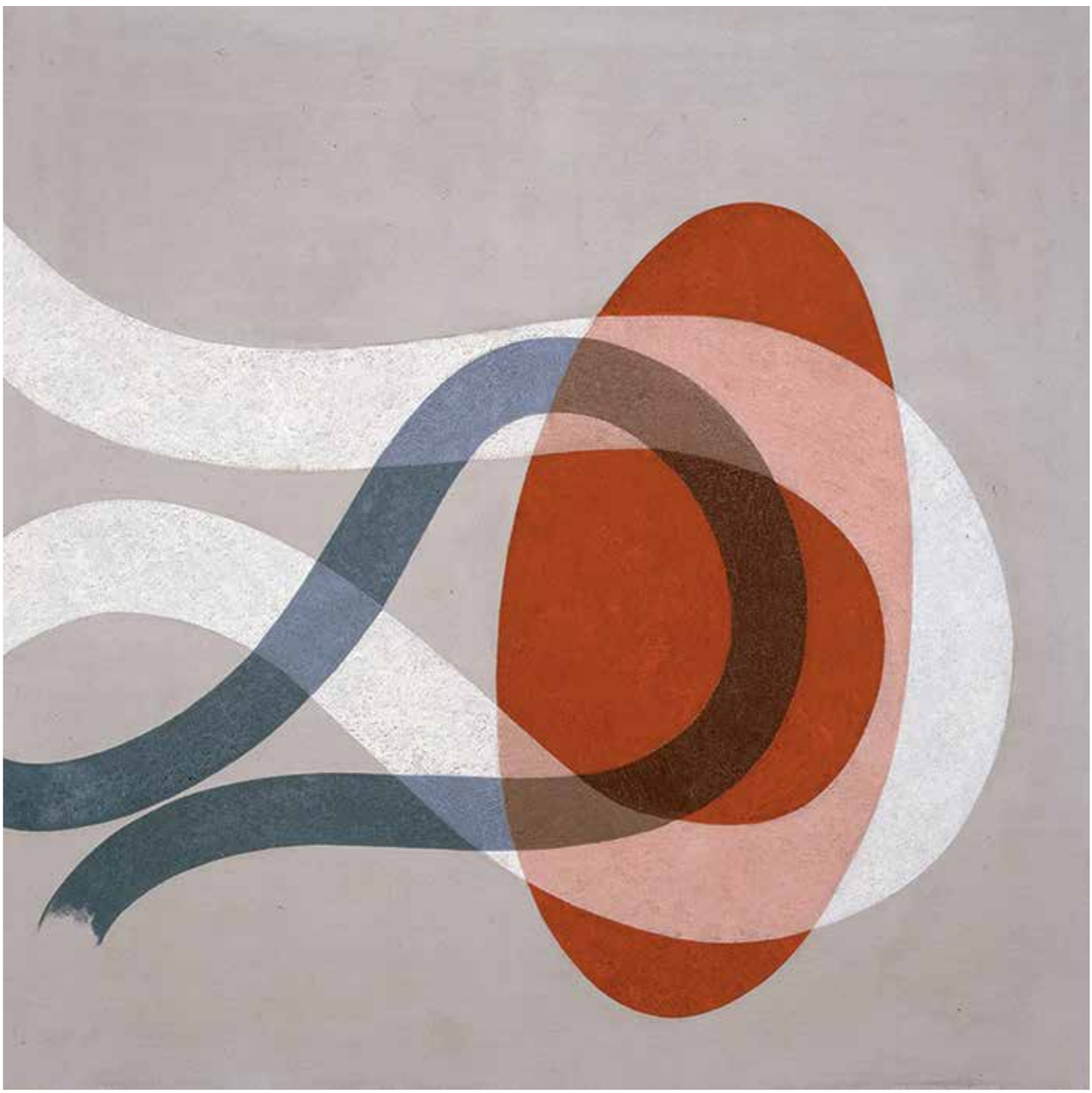
20 **Prospectus and application form for the New Bauhaus American School of Design, Chicago** [1937], National Gallery of Art Library



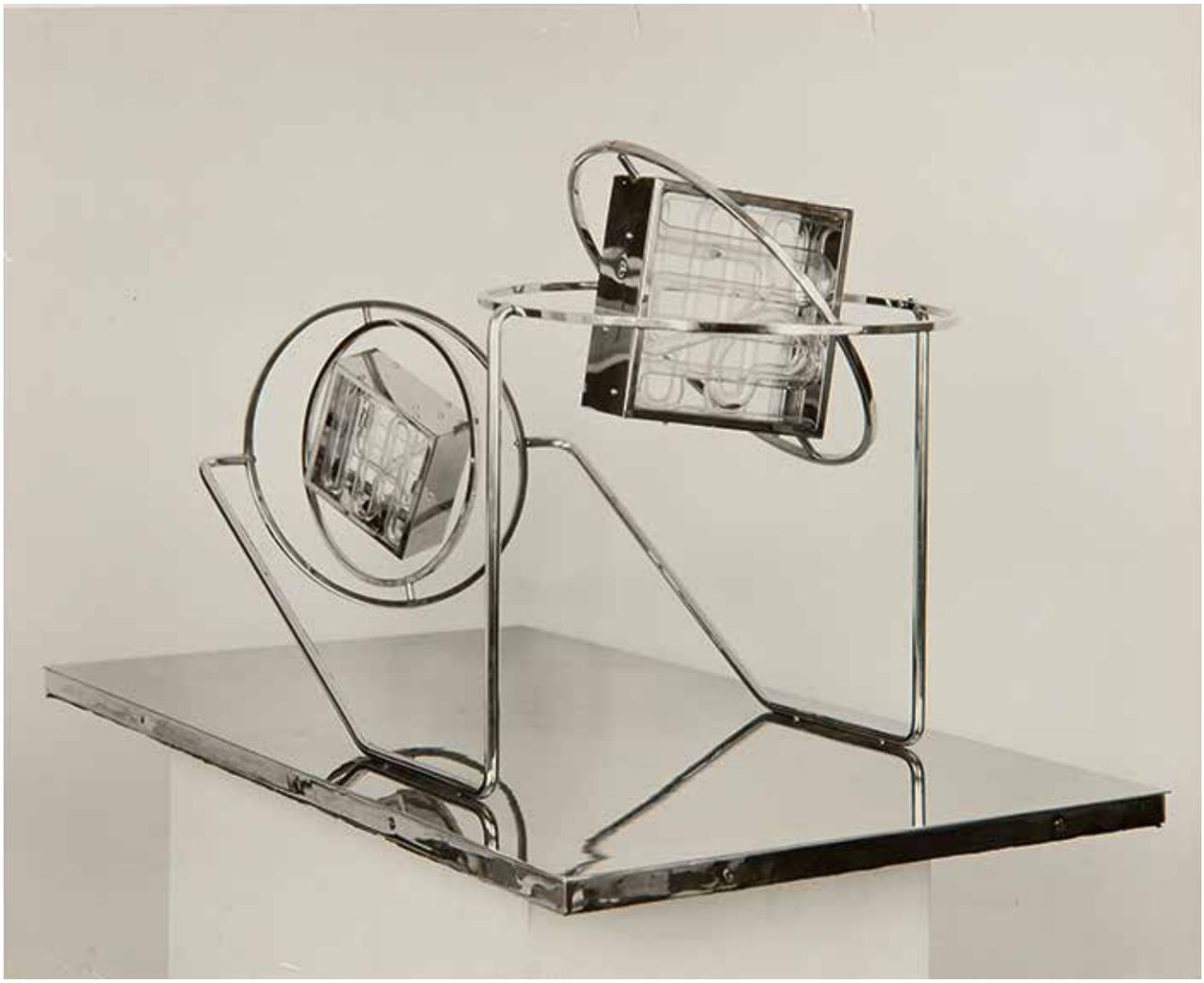
21 ***Photogram*** 1927, Gelatin silver print, 9 ¼ × 6 ³⁄₁₆ in., The J. Paul Getty Museum



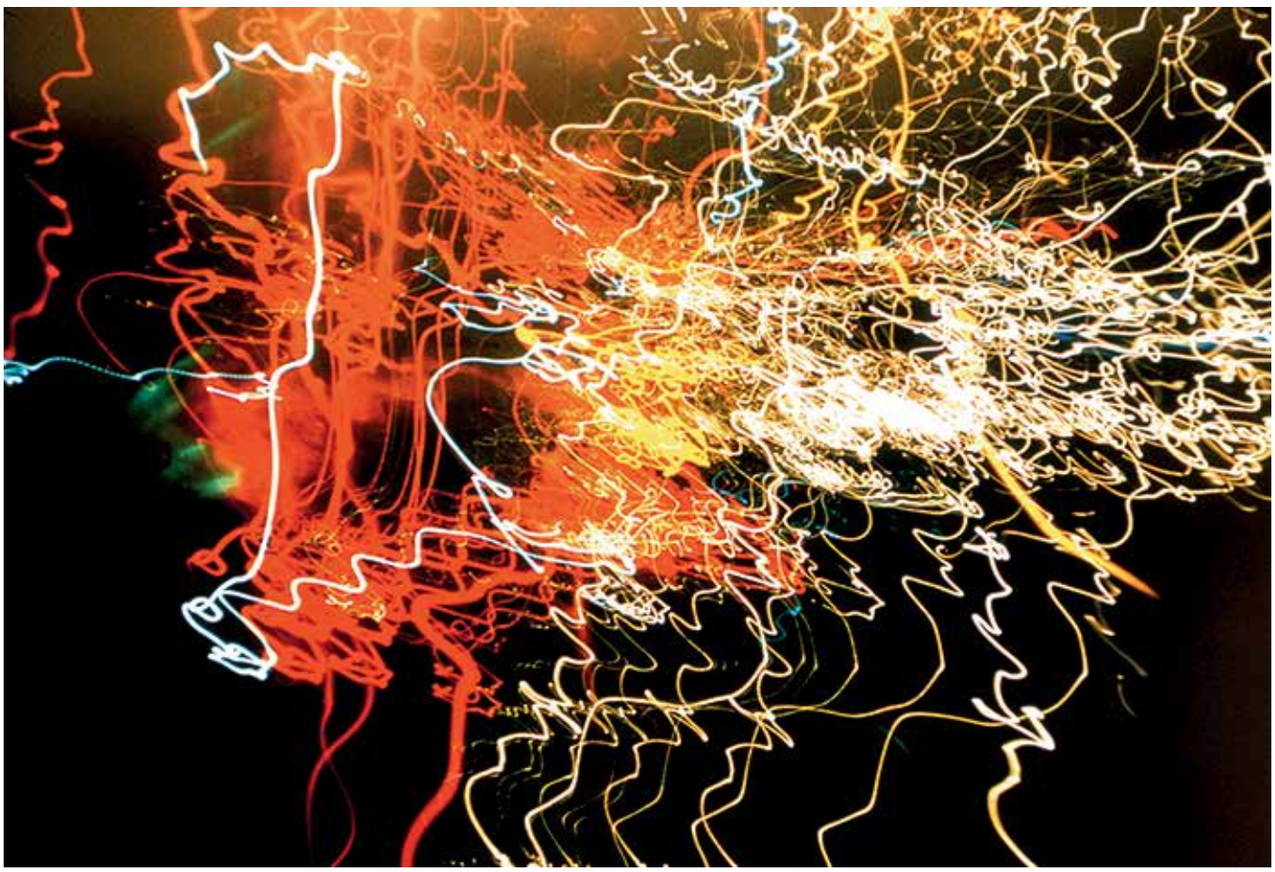
22 ***CH Space 6*** 1941, Oil on canvas, 46⅞ × 46⅞ in., Estate of László Moholy-Nagy



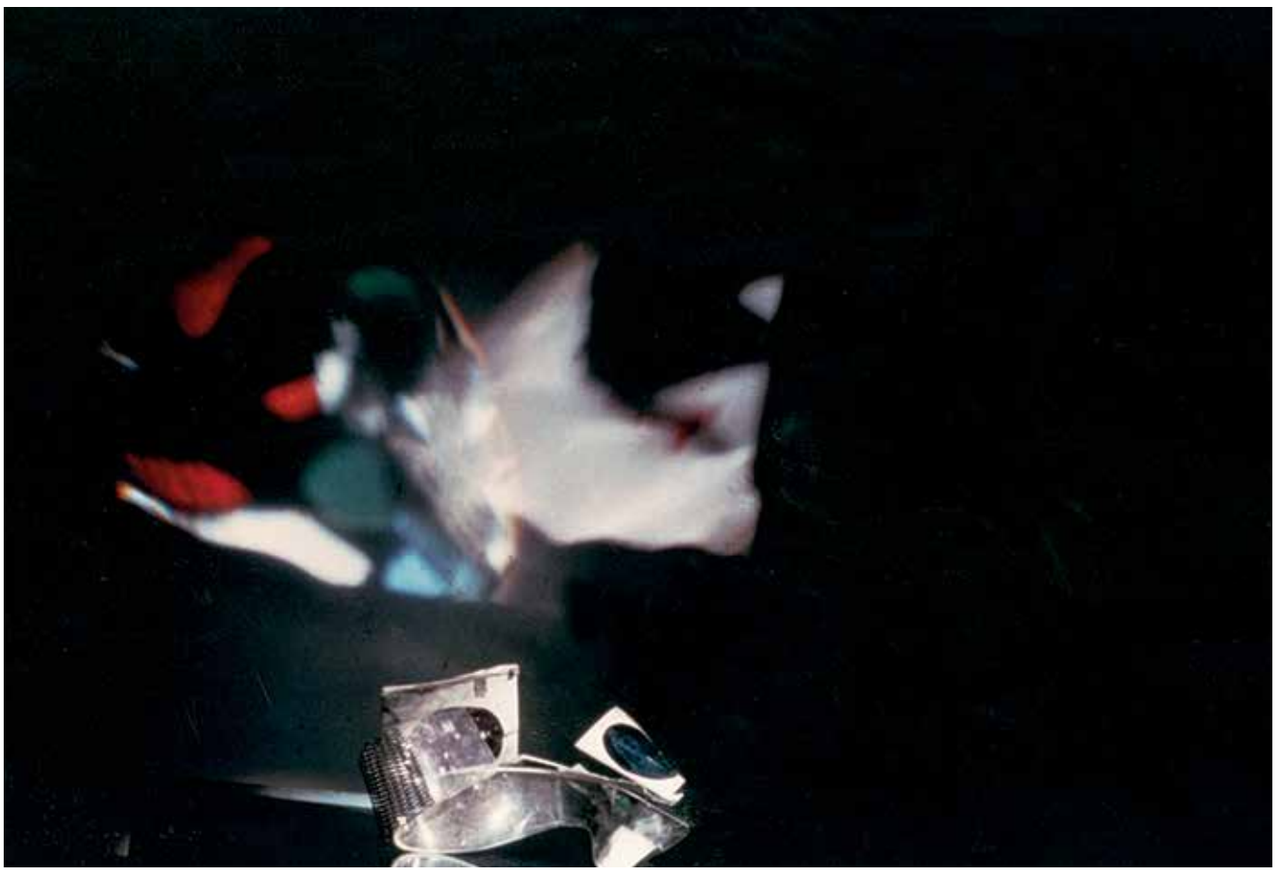
23 **"Gyros" Photograph Set** 1936, Gelatin silver print, 9½ × 11½ in., Estate of László Moholy-Nagy



24 ***CH XI (39)*** 1939, Oil on canvas, 18½ × 25⁵⁄₁₆ in., Mills College Art Museum



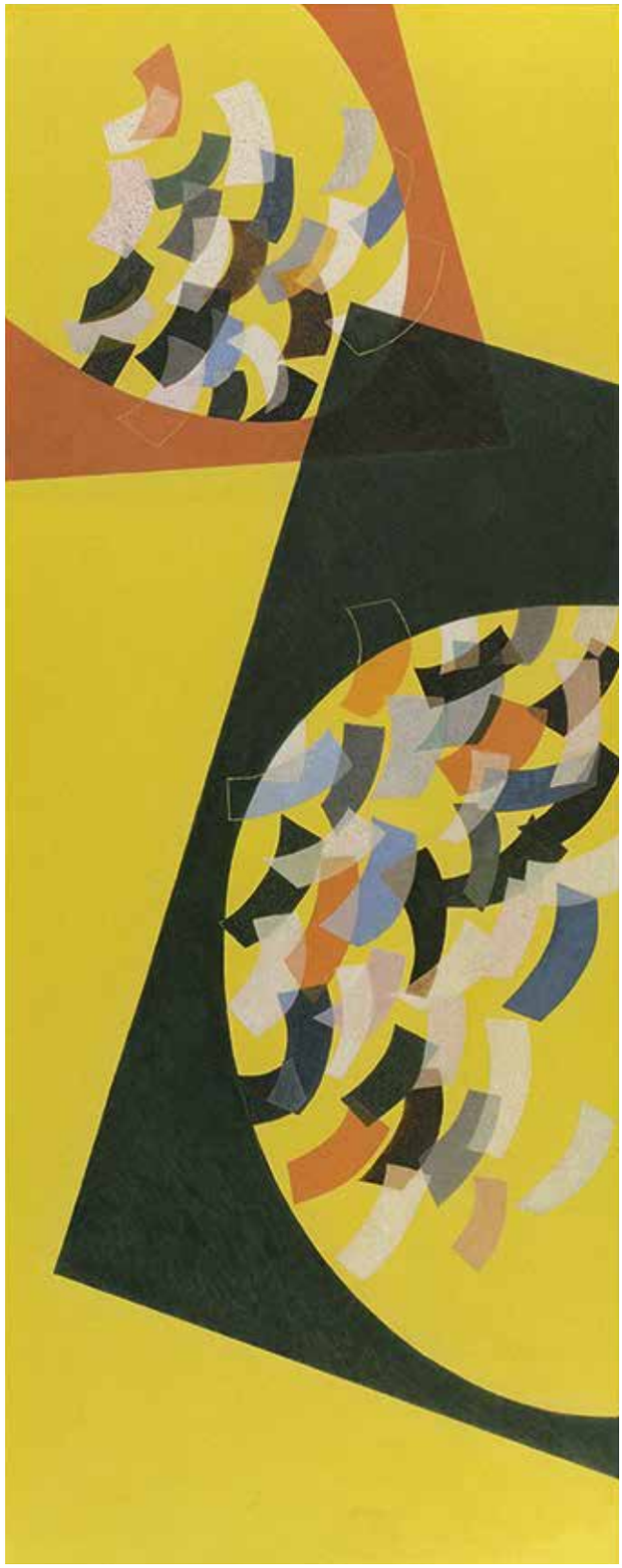
25a **[Auto headlights]** 1939–46, Kodachrome slide, Estate of László Moholy-Nagy



25b **[Light painting]** ca. 1942–44, Kodachrome slide, Estate of László Moholy-Nagy

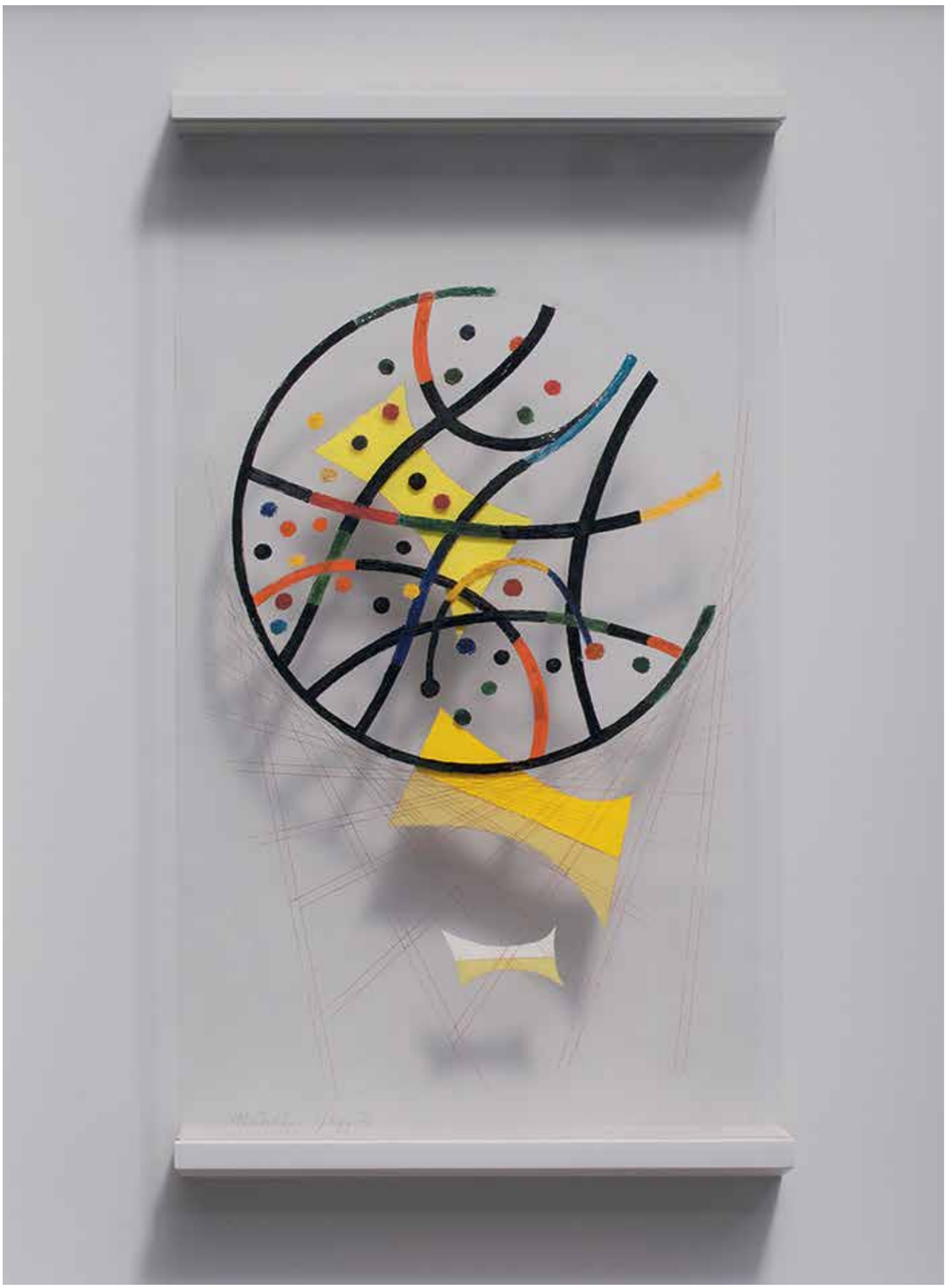
26 ***CH for R1 Space Modulator*** 1942, Oil on red Formica, 60⅝ × 23⅝ in., Estate of László Moholy-Nagy

27 ***CH For Y Space Modulator*** 1942, Oil on yellow Formica, 60⅝ × 23⅝ in., Estate of László Moholy-Nagy

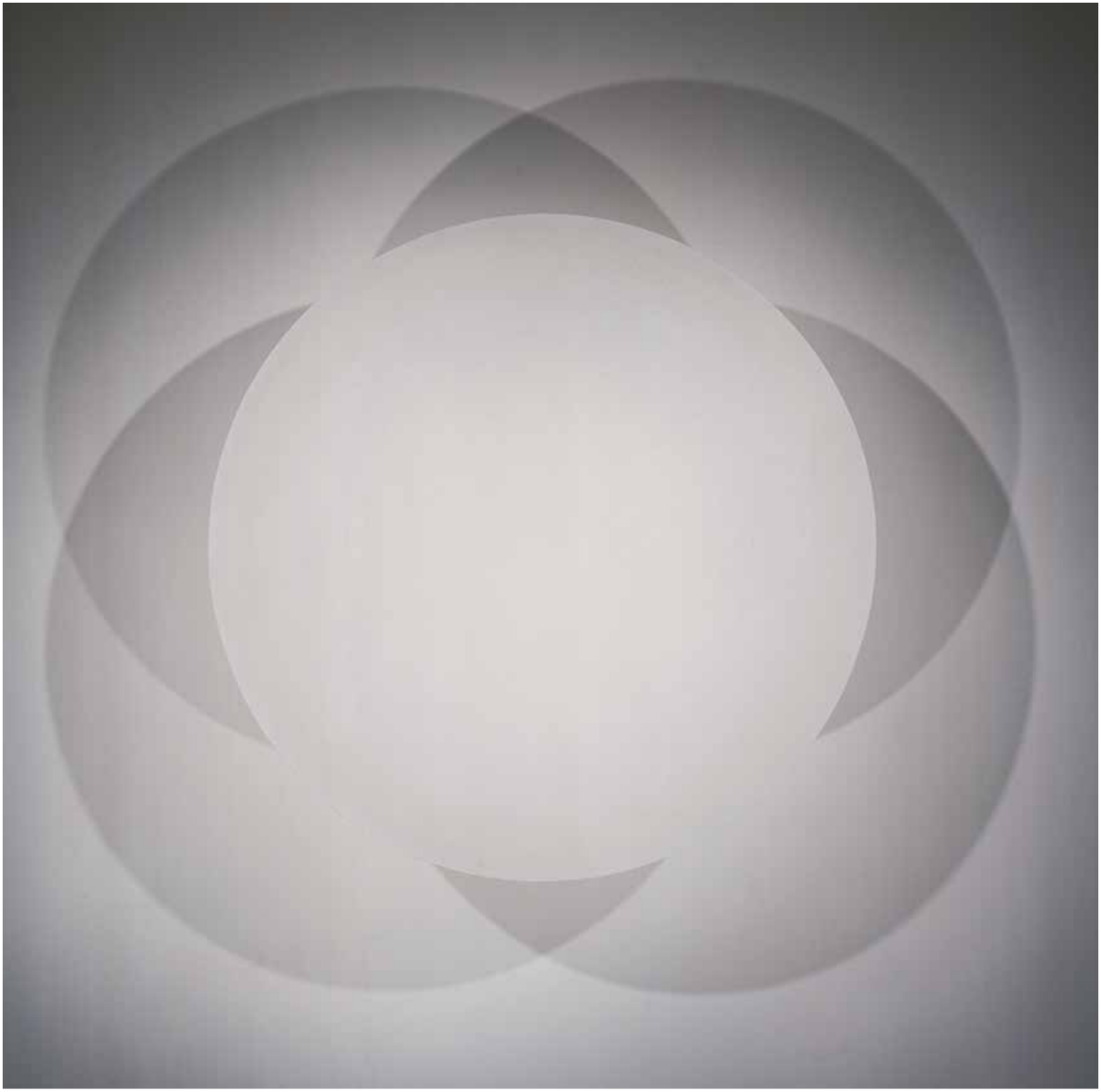


28 ***Leuk 5*** 1946, Oil and pencil on canvas, 30¼ × 38 in., Smithsonian American Art Museum

29 **Untitled (*Space Modulator*)** 1946, Oil on Plexiglas, 14½ × 8½ in., McMaster Museum of Art, McMaster University



30 Jan Tichy ***Things To Come*** 1936–2012, Three-channel digital video projection, Edition 2 of 5, Richard Gray Gallery



James Merle Thomas

THE HUMAN FACTOR: APPLIED ABSTRACTION AND HABITABLE SPACE

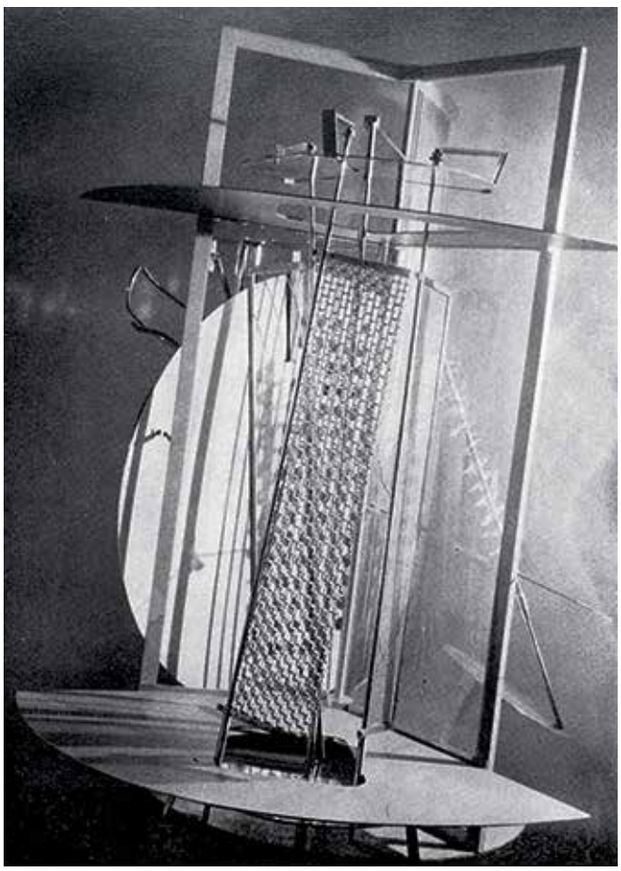
Opposite

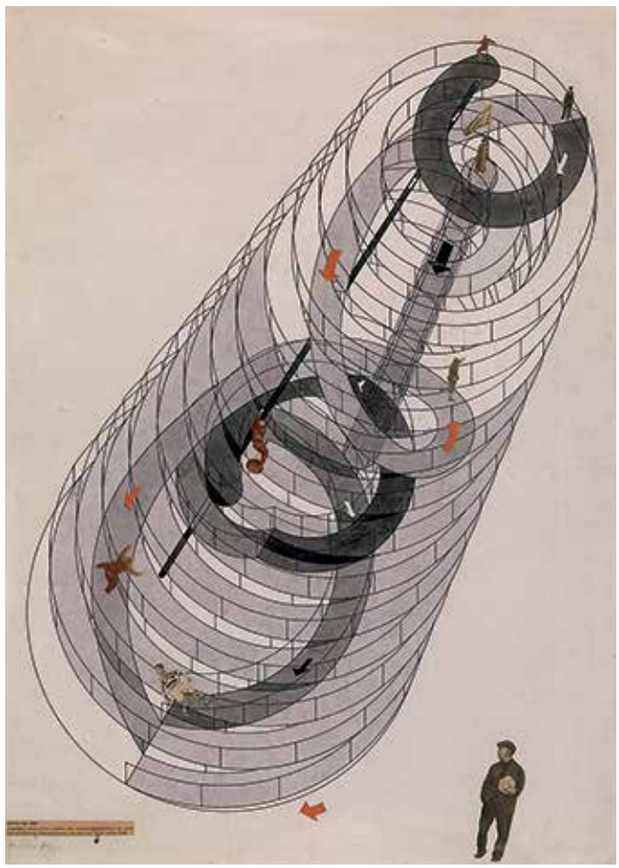
Robert Irwin (American, b. 1928), Untitled (detail), 1968. Synthetic polymer paint on aluminum and light, diam. 60⅜ in.

In 2007, the Departments of Photography and Media at the Museum of Modern Art in New York presented *Geometry of Motion 1920s/1970s*, a group exhibition examining how, in replacing the fixed object or "static image" with a series of experimental photographs, films, and dynamic sculptures, several artists from the 1920s (including El Lissitzky, László Moholy-Nagy, and Hans Richter) anticipated a number of postwar artists (among them, Robert Smithson, Anthony McCall, Gordon Matta-Clark, and Robert Irwin), whose artworks conjured a simultaneously architectural and cinematic sensibility at the dawn of the 1970s. Through its emphasis on the effects of projected light and the highly abstract, volumetric qualities of space such experimentation yielded, *Geometry of Motion* sought to link the "New Vision" of the 1920s with a postwar (and post-minimalist) fixation with perception and quasi-phenomenological awareness of one's surroundings. Amid these connections, the loosely implied resonance between a series of photographs and experimental films related to Moholy's 1930 *Light Prop for an Electric Stage* (fig. 1), and Robert Irwin's carefully illuminated, relief-like aluminum discs (opposite), which the artist produced between 1966 and 1968, merits further comparison. Separated by several decades and trained in different contexts, Moholy and Irwin seem only vaguely related to each other by way of a generalized set of common themes, all revolving around the notion of space (or "Light and Space"), and by aesthetic devices of somewhat understated technological means. Indeed, *Geometry of Motion*, like other exhibitions linking these two moments, attended to formal and technical affinities to establish a genealogical precedent between the two eras. However, I want to suggest that what bridges the two artists is their shared sense that an "applied abstraction" could respond to human needs, urgently felt in these two historical moments.[1]

While Irwin's art has been repeatedly misinterpreted as a set of formalist strategies preciously invested in purely aesthetic effects of light and space, this essay supplies a corrective: I suggest that a closer examination of Irwin's engagement at the dawn of the 1970s with the scientific discourse of "habitability" rehearses key aspects of Moholy's most politically ambitious claims for the "human factor" fostered by abstraction. Turning to Irwin's practice of the late 1960s and early 1970s — and reviewing how his discs were briefly repurposed and envisioned as devices intended (but never realized) for use in spacecraft during the height of the Apollo era — I propose Moholy's "human factor" as a more meaningful precedent for Irwin's practice: a radical re-envisioning of "space" as not merely pertaining to an abstracted world of rarified vision or the fullness of embodied experience, but rather, as a site of potential social and political contact.

1. Moholy-Nagy, "Molding the Plastics" in *The New Vision & Abstract of an Artist* (New York, 1947), 77. For more on Moholy's democratic and social descriptions of space, see Fred Turner, *The Democratic Surround: Multimedia and American Liberalism from World War II to the Psychedelic Sixties* (Chicago, 2013).





①

László Moholy-Nagy and František Kalivoda. *telehor*, issue 1–2 (1936): 81

②

László Moholy-Nagy, *Construction Scheme for Kinetic-Constructive System*, 1922. Photomontage, ink, watercolor on cardboard, 29 15/16 × 21 7/16 in. Theaterwissenschaftliche Sammlung, Universität zu Köln

In linking these two figures and their practices, I wish to suggest that more than merely echoing some of Moholy's calls for a newly critical way of seeing the world, Irwin's artwork — particularly as it evolved at the dawn of the 1970s from a set of object-based sculptural strategies into a more architecturally oriented engagement with physical and institutional "environments" — might be most productively regarded through the historical lens of first, Moholy's calls for a socially inflected, democratic sense of lived, or *habitable* space; and second, through Irwin's encountering of the scientific language of "habitability," an interdisciplinary term used during the 1960s and 1970s to describe both qualitative and quantitative dimensions of dwelling in various spaces, including the upper atmosphere and outer space. By more closely reviewing Moholy's and Irwin's approaches to the abstraction of different kinds of spaces, this essay

considers the relationships between modernist abstraction, industrial design, and ultimately, the metaphors of aviation, flight, and outer space that have often functioned as a thematic correlate (and, at times, a catalyzing professional context) in both artists' careers.

Design for Living: Moholy-Nagy and Habitable Space

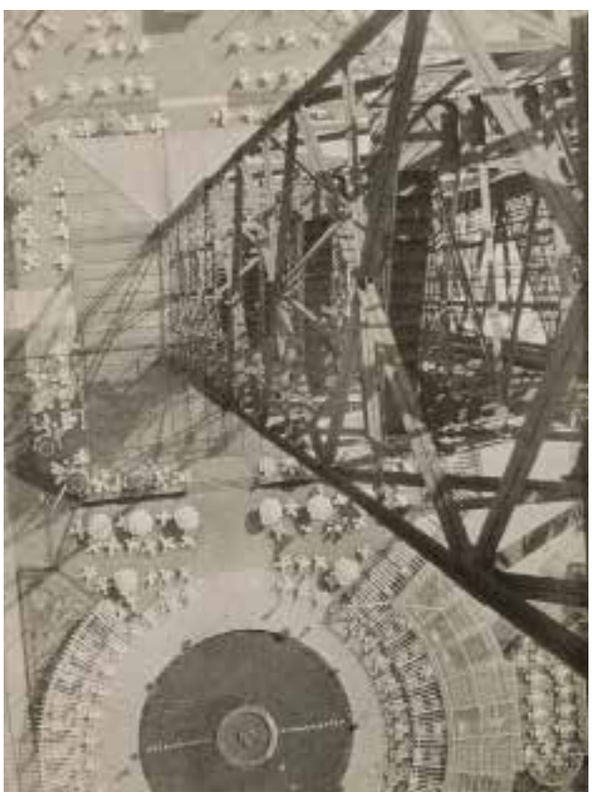
Writing in the 1920s, Moholy drew from philosopher Rudolf Carnap's distinctions between actual and perceived space, and charted a diverse set of categories (physical, mathematical, architectural, pictorial, dimensional, abstract, formal, inner, outer), arriving at his own understanding of the spatial as pertaining to what the artist termed "the human factor," that is, the central and abiding importance of envisioning and creating lived or otherwise *habitable* space. Amid the proliferating array of different kinds of spaces that Carnap's model implied, Moholy's own understanding strikes a slightly democratic (or at very least, social) tone: "We know that space is a reality of sensory experience . . . space experience is not a privilege of gifted architects, but is a biological function of everyone."[2]

Illustrated in early works such as his 1922 photographic collage *Construction Scheme for Kinetic-Constructive System* (fig. 2), Moholy's conception of habitable space unfolded at the porous boundary between sculpture and architecture, and emphasized the experience of the modern subject: a condition bound up in a nexus of aesthetic, social, technological, and even hygienic issues. Organized by two spiraling pathways unfurling at differing tensions, Moholy's tower featured ramps for strolling visitors, included elevators and movable sliding poles for rapid ascent and descent, and was populated by athletes and pedestrians — a coherent, self-contained system for recreation and leisure. A striking composition suggesting both the compressed potential of two screws torqued upon themselves, and the kinetic energy of its inhabitants as they moved throughout its sweeping heights, Moholy's *Kinetic-Constructive System* bears the proximal influence of Vladimir Tatlin's (1885–1956) sketches and models for the *Monument to the Third International* (1919–20), as well as the Eiffel Tower. (The artist reproduced an image of his own model alongside a dizzying perspectival view of the iconic tower as shot from below in *The New Vision*, describing the nineteenth-century predecessor as "a volume creation" existing at "the border line between architecture and sculpture.") Employing oblique perspectives made possible by newly accessible heights (such as his 1928 *Radio Tower Berlin*) (fig. 3), Moholy envisioned systemic, habitable space at the

2. Moholy-Nagy, *The New Vision* (2nd English ed.), 56–62. With regard to the biological connotations that this statement anticipates, Hadas Steiner has described Moholy's brief residence in England between 1935 and 1937 as a period of deep investment in ecological and early cybernetic themes, and as reinforcing a general understanding of the artist's advocacy of biological life in the face of a more static or monolithic architectural style. See Hadas A. Steiner, "The Image of Change," in *Beyond Archigram: The Structure of Circulation* (London and New York, 2008), esp. 18–20.

③

László Moholy-Nagy, *Radio Tower Berlin* 1928. Gelatin silver print, image: 15⅛ × 11¼ in. National Gallery of Art, Washington, D.C., Patrons' Permanent Fund (2007.31.1)



cusp of sculpture, architecture, and urban design by navigating what might best be understood as the *abstraction of space*, a concept that simultaneously encompasses, on one hand, a sense of artistic or "designed" abstract composition, and on the other, a representational logic drawing upon (or even conjuring) a more scientific or "cosmic" sense of outer space as found in the artist's formal abstract paintings.

Regarding this first impulse, we might consider the artist's enthusiasm for flight and the new vistas such heights afforded as intimately related to the passion shared by Kazimir Malevich (1878–1935) and other avant-garde artists who drew explicit parallels between early aviation and the boundless expanse of abstracted sky, a seemingly limitless volume. In this sense, Malevich's inclusion of photographs of military aircraft (and the aerial photographs these planes in turn made possible) in his 1926 book, *The Non-Objective World,* resonates with Moholy's fascination with newly available perspectives: flight, which offered a "more complete space experience."[3]

While these collages and experimental photographs suggest that such aerial perspectives led Moholy to develop new artistic strategies that reconfigured conventional understanding of pictorial space, his oil and aluminum paintings from roughly the same period obliquely acknowledged the unbounded nature of the upper atmosphere and outer space. In this way, Moholy's more formally abstract compositions, such as *AL 3, 1926* (pl. 12) which through the juxtaposition of two colored discs against two diagonal bars suggests a set of ringed planets in orbit — rehearse a "cosmic sensibility" shared by Suprematist painters Ivan Kliun (1873–1943) and Ivan Kudriashev (1896–1972), whose artworks from the same years explicitly referenced interstellar structures and atmospheric events, conjuring parallels between form, shape, and color of a planetary order, and their counterparts in radical painterly abstraction; in other words, between modernist abstraction and the seemingly abstract nature of outer space.[4]

3. Recent scholarship on Moholy has thoughtfully linked the artist's interests in aviation and perspective to his production of photograms and the creation of forms from the manipulation of "pure light." As Herbert Molderings observes of Moholy's innovative use of light-sensitive emulsions, no other medium brought the artist closer to "visualizing the idea of immeasurable, boundless space . . . an infinite spatial continuum created by the finite and controlled expansion of pure light." Herbert Molderings, "Revaluating the Way We See Things," in Ingid Pfeiffer and Max Hollein, eds., *Retrospective László Moholy-Nagy,* exh. cat., Frankfurt: Schirn Kunsthalle (Munich and New York, 2009), 41.

4. Kudriashev, who studied under Malevich, was particularly well versed both in theoretical texts that discussed astronomy and proposed travel into outer space, and in early Russian science-fictional accounts of space travel. See Scott W. Palmer, "Red Stars and Rocket Ships: Space Flight and the Cosmos in Early Soviet Culture," in John Zukowsky, ed., *2001: Building for Space Travel* (New York and Chicago, 2001), 39–44; and Charlotte Douglas, "Energetic Abstraction: Ostwald, Bodganov, and Russian Post-Revolutionary Art," in Bruce Clarke and Linda Dalrymple Henderson, eds., *From Energy to Information: Representation in Science and Technology, Art, and Literature* (Stanford, 2002), 76–94.

5. Hal Foster has described Moholy's work after his arrival in the United States as endorsing a connection between modernist abstraction and commercial design. See "The Bauhaus Idea in America," in Achim Borchardt-Hume, ed., *Albers and Moholy-Nagy: From the Bauhaus to the New World* (New Haven and London, 2006).

6. See Robin Schuldenfrei, "Assimilating Unease: Moholy-Nagy and the Wartime/Postwar Bauhaus in Chicago," in Robin Schuldenfrei, ed., *Atomic Dwelling: Anxiety, Domesticity,*

Upon emigrating from Germany and reconfiguring his "New Vision" for an American audience in the late 1930s, Moholy further developed his understanding of space while attempting to meaningfully transpose the study of abstract form onto a set of tangible applications.[5] Emphasizing the integration of fine arts with the increasingly modular and high-output requirements of mid-century industrial reproduction, Moholy updated the holistic craftsmanship of the German Bauhaus with a pragmatic approach to both pedagogy and design, firmly grounding the curriculum of the Chicago School of Design in principles of utilitarianism, broad societal relevance, and above all, what he saw as the growing need for artists and designers to support the U.S. response to the growing crisis in Europe. By the first months of 1942, as the United States entered the Second World War, classes at the School of Design were increasingly tailored toward the development of practical military applications. Through a variety of courses, students were encouraged to use non-rationed materials such as plywood, acrylic plastics, and rubberized fabric to produce designs and mockups of items such as helmets, portable runways, parachute clothing, and infrared food ovens. In addition to these design workshops and a series of applied classes in illustration, projection drawing, photography, photomontage, drafting, and architectural concepts, the school was among the first in the nation to offer a comprehensive course in military and civilian camouflage design, which included studies in artificial lighting, experimental projection techniques, and other technologies intended to heighten (or conversely, frustrate) the accurate perception of targets.[6]

An extension of his inquiry into the relationships between perception, technology, and the built environment, Moholy's self-proclaimed "war efforts" rested at the nexus of psychology, industrial and interior design, architecture, hygiene, and even urban planning. While his interest in these fields (and his attempts to transpose these themes onto military and industrial applications) in many ways anticipated the postwar development of a systematic field of "human factors" research, more on which below, equally important was the central role that Moholy envisioned designers and artists would play in shaping a more habitable world *after* the war. "A properly trained designer will find solutions," the artist-educator wrote, "not alone for problems arising in daily routine, or for development of better ways of production, but also for all problems of living and working together. There is design in family life, in labor relations, in city planning, and living together as civilized human beings. Ultimately, all problems of design fuse into one great problem of 'design for living.'"[7] Such sentiments are in fact present throughout Moholy's writings and artworks: just as his early collages, abstract

and Postwar Architecture (Oxford and New York, 2012), 87–126, esp. 100–108. For more on Moholy's revision of his earlier Bauhaus pedagogical model, see Alain Findeli, "Moholy-Nagy's Design Pedagogy in Chicago (1937–46), *Design Issues* 7, no. 1 (Autumn 1990): 4–19. Upon closer examination of the war design curriculum, one may in fact trace a striking correspondence between Moholy's efforts in training a corps of young artists in the arts of visual concealment and camouflage (to be coordinated with various federal and local civil defense agencies) and the practical concerns that dominated military aviation during the same period. The School of Design's camouflage course — which was taught by Gyorgy Kepes, who was trained in camouflage by the U.S. Army Engineer School in Fort Belvoir, Virginia, in 1942 — not only included foundations in methods of concealment, but also introduced students to strategies of aerial bombardment. While this pedagogical approach was developed ostensibly to better acquaint students with the most current military tactics they hoped to combat, the use of films and aerial photography corresponds closely to its corollary: namely, the use of film, photography, and the conditioning of perception to train pilots in the acquisition of targets. See accounts of perceptual psychologist James J. Gibson's descriptions of using film and photography to train pilots, and his subsequent description of perception as "ecological," i.e., linked to its environment, and deriving sensate clues in a dynamic fashion from surrounding forms, in James Gibson, *Motion Picture Testing and Research*, Army Air Forces Aviation Psychology Program Research Reports (1947), and his subsequent work, e.g., *The Senses Considered as Perceptual Systems* (Boston, 1966).

7. Moholy-Nagy, "Relating the Parts to the Whole." *Millar's Chicago Letter* 2, no. 23 (August 5, 1940): 6–7.

paintings, experimental photography, and kinetic light sculptures of the 1920s signaled the possibility of dwelling within another spatial order (or at the very least prompted a rethinking of one's current perspective), his convictions pertaining to the biological, or "human" nature of dwelling within modern urban space motivated his long-standing involvement with CIAM (Congrès Internationaux d'Architecture Moderne), a commitment that led the artist to produce a short film which served as the official documentation of the CIAM 4 Congress, held aboard a ship en route from Marseilles to Athens in 1933; by 1945, while developing the wartime curriculum at the Chicago School of Design, Moholy played an active and central role in various planning committees in the American chapter of CIAM, using the organization as a platform to promote the rebuilding of Europe.[8]

Robert Irwin and Environment

Much as Moholy began in the late 1920s to work with new materials such as plastic, and to more directly manipulate light and space (as opposed to merely translating their interactions through painting) by way of devices such as his *Light Prop for an Electric Stage,* Robert Irwin (b. 1928) also grew dissatisfied with what he perceived as the structural and perspectival limitations of the modernist canvas to fully depict the complexity of perceived space. After gaining success as a painter of large-scale monochromatic canvases in the early 1960s, Irwin diverged from Clement Greenberg's model of modernist painting, going so far as to write to the critic directly, asking that he not include his paintings in any upcoming exhibitions.[9] Irwin's earlier experimentation with late Abstract Expressionism and Color Field painting was replaced by his increasing interest in light, space, architecture, and more generally, an attention to the wide-ranging "environmental" factors that structured the relationship between the viewing subject and the artistic object.

Handcrafted on a manually operated drop-hammer press normally used to make metal signs and automobile parts, Irwin's first discs were made of thinly stamped aluminum and shaped into a circular form measuring sixty inches in diameter. The resulting convex disc, attached to a small bracket and mounted on a neutrally painted wall, protrudes from the support structure of the wall at a distance of more than a foot, a distance further dramatized by the careful installation of a series of focused spotlights, which illuminate the disc from four discrete points, casting a series of shadows on the surrounding walls that seem as material as the disc itself (fig. 4).

8. For more on Moholy's involvement with CIAM, see Eric Mumford, *The CIAM Discourse on Urbanism, 1928–1960* (Cambridge, Mass, 2000), 77–80, 147–50; and Moholy-Nagy, *Vision in Motion* (Chicago, 1947), 256–58.

9. After learning that Greenberg intended to include his paintings in *Post-Painterly Abstraction*, a group exhibition that was to open in 1964 at the Los Angeles Country Museum of Art, Irwin wrote a personal letter to the critic, politely declining the invitation, citing "differences of opinion that demand I stay outside of your classification." Robert Irwin to Clement Greenberg, April 2, 1964, Clement Greenberg Papers, Archives of American Art, Smithsonian Institution, Washington, D.C.

④
Robert Irwin, Untitled, 1969. Acrylic lacquer on formed acrylic plastic, diam. 53 in.

Appearing in a series of exhibitions in New York and Los Angeles (and on the cover of *Artforum*) in spring of 1968, Irwin's discs invariably prompted lush, almost poetic reveries of halation and the discussion of an "atmospheric" color that exceeded the properties of the aluminum disc itself.[10] Yet while these qualities hinted at concerns about the painted surface or the deductive nature of painting as understood in relation to the frame of the canvas, Irwin's own statements about these works ("How do I paint a painting that does not begin and end at an edge, but rather, starts to take in and become involved with the space or environment around it?")[11] emphatically positioned the discs beyond the limits of modernist painting, and instead closer to a series of minimalist debates concerning the space around objects, a liminal envelope comprising the internal and adjacent spaces of the work of art, and the relationship between the viewer and the object — and, significantly, raised questions about whether the ideal viewer of these objects was conceived as a static, idealized audience, or rather as an active, embodied subject moving through space and time.

After creating a second series of discs using molded, semi-transparent plastic (and painting a single horizontal band across their acrylic surfaces, a device further signaling the continuity between the artwork and its surrounding environment), Irwin dramatically reduced the visual palette of his artworks until they almost disappeared from view. Describing layers of visual and linguistic abstraction, the artist began producing a series of temporary, often fugitive, room-based installations, at times simply realized via whitewashing walls and the cleaning of windows or fixtures. Consisting of subtle manipulations of existing skylights or fluorescent lighting, and the occasional use of semi-opaque theatrical scrims, Irwin realized these spaces surreptitiously in his studio, museums, and other public institutions, and until his 1977 retrospective at the Whitney Museum of American Art, often allowed them to remain unadvertised or undesignated as his own creations.[12] As Irwin has noted of this decade-long period in his practice, these last sculptural objects and rooms were an even more emphatic turn toward the qualities of space itself,

10. In 1968, Irwin's discs were shown simultaneously in New York at both a one-man exhibition at the Pace Gallery (15 March–11 April), and as part of a three-man exhibition (with Gene Davis and Richard Smith) at the Jewish Museum (March 20–May 12). For a number of primary accounts of these exhibitions, see Emily Wasserman, "Robert Irwin, Gene Davis, Richard Smith" *Artforum* 6, no. 9 (May 1968): 47–49; Rosalind Krauss, *Artforum* 8, no. 4 (December 1969): 70; John Perrault, "Out of the Doldrums," *Village Voice*, 28 March 1968, 18–20; and Corinne Robins, "The Circle in Orbit" *Art in America*, November/December 1968, 62–65.

11. Quoted in Lawrence Weschler, *Seeing Is Forgetting the Name of the Thing One Sees* (Berkeley and Los Angeles, 2004), 102.

12. Most notable among these is *Fractured–Light Partial Scrim Ceiling — Eye-Level Wire*, which Irwin produced at the request of curator Jennifer Licht and installed furtively on the third floor of the Museum of Modern Art in New York from October 1970 until mid-February 1971. See Michael Auping, "Stealth Architecture: The Rooms of Light and Space" in Robin Clark, ed., *Phenomenal: California Light, Space, Surface* (Berkeley and Los Angeles, 2011), 79–104.

"an indication of . . . wanting to get out and treat the environment itself . . . of dealing with the quality of a particular space in terms of its weight, its temperature, its tactileness, its density, its feel — all of those semi-intangible things that we don't normally deal with."[13]

While this transition has been discussed in terms of anticipating Irwin's subsequent practice, a set of strategies the artist refers to as "site-conditioned" art,[14] less frequently mentioned is how this change was influenced by Irwin's evolving understanding of habitable space as envisioned by the postwar aerospace industry as it defined and administered the contours of the upper atmosphere and outer space.

Edward C. Wortz and the Habitability of Flight

Both Moholy's early discussion of space as "a reality of sensory experience" and Irwin's interests in exploring the relationships between perceived and actual space resonate profoundly with a more technically oriented schematization of space that was developed in military, industrial, and commercial settings beginning in the 1940s. Influenced by the fields of psychology, physiology, sociology, industrial design, and cognitive science, modern human factors research (alternately known as ergonomics or "habitability research") dramatically shaped the look and feel of office architecture, domestic interiors, office spaces, and, significantly, military and commercial aircraft during the early decades of the Cold War period.[15]

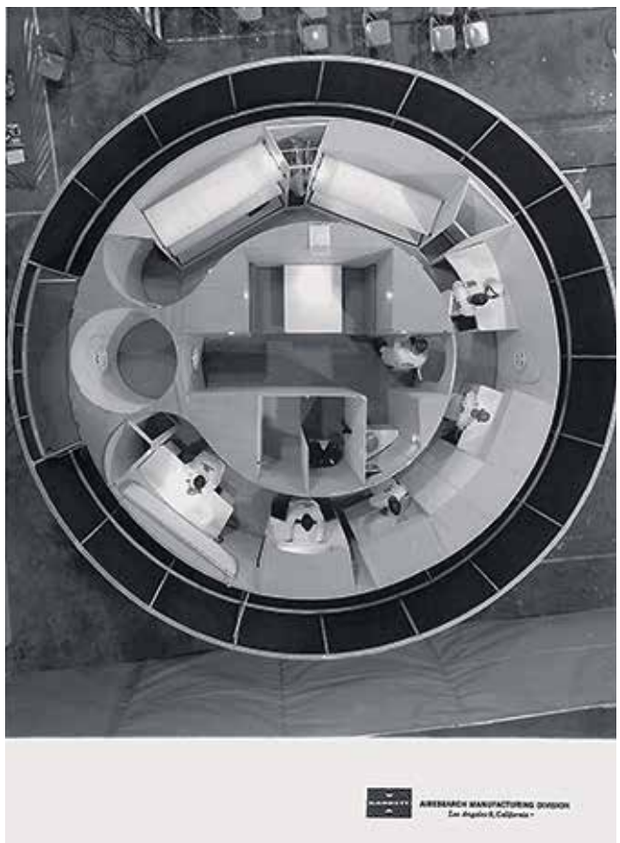
A veteran of the Korean War who later trained as an experimental psychologist, Edward C. Wortz (1930–2004) was a widely respected expert who worked at the nexus of these diverse fields during the 1960s and 1970s. After joining the Martin-Marietta aerospace corporation in 1959, Wortz worked under contract with the newly formed National Aeronautics and Space Administration (NASA) to modify the payload components of early intercontinental ballistic missiles — typically intended for the delivery of a nuclear warhead — into a self-contained environment suitable for sustaining astronauts for a period of up to two weeks in orbit.[16] This transformation directly led to the capsule used in NASA's two-person Gemini missions; throughout the 1960s and 1970s, Wortz continued his repurposing of military technology for the civilian sector with the Garrett Corporation, a Los Angeles–based aerospace company known for its complex "environmental control systems," which provided stable air pressure and temperature to both military and commercial airplane cabins designed for increasingly higher altitudes.

13. Weschler, *Seeing Is Forgetting*, 180–84.

14. Robert Irwin, *Being and Circumstance: Notes toward a Conditional Art* (Larkspur Landing, Calif., and New York, 1985).

15. See David Crowley and Jane Pavitt, eds., *Cold War Modern: Design, 1945–1970* (London, 2008); Beatriz Colomina, *Domesticity at War* (Cambridge, Mass., 2007); and Reinhold Martin, *The Organizational Complex: Architecture, Media, and Corporate Space* (Cambridge, Mass., 2005). For more on the development of human factors research within the aerospace industry, see Nicholas de Monchaux, *Spacesuit: Fashioning Apollo* (Cambridge, Mass., 2011).

16. E.C. Wortz, N.J. Belton, N.W. Levora, and B.P. Davis, "A Self-Contained Atmospheric Ensemble for Titan II," *Journal of American Industrial Hygiene*, May 1962; reprinted in *Aerospace Medicine* 35, no. 11 (1964), 1062–66.



⑤
Engineer testing astronaut's self-locomotive capabilities in lunar gravity simulation device, ca. 1967

⑥
Overhead view of engineers demonstrating full-scale mockup of Orbital Workshop, ca. 1970.

Garrett's dual address in creating habitable space — an attention to basic physiology, as well as design and comfort — naturally meshed with the booming commercial aviation and nascent aerospace industries of the 1960s, and Wortz flourished in this milieu, eventually assuming directorship of the Life Sciences Division at Garrett; under Wortz's lead, Garrett and its research subsidiary (AiResearch) were awarded numerous patents and NASA contracts throughout the 1960s.[17]

As the illustrations accompanying his technical research publications suggest, the majority of Wortz's studies published during his tenure at Garrett communicate his grounding in military and aerospace human factors research, underscoring his expertise in the study of human respiration, locomotion, and capacity for physical labor

17. In 1942, the AiResearch Manufacturing Company of Arizona was officially established as a Garrett Corporation subsidiary; in subsequent years, both names were used in corporate literature. See William A. Schoneberger and Robert R.H. Scholl, *Out of Thin Air: Garrett's First 50 Years* (Phoenix, 1985).

18. Typical studies include Edward C. Wortz, "Metabolic Demand during Man's Lunar Activity in Space Suits," *Fifth Annual Meeting of the Working Group on Extraterrestrial Resources*, March 1967, 219–22; and E.C. Wortz et al., "Man's Capability for Self-Locomotion on the Moon," *NASA CR 1402* and *NASA CR 1403*, 1969.

under simulated conditions of isolation and weightlessness (fig. 5).[18] Yet Wortz's interest in the physiological impact of outer space on the human body was gradually matched by his focus on the perceptual, psychological, and even social effects of the isolating conditions of living and working in outer space — such that by the end of the decade, the Life Sciences Division at Garrett included a provisional anechoic chamber, experimental facilities for testing biofeedback mechanisms, and full-scale space station mockups for the psychological and sociological study of small group interactions (fig. 6).

Given his expansive view of human factors and interest in human perception and response as they occurred in extreme conditions, Wortz was well positioned as an interlocutor between pure and applied science, capable of studying habitability — the relative measure of how "livable" a given space is — as it unfolded at the cusp of a number of disciplines, including physiology, physics, and psychology. What distinguished Wortz from his colleagues, however, was his willingness to engage with the basis of habitability at a fundamentally theoretical and even aesthetic level. Thus, what began for Wortz, as it did for many others in the highly quantitative field of "human factors" during the 1950s and 1960s — that is, as a largely mechanical inquiry into "environmental systems of control" — transitioned into an increasingly expansive understanding of enclosed, open, extreme, isolating, or disorienting space, to be addressed not only in mechanical or physiological ways, but also through newly available psychological methods that proposed to study the phenomenon of being isolated or confined under varying conditions of inhibition, deprivation, disorientation, or even duress.

The First National Symposium on the Habitability of Environments, 1970

It was precisely because of their shared interests in the human perception of abstract space that Wortz and Irwin began to collaborate in the late 1960s, delving into the simultaneously technical, philosophical, and aesthetic contours of the expanding field of habitability research. Prompted by Irwin's participation in *Art & Technology*, an exhibition program curated by Maurice Tuchman that paired avant-garde artists with leading technology and information-oriented corporations in Southern California, Wortz agreed to work with Irwin (along with artist James Turrell [b. 1941], who left the collaboration after several months) at Garrett's Life Science research facilities. A memorandum written by *Art & Technology* assistant curator Jane Livingston in early September 1968 reflects Irwin's pronounced interest in developing an applied

environment intended for the study of human perception under conditions of relative isolation, such as those experienced during long-term spaceflight. Of Irwin's intentions that fall, Livingston noted, "Generally Bob is involved with perceptual psychology: Processes of receiving and reacting to information . . . the application of studies and equipment used in recording people's reactions to light, sound, color, weight, density, etc., before he even begins to work out a project."[19] At the same time, Livingston explicitly linked Irwin's growing interest in sensory deprivation to Wortz's study of the psychology of space exploration, noting that "Wortz has done considerable research on the problem of actually walking on the moon — this implies such considerations as the astronaut's perceptions of space and perspective when he is near or on the lunar surface, what his physical and psychological tolerances are during various stages of his exertions, etc."[20]

While the resulting collaboration between Wortz, Irwin, and artist James Turrell — which consisted of spending hours in anechoic chambers and exploring the effects of gazing into Ganfelds (large fields of undifferentiated light) — has subsequently assumed foundational importance in the history of the Los Angeles–based "Light and Space" movement of the 1960s and 1970s,[21] far less explored is Irwin's subsequent work on habitability research with Wortz and, moreover, the implications for its parallels to Moholy's conception of habitable space.

Shortly after Turrell left the collaboration with Irwin and Wortz in August of 1969, NASA asked Wortz to plan a conference on the topic of habitability, to be held in Los Angeles in early 1970. Sponsored by NASA, the *First National Symposium on the Habitability of Environments* was intended as an interdisciplinary summit at which engineers and designers would gather to discuss the dynamics of various habitable spaces. But while NASA had routinely organized similar conferences since its inception in 1958, Wortz made clear his intentions to bring artists and architects to this discussion; in addition to Irwin, Tuchman, and other artists affiliated with *Art & Technology* and the Los Angeles art community of the early 1970s, Wortz invited architects Richard Neutra and Frank Gehry to participate. Significantly, Wortz's list of potential contributors also included high-ranking administrators and researchers from the U.S. Department of Housing and Urban Development (HUD), the City of Los Angeles, the National Institute of Mental Health (NIMH), educators at the newly formed California Institute of the Arts, as well as numerous psychologists, systems analysts, and directors of social science initiatives from major research universities throughout the United States.

19. Jane Livingston, "Robert Irwin/James Turrell," in Maurice Tuchman, *A Report on the Art and Technology Program of the Los Angeles County Museum of Art, 1967–1971* (New York 1971), 127. *Art and Technology* was hosted by the Los Angeles Country Museum of Art, but Irwin, Turrell, and Wortz ultimately failed to produce a contribution to the exhibition, which was shown at the museum in 1970.

20. Ibid., 128.

21. For a recent overview of the range of practices and theories that shaped a Southern California "Light and Space" movement during this period, see Robin Clark's "Phenomenal: An Introduction" in *Phenomenal: California Light, Space, Surface*, 19–78.

The inclusion of these figures and the institutions they represented suggests that habitability, until more recently understood as a largely technical discourse focused on the physical and physiological limitations of outer space (and in turn, the technology developed to overcome these limits), was in fact a methodological concern of broader importance to the postwar social sciences, with profound implications for visual artists and architects who sought to engage the visual and built environment. Working beyond its NASA and military-specific "operational" application, a growing number of professionals took up questions about the psychological and social importance of a host of more earthly spaces, ranging from university dormitories to office buildings to newly developed suburbs; in their attempts to quantify man's affective relationship to such spaces, sociologists, anthropologists, psychologists, city planners, and systems analysts developed habitability as a theme central to issues of urban planning, development, and public health. In so doing, these researchers helped to transpose the applied scientific research of large federal agencies (such as NASA) onto a wide spectrum of domestic concerns, ranging from the planning and development of major cities and the systems of infrastructure that supported and connected them to the administration of housing, urban, and environmental spaces. In this way, Wortz's symposium, while at times technical in its methodological orientation, was intended not so much to "solve the problems of outer space" per se as to provide a means to translate such knowledge to a wider public. Wortz made such a wide-ranging inter-disciplinary approach clear in his introductory remarks, asserting that "the problems of unique situations such as space craft, undersea craft and isolated environments can assist in the identification of factors that are relevant on a broad scale, and conversely that consideration of the broad scale problems such as urban situations can identify relevant design factors for isolated situations."[22] Moreover, Wortz saw aesthetic concerns as fundamental to habitability research, noting "that artists, designers, planners, and researchers with highly divergent backgrounds have relevant things to say to one another when they jointly consider life quality and the habitability of various environments."[23] Citing — as he frequently would over the course of the ensuing decade — a dynamic (and often elusive) set of affective "life quality factors" central to well-being and satisfaction, Wortz positioned habitability as an inter-disciplinary language that spoke to issues of environment, ecology, society, and even selfhood, a set of concerns that poignantly echoes the profoundly "human factor" of Moholy's approach to the same spaces.

22. Edward C. Wortz, foreword to *First National Symposium on the Habitability of Environments*, 4 vols., AiResearch Report 71-7873-1 (Los Angeles, 1970), 1:1–2.

23. Ibid.

Irwin's Habitability

For his part, Irwin's engagement with habitability was manifested in a series of fragmentary writings, a small number of artistic contributions to Wortz's aerospace research, and perhaps most dramatically, the transformation of his Venice Beach studio as the primary site for Wortz's symposium. To those attending the conference in May of 1970, Irwin's personal investment in the aesthetic importance of habitability would have been all but unmistakable: photographic documentation of the event shows attendees entering Irwin's Market Street studio through a modified alleyway entrance, then emerging into a large room measuring approximately seventy feet long, thirty feet wide, and fourteen feet high. Stripped of nearly all orienting features, Irwin's studio was bathed in soft, white, undifferentiated light, and specially outfitted with a series of short risers (designed by Frank Gehry for the occasion). One immediately notes that Irwin intended the space to be quite functional: Gehry's wooden risers subtly parsed the room into a non-hierarchical field, where, aside from several folding chairs positioned at the center of the room, presenters and audience were positioned (more or less) as equals. Once populated, Irwin's studio took on an entirely different characteristic. Garrett Corporation documentation suggests the inherent strangeness that emerged as the symposium unfolded: engineers perched awkwardly on Gehry's risers, hunched over their elbows and knees, and, ultimately, lounged in various positions of repose, while observing the proceedings or gazing at the bright space.

In transforming his studio into a vast space of white light and slightly modifying its orientation before the beginning of each day's meetings, Irwin envisioned his studio as an immersive and dynamic environment, itself intended to prompt thinking about the affective qualities of space that Wortz used to frame the themes of the symposium. While Wortz acknowledged his peers' provisional acceptance of Irwin's space, conference proceedings also clearly reflect the general discomfort of some attendees. During the third day of meetings, one commenter reflected on "a substantial number of participants who remarked about their uneasiness in these environments . . . that at the meeting last night someone remarked that the stark, white walls that surround him kept him from visually focusing on them; he was almost forced to look at the people in his group." Such comments, along with Wortz's observations at the end of the second day that "the assemblage is polarized with respect to the utility of the symposium, the method of operation of the symposium, and every other aspect of it," reveal a broader fault line, namely, that alongside largely qualitative and quantitative methodological

24. Richard F. Haines and Wortz in ibid., vol. 4: "Comments: General Session, Day 3," 124–27.

approaches, the very notion of habitability, its terms, and the methods deemed useful for its study were actively contested, on down to the level of whether or not Irwin's space was actually effective in prompting reflection on the relative habitability of an enclosed space.[24]

The artist was apparently undeterred. Just four months after Irwin reconfigured his studio, Wortz noted that Irwin continued his work at Garrett, by way of a long-term research commission that NASA had awarded Wortz's Life Sciences Division:

> Right now we're establishing some criteria for a spacecraft. Bob has helped us on this . . . We've looked at the problems of providing a very enriched environment. Bob is very interested in the arts involved in the construction of things . . . of hot-rodding, for example, as a very artistic endeavor. . . . Hot-rodders will massage portions of the machine that no one will ever see, just because it feels right. This is the way Bob feels about art. Everything has to feel right. He was thinking that portions of the spacecraft should be designed or painted to have an appropriate suchness for their function. He's designed us a little oven. So we have the first tentative art input into a spacecraft.[25]

Commissioned by NASA to produce a major study of the design features to be integrated into a space station intended for missions lasting up to several months, Wortz and his colleagues produced *Habitability Guidelines and Criteria*, a four-hundred-page publication that blended Wortz's earlier human factors research with the qualitative sensibilities of the 1970 symposium.[26] Researching aspects of NASA's existing habitability categories (for example, concepts and designs for interior architecture, food and water systems, clothing, communications, and leisure activity), Wortz and his colleagues used plywood, paint, tape, basic plastic and metal elements to produce a series of full-scale mockups of possible spacecraft (in ways very similar to the mockups that Moholy and his students first built as military prototypes), in order to test various habitability factors such as astronaut mobility and aesthetic response to interior design. In his foreword, Wortz explicitly thanks Irwin for his contributions, which included "consultation in aesthetics and the infrared oven mockup."

Oriented horizontally and approximately thirty inches in diameter, Irwin's mockup device appears to consist of two convex discs, made of aluminum or other lightweight metal, connected by durable plastic or glass. Sleek and aerodynamic, Irwin's "little oven" appears throughout the publication, at times framed and photographed in color film — an effect that emphasizes its sensuous materiality and self-contained form — and in other photographs is mounted onto a zero-gravity table (figs. 7, 9),

25. Wortz quoted in September 1970 in Livingston, "Robert Irwin/James Turrell" in Tuchman, *Report on the Art & Technology Program*, 143. From the 1950s onward, "hot-rodding" — a term deriving from the precision tuning and customization of automobiles — contributed to the general perception of southern California as a site for car culture. By the 1960s, as Light and Space artists began using "hod-rodding" techniques and materials (airbrushing, customized fiberglass) to produce their artwork, the minimalist Californian aesthetic was perpetually associated with California's car culture.

26. E.C. Wortz, C.E. Richter, D.P. Nowlis, V.B. Dunn, and N.J. Belton, *Habitability Guidelines and Criteria*, January 7, 1971, prepared under NASA Contract NAS-825100 for Marshall Space Flight Center, Huntsville, Alabama. Los Angeles: Garrett Corporation/AiResearch Manufacturing Company, 1971. While existing human factors data were valuable in developing the publication, the authors also noted in their introduction the importance of the 1970 habitability symposium, which focused on "science, arts, and humanities [and] the philosophical aspects" of habitability.

⑦

Attributed to Robert Irwin. *Prototype Microwave Oven for Garrett Corporation* (top and side views), 1970–71. Diam. 30 in.

thus suggesting a highly aestheticized, albeit utilitarian, role for Irwin's object: the meticulously crafted, curved disc could fit as easily into the crisp modern space of the white gallery as it does atop a table, humbly designated as a microwave.

Significantly, Irwin's oven mockup appears to have been manufactured using the same techniques the artist used to make his larger aluminum discs several years earlier, a method prompting descriptions of semi-luminescent qualities similar to those cited in reviews of the discs in 1968. In the first color plate of the device, Irwin's oven is viewed from above, which effects a tan appearance, due to the unique finish applied to the surface of the disc; a following plate features the same object, now viewed from a seated or "operating" position, a shift in perspective that purportedly results in the same surface now appearing in a green hue. The author (presumably Wortz and not Irwin) emphasizes such dynamic change in an accompanying text titled "Color and Illumination for Perceptual Richness and Task Performance": "Perceptual richness is the sensible variety offered by a given ambient. One method of providing perceptual richness is to vary the color texture, and illumination of the surroundings. . . . Other simple techniques for providing perceptual richness include the application of dichromatic paint to various components, [providing] visual richness by apparent changes in the color of the object as the observer's perspective changes."[27] Throughout the publication, Garrett engineers, dressed in lab coats, interact in various full-scale mockups of sleeping and working quarters, demonstrating the supposed efficiency, comfort, and satisfaction that their carefully researched environments

27. Ibid., sections 5.1–5.38. Note that in the same section, figure 5-3, "Waterdrop Finish on Audiovisual Viewer," is attributed to Billy Al Bengston, another artist affiliated with the Light and Space Movement. See also foreword, iii.

⑧

Engineers demonstrating food storage, preparation, and knee-restraint devices for Orbital Workshop mockup, ca. 1970–71

⑨

Attributed to Robert Irwin, *Prototype Microwave Oven for Garrett Corporation*, 1970–71

will ensure. Documented in lustrous color film to illustrate the dynamic "visual richness" that Irwin's device would grant its viewer/user, or, in black-and-white photographs that echo the sterile working conditions commonly associated with aerospace research, Garrett employees pose around a full-scale mockup of a zero-gravity table, demonstrating its mediating role between astronaut and the repurposed work of art: such "models for living" draw awkwardly from the artist's "consultation in aesthetics," visually rhyming with the pristine, white spaces of Irwin's studio, as he modified it for the habitability symposium.

Returning to *Light Prop* of 1930 — and to the revelatory, environmental installations of projected light it was intended to produce — how might one gauge the relationship between Moholy's most abstracted visions of transformed space and perception and his attempts to modulate the intended emancipatory effects of such a device onto the outcome-based curriculum of the School of Design? As briefly suggested above, one way to consider this relationship is in terms of a kind of "applied abstraction." For whereas Moholy's radical abstraction of space created (or at the very least imagined) an aesthetic order exceeding rapid comprehension while offering the promise of flexibility and contingency, his wartime pedagogy required of this abstraction a certain expediency: in a

time of crisis, such forms were to function as instruments, appliances, and tools, briefly bringing the world to graspable order.

Such a relationship between abstraction and expediency, or to use a set of terms that Irwin would more likely endorse, between a more open-ended conditional art and its agreed-upon convention, seems to have similarly structured the dynamics of the collaborative habitability research he and Wortz embarked upon at the dawn of the 1970s. To be sure, Irwin modulated his response to Wortz's research to varying degrees of enthusiasm and criticism: at times, the artist's engagement with habitability seemed to readily echo NASA's interests in the psychology of spaceflight; at other times, he critically repurposed the technical concept of habitability in order to describe perception itself as a kind of abstraction, a layer through which we grasp our affective relationship to space. In this way, Irwin's momentary attempt to translate the complex perceptual effects of his earlier discs into an everyday device intended for visual stimulation inside a spacecraft suggests a kind of operational aesthetic — and therefore resonates provocatively with Moholy's interests, for example, in using principles of abstraction in order to in turn create disruptive overlays of ground-based camouflage.

While Irwin's discs were briefly aligned with Wortz's inquiry into "perceptual richness" and designs for living in outer space, his subsequent architectural interventions more meaningfully addressed the simultaneously political and aesthetic stakes of the metaphors of "habitable space" and its administration during the Cold War period. These projects, produced just months after reconfiguring his studio for the 1970 habitability symposium, also illustrate what could be construed as Irwin's response to Moholy's calls for designers to resolve "the problems of living and working together." While attempting to link "New Vision"'s radical projections with a series of later artworks that pondered the materiality of light, the curators of *Geometry of Motion* would have therefore found a more apt comparison in *Fractured — Light Partial Scrim Ceiling — Eye-Level Wire*, a nearly invisible room-sized installation Irwin produced at the Museum of Modern Art, New York, in 1970. Not simply a version of applied abstraction — a transposing of the perceptual charge of his discs onto the functional demands of NASA's habitability research — Irwin's abstract environments updated Wortz's habitable space with an apprehension of its fundamentally social quality, as advocated by Moholy. It is within these installations — a series of understated architectural interventions that do not conjure the illusion of another space, so much as quietly reveal the politics of the actual spaces we already occupy — that we locate Moholy's meaningful influence on Irwin's practice.

Friederike Waentig
and Joyce Tsai

Translated by
Timothy Grundy

AN **INTRODUCTION** TO MOHOLY'S **PLASTIC** MATERIALS

Opposite

László Moholy-Nagy, *Space Modulator Experiment, Aluminum 5* (detail), 1931–35. Aluminum and Rhodoid, 33¾ × 28 in. Private collection

László Moholy-Nagy began using plastics in his art during the mid-1920s, around the time he was appointed to the Bauhaus as a faculty member and head of the institute's metal workshop. Avant-garde artists had laid the groundwork for the use of new materials in the first decade of the twentieth century. In his 1912 *Technical Manifesto of Futurist Sculpture*, Umberto Boccioni (1882–1916) sought to undermine the "nobility of materials" and maintained that "twenty different materials can compete in a single work to effect plastic emotion." He proposed that "glass, wood, cardboard, iron, cement, horsehair, leather, cloth, mirrors, electric lights, etc., etc." — were ideally suited to sculpture commensurate with the modern age.[1] Within the same decade, the Russian avant-garde artists Naum Gabo (1890–1977) and Antoine Pevsner (1886–1962) added plastics to this repertoire, beginning with the use of Celluloid as a medium for sculpture.[2] They later incorporated a diversity of plastic materials introduced by various industrial manufacturers over the course of their careers. Moholy worked with this same range of materials, exploring their qualities in his sculpture, photography, and painting.

For many artists working in the early twentieth century, plastics were appealing because they were not only unburdened by art historical precedents but were also entirely the product of human ingenuity. Plastics exemplified industrial modernity, as well as technological and scientific progress. They offered seemingly limitless applications: they could insulate high-voltage electrical wiring; provide durable surfaces for furniture or walls; coat fabrics for use as airplane wing coverings; or serve as a safer, lightweight substitute for glass in aviation and new vehicle designs. Their appeal to artists was that they could be manipulated with an ease unmatched by traditional stone, metal, or glass, allowing for new forms and new artistic approaches.[3]

In 1944, Moholy wrote in his autobiographical text, "Abstract of an Artist," that he "began to paint on aluminum, highly polished non-ferrous alloys, and on thermosetting and thermoplastics" early in his career. His enthusiasm for these materials, however, was tempered by his fear, quickly confirmed, that "these latter materials were not permanent."[4] He learned from experience that unlike traditional fine-arts materials such as canvas, stone, or bronze, plastics are relatively new, and they may degrade under certain conditions with alarming speed. The physical characteristics, chemical composition, and even what we might consider the lifespan of plastic differ profoundly between types, and even between batches made by the same manufacturer. Further complicating matters is the problem of brand and trade names that proliferated during

1. *Technical Manifesto of Futurist Sculpture*, in Herschel Browning Chipp, ed., *Theories of Modern Art: A Sourcebook by Artists and Critics* (Berkeley, 1968), 304.

2. Friederike Waentig, *Kunststoffe in der Kunst: Eine Studie unter konservatorischen Gesichtspunkten* (Petersburg, 2004), 71.

3. Ibid., 29.

4. Moholy-Nagy, "Abstract of an Artist," in *The New Vision: Fundamentals of Design, Painting, Sculpture, Architecture*, trans. Daphne Hoffmann, 4th rev. ed. (New York, 1947), 83.

Moholy's lifetime, most of which are no longer in common use and which tend not to describe the materials' properties. In 1932, one critic, writing in a trade publication, remarked:

> The industry needs to assign the different types of plastics names that can easily be remembered and clearly define the specific product. In order to create sufficient distinctions, the list of names has been extended exponentially, but without this diversity of nomenclature being matched by any material diversity. Most names are fantasy constructs, sometimes seeking to play on certain raw materials, ideals, or qualities, sometimes constituting a mere sequence of letters either taken from the name of the manufacturer or simply invented. It should come as no surprise that such names are obscure and perhaps cause even more confusion than if they were missing completely, i.e., if the product were named merely for its application or for its characteristic qualities.[5]

The commentator highlights a key problem in identifying plastics: many companies manufacturing similar materials invented new trade names simply to distinguish themselves from their competitors. Further exacerbating this problem is the fact that a single trade name can refer to materials that belong to different chemical categories. *Celluloid* can refer to both cellulose nitrate and cellulose acetate. The same is true of another trade name, *Trolit*, which has recently posed new questions in media identification. In Moholy's work, as well as in the work of other avant-garde artists who used plastics during this period, this problem of nomenclature has bred confusion about his materials. Even Sibyl Moholy-Nagy, the artist's widow, has misidentified some of the materials used in his plastic paintings.[6]

This essay seeks to provide an introduction to the plastics Moholy wrote about and used in his art. We describe the invention, history of production, and trade names associated with six distinct categories of plastic materials that Moholy used and wrote about in his lifetime: cellulose hydrate, cellulose nitrate, cellulose acetate, polymethyl methacrylate, casein formaldehyde, and phenol formaldehyde. By organizing the trade names according to their defining chemical substrate, we hope to reveal affinities and draw distinctions among the plastics that Moholy used in his artworks. As an overview, the accompanying geographical timeline of these materials summarizes the dates of invention, period, and countries in which they were available, and under what trade names they circulated (see Table 1, opposite).

5. Viktor Pöschl, "Die Bezeichnung der Kunststoffe," *Kunststoffe* 22, no. 9 (1932): 196.

6. Sibyl Moholy-Nagy, *László Moholy-Nagy: Ein Totalexperiment* (Mainz, and Berlin, 1969) 67, 69.

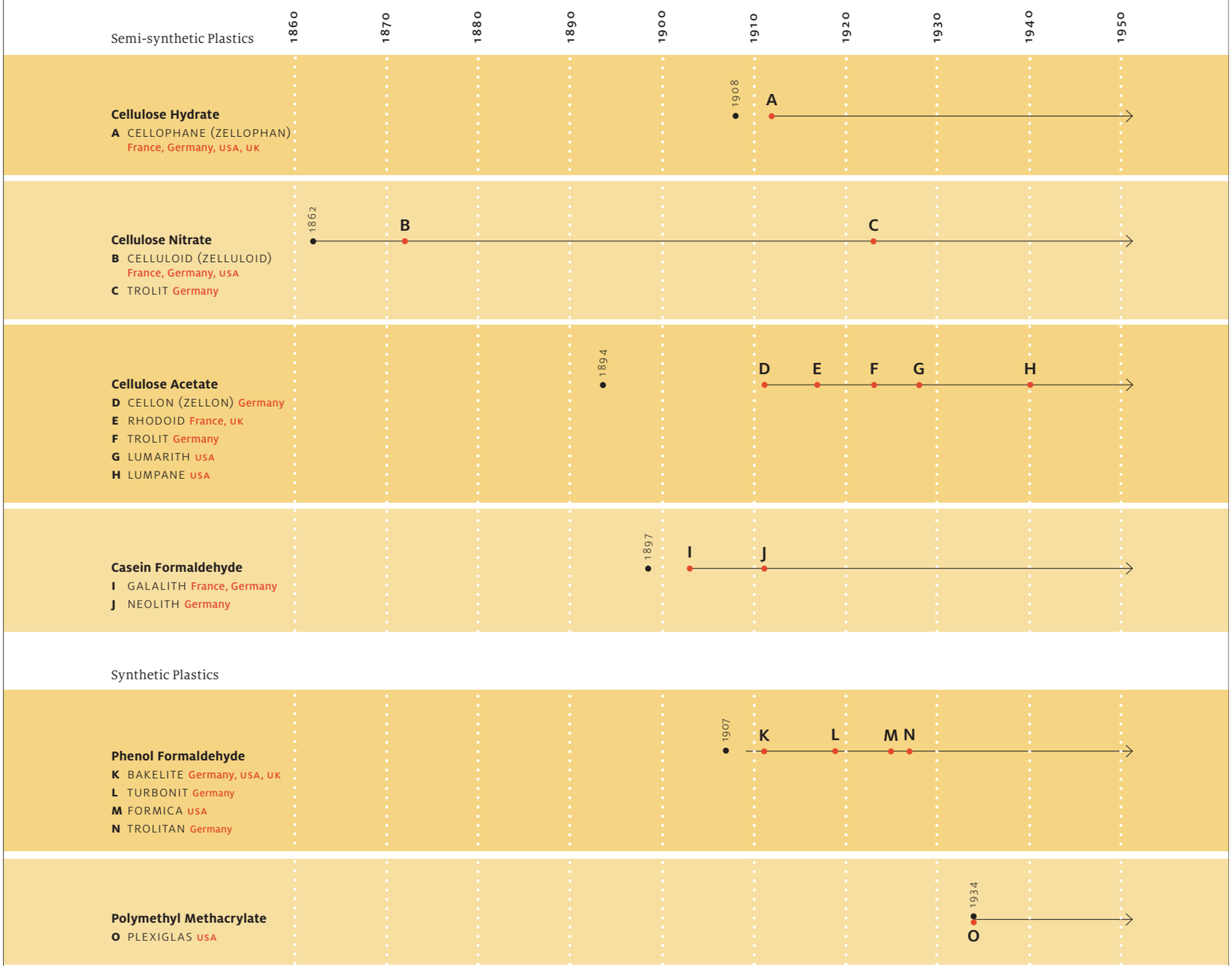
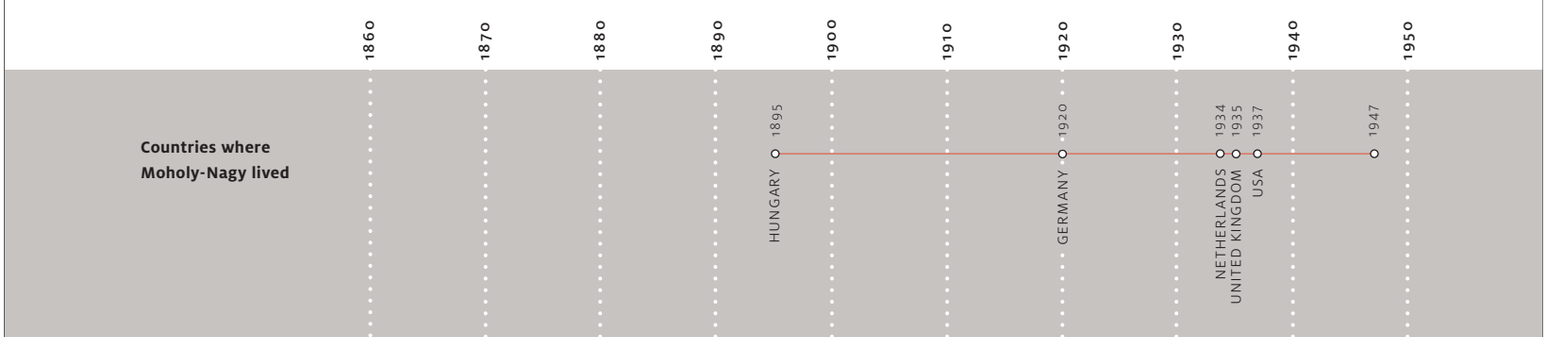


Table 1: Timeline of Plastics Available during Moholy-Nagy's Lifetime ● year of development ● year of market launch ⟶ period of production



① *below*

László Moholy-Nagy, Photograph of stage set model for Jacques Offenbach, *Tales of Hoffmann*, Kroll Opera House, Berlin, 1929

② *opposite*

László Moholy-Nagy, *Study with Pins and Ribbons*, 1937–38. Color print, assembly (Vivex) process, 13 ¾ × 10 7/16 in. George Eastman House, Rochester, N.Y., Gift of Walter Clark (1978:1421:0007)

Cellulose Hydrate

The Swiss chemist and textile engineer Jacques Edwin Brandenburger (1872–1954) invented cellulose hydrate in 1908 while attempting to develop a waterproof coating for fabrics. The material he created was too inflexible to serve as a coating, but the clear film peeled easily away from its fabric backing as a thin, transparent foil. In 1912, Brandenburger patented and marketed this cellulose hydrate foil as *Cellophane*.[7] In Germany, cellulose hydrate foil was also frequently referred to as "glass skin" (*Zellglas*) to emphasize the material's clear, tissue-like quality.

Cellophane was widely available after 1912 and was sold in rolls and as cut sheets. It was employed extensively as an inexpensive packaging material and, because of its transparency, was often used as a color filter in lighting design. Developed initially by the textile industry, it is distinguished from traditional fabrics in that it is not woven, and its surface is undisturbed by weft and warp, which lends it an intense glossiness and transparency. It is as easy to handle as paper and can be cut to size with scissors.

Available Manufactured Forms

Cellophane is produced as rolled foils for wrapping and packaging, as well as for bottle caps and decorative tinsel. During Moholy's lifetime, it was available as 95 cm–wide

7. Georg Schwedt, *Plastisch, Elastisch, Fantastisch* (Weinheim, 2013), 172–73.

rolls or as sheets measuring 95 by 100 cm and in thicknesses ranging from 0.015 to 0.5 mm.[8]

Application and Significance for Moholy

Moholy used cellophane in stage designs, as documented in photographs of the movable walls in his sets for the 1929 production of Jacques Offenbach's *Tales of Hoffmann* at the Kroll Opera House, Berlin (fig. 1). Some accounts list cellophane among the media in *Light Prop for an Electric Stage*, but recent conservation research has confirmed that the clear sheeting originally used was more likely cellulose acetate (see below).[9] As art director of the Pallas Studio in Amsterdam in the early 1930s, Moholy began working with color photography and used cellophane in artistic and commercial projects.[10] Very few color photographic prints survive from this period, but his *Study with Pins and Ribbons* offers an example of his use of colored cellophane and other plastics (fig. 2). He continued to use cellophane when he taught in Chicago at the New Bauhaus, and later at the School of Design (renamed the Institute of Design).[11] His daughter Hattula recalls that Moholy kept a constant supply of cellophane at home and at school.[12] Cheap, colorful, glossy, easy to cut, fold, crinkle, and combine with other materials, it was ideally suited to experimentation. The material was a mainstay in his pedagogy, and he used it extensively in his color photographic experiments (pl. 25b).[13]

Product Names and Manufacturers

Cellulosehydrate foil was marketed in the twentieth century as *Cellophane* (S.A. La Cellophane, France; Kalle & Co. Germany; and DuPont, United States); other trade names include *Transparit* (Wolff & Co., Germany); *Heliozell* (Fa. Feldmühle, Papier- und Zellstoffwerke, Germany); *Esslinger Zellglas* (Fa. Langheck & Co., Germany); and *Sidac* (Société Industrielle de la Cellulose, France).

8. Marta Halama, *Transparentfolien (Cellophan, Transparit, Heliozell, Utraphan usw.)* (Berlin, 1932), 187–88.

9. Henry Lie, "Replicas of László Moholy-Nagy's Light-Prop: Busch-Reisinger Museum and Harvard University Art Museums," *Tate Online Research Journal*, Tate Papers Issue 8 (1 October 2007), 69 (www.tate.org.uk/research/publications/tate-papers/issue-08).

10. Jeannine Fiedler and Hattula Moholy-Nagy, eds., *Color in Transparency: Photographic Experiments in Color, 1934–1946*, exh. cat., Berlin: Bauhaus Archive (Göttingen, 2006), 70–71.

11. Isabelle Duvernois, "Moholy-Nagy's 'Vision in Motion' Stilled: A Study of Wire Mesh Plastic Laminate Deterioration" (MA Thesis, New York University, 2003), 12.

12. Hattula Moholy-Nagy in conversation with Joyce Tsai (Ann Arbor, Michigan, August 7, 2014).

13. Jeannine Fiedler and Hattula Moholy-Nagy, eds., *Color in Transparency: Photographic Experiments in Color, 1934–1946*, exh. cat., Berlin: Bauhaus Archive (Göttingen, 2006), 70–71.

Cellulose Nitrate

In 1846, Christian Friederich Schönbein discovered that cellulose nitrate could be made by combining cellulose, nitric acid, and sulphuric acid to produce a highly combustible product also known as flashpaper. Further experimentation with this compound in combination with camphor led to the development of cellulose nitrate plastics, produced initially as ivory substitutes in the second half of the nineteenth century; these early materials warped and broke easily. In 1872, a new manufacturing technique was developed, and the Celluloid Manufacturing Company in Newark, New Jersey, patented and produced cellulose nitrate products under the trade name *Celluloid*. It was available in Europe from 1875 by license through the Compagnie Franco-Americaine in Stains outside of Paris and the Amerikanische Gummi-Waren Fabrik in Mannheim.[14] German production of cellulose nitrate began in 1880 at the Rheinische Gummi- und Celluloidwaren-Fabrik in Mannheim and in 1887 at the Deutsche Celluloid Fabrik of the Eilenburger Celluloidwerk.[15] In Troisdorf, cellulose nitrate was marketed under the trade name *Trolit F* and was produced with gypsum fillers for use in electrical and industrial contexts.[16] During World War I, commercial production of cellulose nitrate was halted, recommencing in Troisdorf in 1920.[17] Cellulose nitrate was also used in the production of linoleum substitute flooring called *Triolin* that was used in early Bauhaus architectural projects.[18]

Cellulose nitrate was used in the manufacture of a range of goods, including billiard balls, visors, and shirt collars. Its primary significance for avant-garde artists, however, was its association with film and photography. Cellulose nitrate-based photographic roll film was commercially introduced by the Eastman Corporation in 1889, and was commonly referred to as celluloid photographic film. In 1895, this flexible film was introduced as the substrate for motion picture film. Cellulose nitrate was also produced in thicker translucent sheets that were lightweight and easy to cut with scissors, precision blades, files, or saws; the sheets could be joined through the use of chemical solvents, which allowed for the layered fusion of glazes. Gentle application of heat could also aid in manipulation, but extreme care had to be taken because the material can be flammable.

Available Manufactured Forms

Cellulose nitrate was used in the first half of the twentieth century for molded fittings, pressure- and injection-molded articles, cast blocks, sliced plates, and foils.[19]

14. Dietich Braun, *Kleine Geschichte der Kunststoffe* (Munich, 2013), 148–49; Waentig, *Kunststoffe in der Kunst*, 203–4.

15. Reiner F. Oelsner, *Formalisierung durch Technik contra Vielfalt durch Natur. Fallstudie zur Geschichte der Kunststoffe am Beispiel des Celluloids* (Mannheim, 1997), 18.

16. Matthias Dederichs,"100 Jahre Kunststoffe aus Troisdorf: Das Troisdorfer Werk 2000," *Schriftenreihe des Archivs der Stadt Troisdorf*, no. 23 (2008): 11. Recent analysis conducted by the Northwestern University/Art Institute of Chicago Center for Scientific Studies in the Arts (NU-ACCESS) has confirmed the presence of gypsum, zinc oxide, dark pigments and plasticizers (phthalates and organophosphates) in two cellulose nitrate sheets used by Moholy as supports for paintings in the collection of the Solomon R. Guggenheim Museum. See Julie Barten, Carol Stringari, Francesca Casadio, Federica Pozzi, Johanna Salvant, Ken Sutherland, and Marc Walton, "A Wealth of Optical Expression: László Moholy-Nagy's Works in the Collection of the Guggenheim Museum," *Abstracts of the American Institute for Conservation's (AIC) Forty-third Annual Meeting*, Miami, Fla., 13–16 May 2015. The result of the analysis matches the Deutsche Reichspatent "Herstellung hartgummiähnlicher plastischer Massena aus Zellulosederivaten," no. 379299, filed 20 March 1919, and issued 21 August 1923. Paul Balke and Gustav Leysieffer list the filler material as calcium carbonate, gypsum, pigments, and plasticizers.

Application and Significance for Moholy

Moholy referred to *Triolin, Trolit*, and *Celluloid* (sometimes spelled *Zelluloid*), trade names of cellulose nitrate plastics produced during the 1920s, in his writings from the period.[20] Triolin was a cellulose nitrate-based flooring manufactured with wood fillers and gelatin, available in a range of colors. Its appearance in Moholy's book *Painting Photography Film* in 1925 coincided with the Bauhaus promotion of the material as an economical alternative to linoleum. It was used on several projects, including the school at Dessau.[21] Use of the material was discontinued because of concerns regarding its flammability and odor. The problems with this material might have led Moholy to remove it from a list of future supports for the manufacture of paintings in the second edition of *Painting Photography Film*, revised and published in 1927.[22] Moholy included images of Gabo's sculptures and noted the artist's use of Celluloid in *Von Material zu Architektur* (1928).[23]

The lightweight translucency of Celluloid is well suited to airy, open forms. Moholy also produced paintings that explicitly named Celluloid as their support. However, the identification of a material support as cellulose nitrate cannot rely upon the name alone. *Celluloid* not only referred to cellulose nitrate but was often associated with cellulose acetate materials as well. Trolit, which is opaque, has posed similar problems, confused not only with cellulose acetate versions of the same name but also with Trolitan, a phenol formaldehyde produced by the same manufacturer. Moholy's use of Trolit will be addressed in the conclusion of this essay.[24]

Product Names and Manufacturers

Cellulose nitrate was marketed in the twentieth century as *Trolit* (by Rheinisch-Westfälische Sprengstoff Inc., Troisdorf; Trolitwerke, Troisdorf; Dynamit Nobel, Troisdorf); *Triolin* (by Köln-Rottweil A.G., Cologne); and *Zelluloid* or *Celluloid* (by Celluloid Corp., Newark, New Jersey; Rheinischen Gummi- und Celluloidwaren-Fabriken, Mannheim).

Cellulose Acetate

Cellulose acetate is made by treating cellulose with acetic acid anhydride and a small amount of concentrated sulphuric acid. It was introduced industrially in 1894 as a varnish, marketed under the name *Cellon-Lack* (lacquer). It was later employed as water-proofing, used on the fabric covering of World War I airplanes. In 1905, the paint

17. Ibid., 10.

18. A. Simon, "Über Linoleum und Triolin," *Chemische Umschau* 32, nos. 43–44 (1925): 27; Monika Markgraf, ed., *Archäologie der Moderne/Archaeology of Modernism*, Edition Bauhaus 22 (Dessau, 2006), 163.

19. Charles Selwitz, *Cellulose Nitrate in Conservation* (Los Angeles, 1988), 8.

20. See Catherine David, "Vision, Motion, Emotion: Moholy-Nagys experimenteller Einsatz," in Catherine David et al., *Laszlo Moholy-Nagy*, exh. cat., Kassel: Museum Fridericianum Kassel (Osftfildern bei Stuttgart, 1991), 9–12 ; Krisztina Passuth, *Moholy-Nagy* (Weingarten, 1986), 65; *László Moholy-Nagy*, exh. cat., Stuttgart: Württembergischer Kunstverein (Stuttgart, 1974), 51; Duvernois, "Moholy-Nagy's 'Vision in Motion' Stilled," 6.

21. Markgraf, *Archäologie der Moderne*, 163.

22. László Moholy-Nagy, *Malerei Fotografie Film*, 2nd rev. ed. (Köthen, 1927), 23.

23. Naum Gabo and Antoine Pevsner's use of cellulose nitrate in their sculpture (as well as problems the material poses in the conservation of these works) is well documented. See Stephen Hackney, "Degradation of Naum Gabo's Plastic Sculpture: The Catalyst for the Workshop," *Tate Online Research Journal*, Tate Papers Issue 8 (1 October 2007) (www.tate.org.uk/research/publications/tate-papers/issue-08). See also Michele Derrick, Dusan Stulik, and Eugena Ordonez, "Deterioration of Cellulose Nitrate Sculptures Made by Gabo and Pevsner," in David W. Grattan, ed., *Saving the Twentieth Century: The Conservation of Modern Materials* (Ottawa, 1993), 169–82.

24. László Moholy-Nagy, *Von Material zu Architektur* (Passau, 1929), 135, 137. In Moholy's references to the use of Trolit even in correspondence with the manufacturer, he does not distinguish between Trolit F, cellulose nitrate, and Trolit W, cellulose acetate.

manufacturer Bayer developed a secondary acetate material and manufactured it as the thermoplastic *Cellit*.[25] The Rheinisch-Westfälische Sprengstoff A.G. in Troisdorf manufactured cellulose acetate thermoplastic under the brand name *Cellon* (sometimes spelled *Zellon* and was later marketed under the name *Trolit W*).[26] In the United States, cellulose acetate was introduced by the American Cellulose and Chemical Manufacturing Company under several different names.

Cellulose acetate has many of the same properties as cellulose nitrate. It is lightweight, translucent, and easy to cut and join. Like cellulose nitrate, it can be manipulated with the light application of heat, and solvents allow it to be joined or applied to substrates as colored laminates and layers. Cellulose acetate differs significantly from cellulose nitrate in that it is more resistant to heat and does not spontaneously combust, a problem that plagued cellulose nitrate by reputation. Because of cellulose acetate's stability, it replaced cellulose nitrate as the substrate for cinematic film in the 1930s; it came to be known as safety film.

The difference between cellulose nitrate and cellulose acetate is difficult if not impossible to determine purely visually. One key indication of the difference is evident as the plastic ages. As cellulose nitrate deteriorates, it gives off the light scent of camphor; as cellulose acetate deteriorates, it gives off a strong vinegar scent. The kinship between cellulose acetate and cellulose nitrate is evident from the trade names given to the material. From the 1920s through the 1940s, cellulose nitrate and cellulose acetate often were produced by the same manufacturers and sold under the same trade names, for instance, in the cases of Celluloid and Trolit.

Available Manufactured Forms

Cellulose acetate was used in the first half of the twentieth century for molded fittings, pressure- and injection-molded articles, blocks, and sheets. Foils were generally available in widths of 60 cm before 1932, after which sheets in widths of 95 cm became available.

Application and Significance for Moholy

Trolit and Celluloid were available to Moholy both as cellulose acetate and cellulose nitrate, making it difficult to distinguish between the materials visually. Nonetheless, there is ample documentation of Moholy's use of cellulose acetate in his paintings and in trade show and window displays, especially in the 1930s and 1940s. Moholy

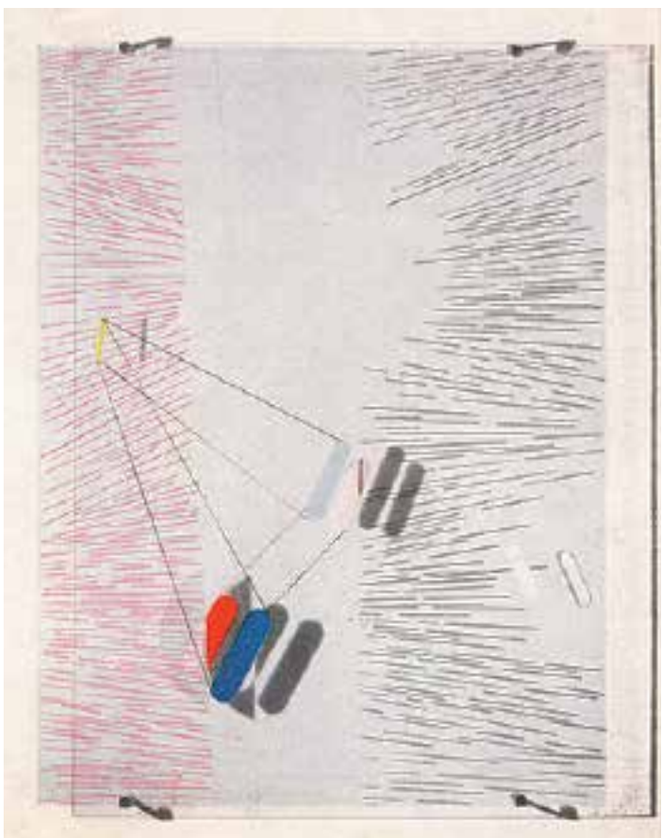
25. Waentig, *Kunststoffe in der Kunst*, 216 and Braun, *Kleine Geschichte der Kunststoffe*, 157; Deutsches Reichspatent 252,706, filed 30 September 1905, issued 26 October 1912.

26. Deutsches Reichspatent 238,348, filed 26 January 1909, issued 19 September 1911. This was further refined in 1919 by using softeners and with the development of injection molding (Deutsches Reichspatent 441,023, filed 26 January 1919, issued 21 February 1927) and the first hand-operated injection-molding machine made by Eckert & Ziegler. See Braun, *Kleine Geschichte der Kunststoffe*, 158–59. Beginning in 1923, Trolit W was produced in Troisdorf using the patented process "Verfahren zur Herstellung hartgummiähnlicher Massen aus Acetylcellulose," Deutsches Reichspatent 470,579, filed 9 November 1924, issued 3 January 1929.

corresponded directly with the manufacturers of Trolit to obtain sheets of the material to use in his exhibition designs for the Paris Werkbund Exhibition in 1930. Contemporary press accounts remark upon the use of Trolit, described as a cellulose acetate product.[27] In London, he worked extensively with Rhodoid, a French brand of cellulose acetate manufactured under license in Britain by May and Baker.[28] He used the plastic in the sets of *Things to Come*, a science fiction feature film on which he worked while living in London (see pp. 51–52).[29] Moholy also painted a number of works on Rhodoid. One such work *Space Modulator (Rhodoid)*, now lost or destroyed, was shown in London in 1936 and was reproduced in color in his posthumous book *Vision in Motion* (1947). The work was rendered on a sheet of cellulose acetate mounted on a wooden board with metal brackets (fig. 3). Its front and back surfaces were scratched to make the oil paints adhere, using a technique he used with other plastics. Such works resemble many of the Plexiglas paintings that Moholy produced at around the same time, but cellulose acetate is far more prone to yellowing, warping, and cracking with age. For this reason, the color reproduction of *Space Modulator (Rhodoid)* in *Vision in Motion* serves as a document that captures Moholy's intended effects. The effects of aging are visible in *AL 5*, a painting composed of a Rhodoid disc mounted on an aluminum support (see fig. 21, p. 44). What might at first glance look like deliberate curvature of the form has resulted from the disc's shrinkage; this has created areas of warpage and tension at the sites where the plastic is fastened to aluminum pins.

③

László Moholy-Nagy, *Space Modulator (Rhodoid)*, 1935 (lost or destroyed)



In the United States, Moholy made use of Lumarith and Lumapane, cellulose acetate plastics produced by the Celanese Corporation of America[30] that exploited the material's transparency and ability to take color.[31] He executed two paintings in 1946, the year of his death, on cellulose acetate glazing embedded with wire mesh, manufactured during the war as shatter-resistant glass. These objects, in the collections of the Metropolitan Museum of Art and the Detroit Institute of Arts, have deteriorated beyond repair.[32]

27. Reviews that name *Trolit* as a cellulose acetate material used in the exhibition include P. Bromberg, "De Duitsche Afdeeling op de 'Salon des Artistes Decorateurs' te Parijs," *Binnenhuis* 12, no. 14 (3 July 1930): 151–62; E. Roland, "La section allemande au Salon des Artistes Décorateurs," *La Revue de l'Habitation* (1930): 20; "Le XXe Salon des Decorateurs," *L'Art Vivant* 132 (15 June 1930): 476–80, 496. No distinction, however, is ever made between Trolit F and Trolit W in these reviews.

28. Andréi Nakov, "Eine "Lichtarchitektur, die sich über das rein Formale erhebt," in David et al., *László Moholy-Nagy*, 31; Duvernois, "Moholy-Nagy's 'Vision in Motion' Stilled," 5; Terence A. Senter, "Moholy-Nagy: The Transitional Years," in Achim Borchardt-Hume et al., *Albers and Moholy-Nagy: From the Bauhaus to the New World*, exh. cat., London: Tate Modern (London, 2006), 89. For evidence of Moholy's purchase of Rhodoid directly from British manufacturers May and Baker, see Sibyl Moholy-Nagy to László Moholy-Nagy, 27 January 1937, Archives of American Art, Smithsonian Institution, Washington, D.C.

29. Christopher Frayling, *Things to Come* (London, 2008), 72–73.

30. László Moholy-Nagy to Robert Jay Wolff, 6 July 1942, Archives of American Art, Smithsonian Institution, Washington, D.C.; Duvernois, "Moholy-Nagy's 'Vision in Motion' Stilled," 14.

31. Sibyl Moholy-Nagy to László Moholy-Nagy, 27 January 1937, Archives of American Art, Smithsonian Institution, Washington, D.C.

32. Isabelle Duvernois's thesis, "Moholy-Nagy's 'Vision in Motion' Stilled" (cited in note 11 above) offers extensive documentation about the deterioration of this particular kind of cellulose acetate laminate.

Product Names and Manufacturers

Cellulose acetate was marketed in the twentieth century as *Trolit* (also referred to, incorrectly, as *Trolith)* (Rheinisch-Westfälische Sprengstoff Inc., Troisdorf; Trolitwerke, Troisdorf; Dynamit Nobel, Troisdorf); *Lumarith* (Celanese Plastics Company); *Zellon* and *Cellon* (also referred to, incorrectly, as *Zelon* and *Celon*) (Deutsche Celluloid Fabrik, Eilenburg; Rheinisch-Westfälische Sprengstoff Inc., Troisdorf; Trolitwerke, Troisdorf; Dynamit Nobel, Troisdorf); *Zelluloid* or *Celluloid* (Celluloid Corp., Newark, New Jersey; *Rhodoid*: Société des Usines Chimiques Rhone-Poulenc, Paris; May & Baker Ltd., London); and *Lumapane* (Celanese Celluloid Corporation [United States]).

Polymethyl Methacrylate

Otto Röhm paved the way for research into acrylics with his doctorate, *Über die Polymerisationsprodukte der Acrylsäure* (On the polymerization of acrylic acid), completed in 1901. With Otto Haas, he founded the company Röhm und Haas in 1912, which initially developed products for the leather industry. In 1928, Walter Bauer, while working with Röhm, made a key discovery that made possible the polymerization of acrylics.[33] Around the same time, Rawland Hill at Imperial Chemicals Industries in England also managed to polymerize a clear, glass-like acrylic plastic. Röhm und Haas started manufacturing *Plexiglas* in 1934. In exchange for a license for the large-scale production of polymethyl methacrylate (PMMA) that Imperial Chemical Industries had developed, Röhm und Haas licensed the manufacturing rights in England and marketed the product under the name *Perspex*. In the United States, DuPont reached agreement with Imperial Chemical Industries to start producing Plexiglas in 1936.[34]

Polymethyl methacrylate is a thermoplastic with optical qualities comparable to glass. It can be cut, drilled, and shaped and joined through the use of monomers and solvents. Unlike cellulose nitrate and cellulose acetate, however, polymethyl methacrylate is brittle and susceptible to scratches. Its edges are prone to shattering, so the material must be protected from above and below when cutting or drilling. Filing, however, is easier and poses less risk of damaging the plastic. While the material is remarkably malleable, manipulation under heat must be carefully controlled, since heating polymethyl methacrylate too quickly or at excessively high temperatures can cause the structure to produce small internal bubbles, while exposure to excessively low temperatures makes it vulnerable to tearing and cracking.

33. Deutsches Reichspatent 656,642 filed 27 October 1928 and issued 27 January 1938, and Deutsches Reichspatent 664,568 filed 27 November 1928 and issued 18 August 1938.

34. Waentig, *Kunststoffe in der Kunst*, 266–67; Braun, *Kleine Geschichte der Kunststoffe*, 241–42.

④

László Moholy-Nagy, Untitled, ca. 1939–1945. Plexiglas, 14 × 16 × 18½ in. Rhode Island School of Design, Providence, Gift of Marcel Breuer

Semifinished Products

In the early twentieth century, polymethyl methacrylate was cast in sheets of 0.5 to 10 mm in thickness. Extrusion enabled the production of a greater range of thicknesses after 1938. Its optical qualities made it an ideal substitute for glass. It was and continues to be used in vitrines, as glazing for framed pictures, and in household products, windshields, and jewelry.

Application and Significance for Moholy

Moholy worked extensively with Plexiglas in the United States as the substrate for his sculptures and paintings, making use of its clarity and its malleability.[35] His sculptures often consist of a single sheet of Plexiglas, perforated with drilled holes, sliced partially through and given three-dimensional form through the use of heat lamps (fig. 4). These molded shapes were used as table sculptures or hung as mobiles. Moholy also made paintings on Plexiglas supports in which pigment was applied to roughened areas of the surface on both sides and mounted on painted wooden boards affixed with metal or wood brackets (pl. 29). (He used a similar technique in his treatment of cellulose acetate sheets.) In addition, he subjected some of his painted Plexiglas to heat to produce small sculptural works set in specially made low-profile pedestals. These sometimes were made using his home oven.[36] In addition to these artistic experiments, Moholy promoted his experience using the material with the American military after the United States joined the war. In correspondence with the War Department and with the material's American manufacturer, DuPont Corporation, Moholy suggested that he and his school had developed new repair and friction-welding techniques that might be pursued with simple tools.[37]

Product Names and Manufacturers

Polymethyl methacrylate was marketed in the twentieth century as *Plexiglas* (Röhm & Hass, Darmstadt) and *Perspex* (Imperial Chemical Industries, London).

---

35. David, "Vision, Motion, Emotion," 10; Nakov, "Eine "Lichtarchitektur," 31; Duvernois, "Moholy-Nagy's 'Vision in Motion' Stilled," 5.

36. Hattula Moholy-Nagy, "Reminiscences of Moholy-Nagy in Chicago," in Iguchi Toshino ed., *Moholy-Nagy in Motion*, exh. cat., Hayama: Museum of Modern Art (Kanagawa, 2011), 250.

37. László Moholy-Nagy to Walter B. Kirner, National Defense Research Committee, 7 January 1944, Chicago, Archives of American Art, Smithsonian Institution, Washington, D.C.

Casein Formaldehyde

Casein is a milk protein used in the production of paint and in the early plastic casein formaldehyde. The material synthesized the protein with formaldehyde to produce a mass thermoset plastic that could be cast and pressed. This process was invented by Wilhelm Krische and Adolf Spitteler in 1897 and called *Galalith* (after the Greek *gala* [milk] and *lithos* [stone]).[38] It was first produced in Germany in 1903, initially by the Vereinigten Gummiwaren-Fabriken Harburg-Wien and from 1904 onward by the joint German-French manufacturer Internationale Galalith-Gesellschaft Hoff & Co.[39] *Neolith* was a casein formaldehyde that had minimal thermoplastic qualities and was manufactured according to a patent by Hans Stephan;[40] it was also marketed after 1910 under brand names *Thomasit* and *Oxygalalith*, and *Neolith*, which was also available as thin sheets.[41] The plastic was also used to make buttons and jewelry and as an ivory substitute for furniture inlay. A lightly translucent variant of casein formaldehyde, developed to imitate horn, was marketed under the name *Akalit*.[42]

Like cellulose acetate and cellulose nitrate, casein formaldehyde can easily be shaped using tools such as saws, files, and drills. Its greatest disadvantage is its lack of resistance to humidity, which renders it liable to cracking. Casein products, moreover, tend to yellow and become brittle when exposed to daylight or ultraviolet rays. Its resistance to solvents, however, made casein formaldehyde suitable as a substrate for painting.

Product Names and Manufacturers

Casein formaldehyde was marketed in the twentieth century as *Neolith* (Deutsche Kunsthorn Gesellschaft) and *Galalith* (Internationale Galalith Gesellschaft Hamburg Harburg). Production of casein formaldehyde essentially ceased after the 1960s.

Application and Significance for Moholy

Moholy made several paintings on Galalith in the 1920s, using both opaque and translucent sheets.[43] An untitled work executed in 1925 on a black sheet of Galalith, once owned by Walter Gropius, features a painted composition closely related to Moholy's prints and paintings on canvas (fig. 5). The painting was produced after Moholy's arrival at the Bauhaus, and the treatment of the edges suggests that the sheet might have been reclaimed from another project: three of the four edges of the painting are beveled and finished, while the length of one edge is unevenly cut. (These details are concealed by the work's white wooden frame.) On a cream-colored opaque sheet of Galalith,

38. Deutsches Reichspatent 127,942, filed 7 August 1897 and issued 9 January 1902.

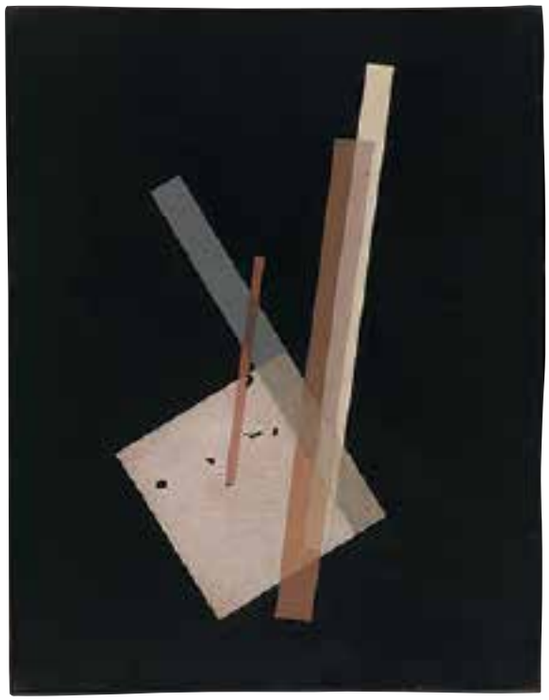
39. Waentig, *Kunststoffe in der Kunst*, 222; Braun, *Kleine Geschichte der Kunststoffe*, 178–79.

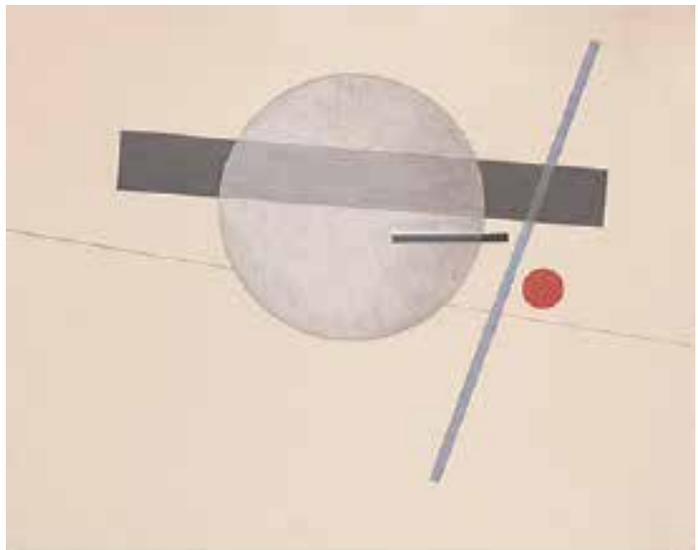
40. Deutsches Reichspatent 240,249, filed 24 September 1910 and issued 28 October 1911.

41. Hans Blücher, *Plastische Massen: Die Erzeugung, Verarbeitung und Verwendung* (Leipzig, 1924), 181.

42. Victor Grafe, ed., *Grafes Handbuch der organischen Warenkunde*, 2: *Halbband des V. Bandes. Gewerblich verwendete Tier- und Pflanzenstoffe—Synthetische Produkte* (Stuttgart, 1929), 57.

43. Moholy-Nagy, *Malerei Fotografie Film*, 2nd rev. ed., 23; David, "Vision, Motion, Emotion," 10; Duvernois, "Moholy-Nagy's 'Vision in Motion' Stilled," 5; Annette Schulz Marty, unpublished conservation report on *Composition G4* (Glockhausen, 2006).





⑤
László Moholy-Nagy, Untitled, 1925. Galalith, 21¼ × 16¾ in. (pre-treatment photograph). Historic New England, Boston, Mass.

⑥
László Moholy-Nagy, *G5*, 1923–26. Oil and pencil on Galalith, 16 9/16 × 20¾ in. Yale Art Gallery, New Haven, Conn., Gift of Collection Société Anonyme (1941.573)

Moholy used traditional oil paints overlaid with pencil markings to make *G 5* (1923–26) (fig. 6). The composition resembles his paintings on canvas and on new metallic alloys made during the same years (pl. 13).

Phenol Formaldehyde

In 1907 the Belgian chemist Leo Hendrik Baekeland (1863–1944), in his laboratory in Yonkers outside of New York, controlled the reaction of phenol and formaldehyde by applying intense heat and pressure, creating one of the earliest wholly synthetic plastics, trademarked as *Bakelite*.[44] Phenol formaldehydes are thermosetting plastics, that is to say, they cannot be manipulated by heat after production but can be cut to shape with saws, blades, drills, and files. Compared with other plastic materials, phenol formaldehyde is extremely hard, very durable, and resilient. Even thin woven sheets or laminates cannot be cut with regular scissors. In 1907 Baekeland produced phenol formaldehyde in small batches, before obtaining financial support to begin mass production through two companies that he founded: General Bakelite Co. in the United States and the Bakelite-Gesellschaft m.b.H. Berlin-Erkner in Germany.[45] As early as 1919, *Turbonit* was advertised in the *Jahrbuch der Elektrotechnik* as a substitute for hard rubber, vulcanized fiber, and mica because of its resistance to heat and chemical

44. Leo H. Baekeland, *Method of Making Insoluble Products of Phenol and Formaldehyde*, U.S. Patent 942,699, filed 13 July 1907 and issued 7 December 1909.

45. Waentig, *Kunststoffe in der Kunst*, 230–31; Braun, *Kleine Geschichte der Kunststoffe*, 197 , 205.

reactions.[46] A German patent from March 1918 describes it as a laminated paper with high heat resistance.[47] *Trolitan* was produced in Troisdorf, outside Cologne, after 1925 and marketed as electrical insulation. *Formica* was produced in the 1920s in the United States and became widely available in the 1930s and '40s. The plastics were inexpensive, stable, extremely resilient, and took colors easily.

Semifinished Products

Phenol formaldehyde products were generally produced by saturating the amber-colored resin with fillers such as wood chips or textile fibers, which resulted in a dark and opaque plastic. They were pressure-molded to manufacture parts for industrial and household goods, control panels for electrical components, and highly durable laminate sheeting. With the development of new techniques to dye the resin and to lighten its color after 1927, the palette of the plastic expanded significantly. The resin without fillers was produced as a decorative material and became popular as costume jewelry and as design elements in household goods.

Application and Significance for Moholy

Moholy refers to Turbonit specifically as a material developed in the electrotechnics industry beginning in the mid-1920s.[48] His enthusiasm for this and other phenol formaldehyde materials was linked directly to the industrial connotations that this entirely synthetic material suggested. He embraced its key visual characteristic — its dark opacity — in a series of works on dark grounds in the mid-1920s using traditional materials such as wood, paper, and canvas. In the 1930s, he painted on Formica during his residence in the United States. His vibrant new palette exploited the bright saturated colors that the decorative laminate afforded (pls. 26, 27).

Product Names and Manufacturers

Phenol formaldehyde was marketed as *Bakelite*, a phenol formaldehyde molding compound impregnated with fibers (manufactured and marketed by Bakelite Corp., New York, NY, and Bakelite-Gesellschaft mbH, Berlin-Erkner); *Turbonit*, a phenol formaldehyde–laminated fabric (Jaroslow's Glimmer-Waren Fabrik, Berlin); *Trolitan*, a phenol formaldehyde molding compound impregnated with fibers): (Rheinisch-Westfälische Sprengstoff A.G., Troisdorf; Trolitwerke, Troisdorf; Dynamit Nobel, Troisdorf); and *Formica*, a laminated semifinished phenol formaldehyde product made with paper, textile, glass, or asbestos (Formica Insulation Co., Cincinnati, Ohio).

---

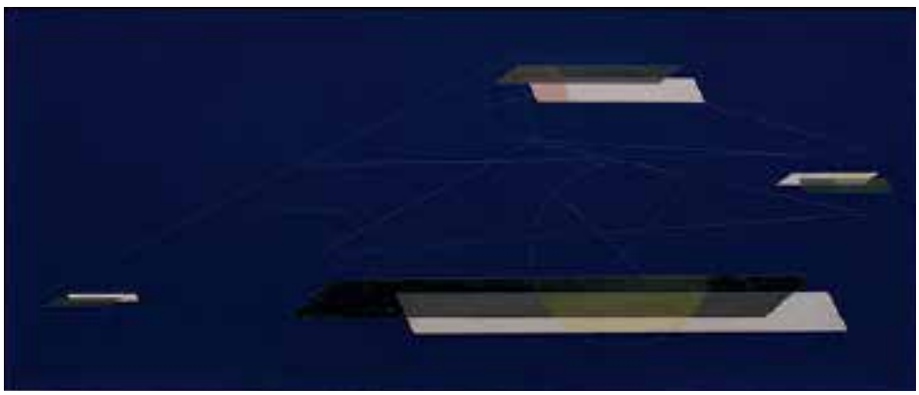
46. See advertisement by Jaroslow's Erste Glimmerwarenfabrik, in Karl Strecker, *Jahrbuch der Elektrotechnik: Übersicht über die Wichstigeren Erscheinungen auf dem Gesamtgebiete der Elektrotechnik* 6 (1917), unpaginated.

47. Jaroslaw´s Erste Glimmerwaren-Fabrik in Berlin, *Verfahren zur Herstellung von hitzebeständigem Papier* (A process for producing a heat-resistant paper), issued 8 March 1918.

48. László Moholy-Nagy, *Malerei Fotografie Film*, 2nd rev. ed., 23.

⑦

László Moholy-Nagy, *Tp 2*, 1930. Oil and incised lines on Trolitan, 24¼ × 56¾ in. Solomon R. Guggenheim Museum, New York. Solomon R. Guggenheim Founding Collection, by gift (37.357)



Moholy worked extensively and enthusiastically with a broad range of plastics whose properties, potentials, and limitations were still being discovered in his lifetime. His correspondence, especially his letters from the late 1930 and '40s, written during his residence in the United States, reveal his nuanced familiarity with the material.[49] Moholy's expertise came in part through his ready and direct engagement with manufacturers, but he also became adept at working with this new material through trial-and-error artistic experiments. Our own ability to understand what he used, however, has been complicated by the names assigned to his materials both by him during his lifetime and in his posthumous records, a state of affairs amply demonstrated by new scientific research conducted on two works at the Solomon R. Guggenheim Museum, *T1* (1926) and *Tp 2* (1930) (fig. 7). The support had been described for decades as Bakelite or Trolitan, phenol formaldehyde plastics. However, scientific analysis has revealed that it is, in fact, cellulose nitrate, possibly circulated under the trade name *Trolit*. The addition of the two letters "-an" in the media lines of the works after 1936 has led to the misidentification of these paintings' support for decades, ascribing them properties they do not have.[50] These new findings point to the urgency of correlating scientific and conservation analysis, with art historical and provenance research in the interpretation of Moholy's plastics.

49. László Moholy-Nagy to Robert Jay Wolff, 6 July 1942, Archives of American Art, Smithsonian Institution, Washington, D.C.

50. See note 16. We are grateful to Julie Barten and Carol Stringari of the Solomon R. Guggenheim Museum in New York and to Johanna Salvant, Francesca Casadio, Marc Walton and Ken Sutherland, scientists associated with the Northwestern University/Art Institute of Chicago Center for Scientific Studies in the Arts (NU-ACCESS), for sharing their still unpublished findings of a research campaign conducted in 2014 to determine scientifically the exact materials and techniques used by Moholy in works in the collection of the Solomon R. Guggenheim Museum.

CHECKLIST

1 ***Architektur 1*** 1922
Oil on canvas, 25 11/16 × 21 13/16 in., The Salgo Trust for Education, New York

PROVENANCE: Nicolas Salgo; Salgo Trust for Education, New York, 1991

EXHIBITED: Valencia-Marseille 1991; New York-New Brunswick 2007, no. 169; New Brunswick 2007–2008; Winnipeg-Berlin 2014–2015

REFERENCES: New York-New Brunswick 2007, 117–21, 135–37; Winnipeg-Berlin 2014–2015, 128.

Architektur 1 is one of Moholy's first abstract paintings and makes use of new materials in its deployment of metallic paint—a highly unusual medium during this period and in Moholy's oeuvre as well. In 1996, Oliver Botar saw the faint outlines of another composition on the reverse of the canvas. During treatment of the painting in 1999, conservator Carol Stringari removed the white-wash layer on the back of the painting to reveal an unrelated early composition. The two paintings show the dramatic transformation of Moholy's aesthetic vocabulary within the span of a few short months. For an extensive description of the painting and its conservation, see Botar 2006.

RELATED WORKS: *Study for Architektur 1*, watercolor on paper, Private collection, New York, published in Chicago-Santa Barbara-Seattle-New York 1969–1970, no. 89; *Architektur*, 1920–21, oil on burlap. Solomon R. Guggenheim Museum, New York, Gift, Andrew Powie Fuller and Geraldine Spreckels Fuller Collection, 2000.42

2 ***Composition*** ca. 1922–23
Paper collage, 12 × 11 in., Santa Barbara Museum of Art, 1953.34.5

PROVENANCE: Gift to the museum by Charlotte Mack, 1953

EXHIBITED: Santa Clara 1986

This collage on black ground relates closely to a number of other works on dark ground executed around the same time and features both metallic and colored papers.

RELATED WORK: *Circle Segments*, 1921, tempera on canvas, Museo Thyssen-Bornemisza, Madrid, inv. no. 676 (1981.31)

3 **Q** 1922/23
Collage with watercolor and pen and black ink over graphite on carbon paper, 23 3/16 × 18 1/4 in. National Gallery of Art, Ailsa Mellon Bruce Fund, 1982.27.1

PROVENANCE: Tommy Noonan, Kensington, Md., by inheritance; National Gallery of Art, by purchase, 1982

EXHIBITED: Washington, D.C., 2001–2002

REFERENCE: Washington, D.C., 2001–2002, 155–56 (no. 47)

Executed against a carbon paper ground with watercolor collage elements, *Q* repeats a compositional structure found in several other works from the period. Typically slipped between two sheets of paper, carbon paper was used to make copies of typed and handwritten documents. In this instance, Moholy uses the velvety, black surface not as a medium of reproduction but as the ground for a collage.

RELATED WORKS: *Q XX*, 1923, oil on wood, Van der Heydt-Museum, Wuppertal; *Q 1 Suprematistic*, 1923, oil on canvas, Museum of Modern Art, The Riklis Collection of McCrory Corporation, 1051.1983; *Suprematistic 1*, 1925, etching, Staatliche Kunstsammlung Kassel

4 Untitled 1922–23
Gouache, watercolor, pencil, charcoal, and pasted paper on black wove paper, 25 ¾ × 19 ½ in. Norton Simon Museum, The Blue Four Galka Scheyer Collection, P.1953.292

PROVENANCE: Purchased from the artist by Galka Scheyer, probably in 1924; Norton Simon Museum by gift, 1953

EXHIBITED: Los Angeles 1927, no. 51; Oakland 1939, no. 22; Oakland 1940; Los Angeles 1941; La Jolla 1960; Pasadena 1989–1990; Pasadena 1994–1996; Seoul 1996; Seattle 1997–1999; Pasadena 2003

REFERENCES: Campbell 1976, 151–52, no. 418; Barnett 2002, 393, no. 393

This collage on black wove paper was likely one of Galka Scheyer's first purchases of Moholy's work and represents one of the first of his works to be shown on the West Coast, included in an exhibition as early as 1927. The compositional structure of this collage relates to lithographs and paintings against dark grounds as well as a painting on light ground, all executed in the early 1920s.

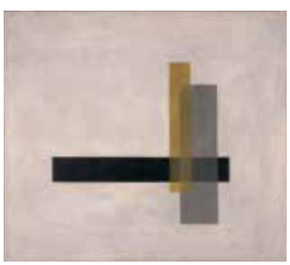
RELATED WORKS: Untitled from *Konstruktionen: Kestnermappe* 6, 1923 (one of six sheets in a lithographic portfolio), Museum of Modern Art, New York, 415.1981.4; *Composition*, 1922-23, oil on canvas, Karl Ernst Osthaus-Museum, Hagen, K 1945

5 *K 1* 1922
Oil on canvas, 30 × 37 ½ in., Smith College Museum of Art, 1951.126

PROVENANCE: Gift of Sibyl Moholy-Nagy, 1951

EXHIBITED: New York 1969–1970, no. 10; Northampton, Mass., 1970–1972

REFERENCE: Northampton, Mass., 1970–1972, no. 39



6 *Composition* 1923
Oil on canvas, 22 ¼ × 25 in., Snite Museum of Art, University of Notre Dame, 1962.028.004

PROVENANCE: Gift of Jean and Julian Aberbach, 1962

EXHIBITED: Weimar 1923

REFERENCE: Wendermann 2009, 239

An installation photograph from 1923 documents the presence of this canvas in the exhibition of the *Freie Arbeiten der Meister, Gesellen und Lehrling des Staatlichen Bauhauses*. Held at the Landesmuseum in Weimar, it was Moholy's first exhibition as a member of the Bauhaus faculty. *Composition* (1923) was shown together with a number of abstract paintings and sculptures that helped to establish Moholy's credentials as a Constructivist artist.

7 *G. SMIRG* 1923
Watercolor and collage on sandpaper, 9 × 11 11/16 in., Saint Louis Art Museum, Museum purchase and bequest of Horace M. Swope by exchange, 67:1969.

PROVENANCE: Gift from the artist to Crombie Taylor, Chicago and Village Green, Calif.; O.P. Reed, Jr., Los Angeles, 1970; Saint Louis Art Museum, by purchase, 1970

EXHIBITED: Chicago 2010

REFERENCE: City Art Museum of Saint Louis 1970

Moholy's title for this work refers to an emery paper commonly used to polish and abrade metal surfaces. It was a staple of any metal and woodworking shop, readily available to Moholy in 1923 when he served as the head of the metal workshop at the Bauhaus. Here, the rough emery surface, an invisible tool in the production of finished metal goods, becomes the textured support for his delicate watercolor and collage. Like the collage *Q* on carbon paper, Moholy explores the use of commonplace materials in ways wholly counter to their intended uses.

RELATED WORK: *Emery Paper Collage*, 1930, emery paper, cartridge paper, and poster paint, Whitworth Art Gallery, University of Manchester, 1936.17

8 **Untitled** ca. 1924
Linoleum cut, 10 ¾ × 8 in., Santa Barbara Museum of Art, 2006.6.2

PROVENANCE: Possible gift from artist to Martin Metal; Stephen Wirtz Gallery; consignment to Catherine E. Burns; Santa Barbara Museum of Art, by purchase, 2000

Moholy made a number of linoleum cuts especially in the early 1920s and published several prints in issues of *Der Sturm*. Linoleum was introduced as flooring material in the 1860s but soon was adopted by artists for printmaking because it was easier to work with than metal or wood printing plates. In this and other linoleum cuts, Moholy experimented with different hatched, lined, and dotted patterns to create effects of depth, translucency, and transparency even when printed against a dark ground.

9 ***Photogram*** about 1924
Gelatin silver print [photogram on developing paper], 9 7/16 × 11 ¾ in., The J. Paul Getty Museum, Los Angeles, 84.XM.231.4

PROVENANCE: Daniel Wolf, New York

REFERENCE: Molderings, Heyne, and Moholy-Nagy 2010, 211, fgm 293

This cameraless photograph, known as a photogram, was produced by exposing to light photo-sensitive paper on which napkin rings and scattered matchsticks had been placed. The photogram produced is a unique image that could serve as a negative to reproduce positive mirror-reversed prints or could be photographed to make copies and enlargements.

10 ***Z VI*** 1925
Oil on canvas, 37 ½ × 29 ¾ in., Harvard Art Museums/Busch-Reisinger Museum, The Fredric Wertham Collection, Gift of his wife Hesketh, 1987.78

PROVENANCE: Valentine Gallery, New York; Walter P. Chrysler Collection; Parke-Bernet, New York, 22 March 1945, no. 102; acquired after auction by Fredric Wertham; Busch-Reisinger Museum, by gift, 1987

EXHIBITED: Brooklyn 1926–1927, no. 135; New York 1936, no. 177; Cambridge, Mass., 1990, no. 85

REFERENCE: Cambridge, Mass., 1990, 45, no. 85

Along with three other paintings by Moholy, *Z VI* was exhibited in 1926–27 at the Société Anonyme exhibition, held at the Brooklyn Museum of Art, and later in Alfred Barr's seminal 1936 exhibition *Cubism and Abstract Art* at the Museum of Modern Art. In both cases, Moholy's paintings were presented as works that exemplify the constructivist impulse in European art. The painting is in remarkably good condition. Its delicate surface reveals the subtle ways Moholy played with local varnish and varied the richness of his paint medium to minimize the facture of his brush and emulate machine-finished textures.

RELATED WORK: See cat. no. 16

11 ***Planes Cutting Planes*** 1926
Watercolor and graphite on paper, 19 ½ × 13 ⅝ in., Yale University Art Gallery, Gift of Collection Société Anonyme, 1941.574

PROVENANCE: Purchased from the artist by Katherine Dreier for the Société Anonyme, probably 1927; Yale University Art Gallery, by gift

EXHIBITED: Cambridge, Mass., 1952; Buffalo 1968; Chicago-Santa Barbara-Seattle-New York 1969–1970, no. 97; New Haven 1984

REFERENCE: Herbert 1984, no. 478

RELATED WORK: *Composition AXI*, 1923 (oil on canvas), Gemeentemuseum Den Haag, The Hague

12 AL 3 1926
Oil, industrial paints, and pencil on aluminum, 15¾ × 15¾ in., Norton Simon Museum, The Blue Four Galka Scheyer Collection, P.1953.293

PROVENANCE: Gift of the artist to Galka Scheyer in 1928; Norton Simon Museum, by gift in 1953.

EXHIBITED: Oakland 1939, no. 21; Oakland 1940; Los Angeles 1941; La Jolla 1960; Stuttgart-Tokyo 1968–1971; Pasadena 1989–1990; Pasadena 1994–1996; Seoul 1996; Seattle 1997; Pasadena 2003

REFERENCES: Campbell 1976, 151, 153 , no. 417; Campbell Abdo 1989, 192; Barnett 2002, 388–90, no. 395

Over the course of his career, Moholy painted a number of works on aluminum, a lightweight metal that was newly developed for use in aviation. When the Bauhaus moved the school to Dessau in 1924, the school cultivated relationships with Junkers, a company that made airplanes, engines, and heating elements. This particular painting was executed using a range of materials including oil and industrial paints applied both by spray machine and by brush. The painting had once featured a prominent blue circle, a defining element that appealed especially to Galka Scheyer, founder of the Blue Four artists group that included Alexei Jawlensky as well as Bauhaus faculty members Lyonel Feininger, Paul Klee, and Vasily Kandinsky. Moholy gave Scheyer the painting as a gift in 1928 but as correspondence attests, the industrial paints swiftly changed over time and by the mid-1930s, its colors had shifted entirely. Scheyer asked that Moholy restore the blue color; Moholy appreciated the new palette the painting had taken on but nonetheless agreed to restore it. It remains unclear how Moholy treated the painting before returning it to Scheyer.

13 *TRB 1* 1928
Oil on plastic, 10⅜ × 15¾ in., Estate of László Moholy-Nagy

EXHIBITED: London 2004, no. 18

This small plastic painting demonstrates Moholy's interest in varying surface textures in the late 1920s. The title may refer to the plastic substrate used in this painting (Turbonit?), but additional scientific analysis would be required to verify the materials.

14 *Light Prop for an Electric Stage* 1929–30
Exhibition replica, constructed in 2006 through the courtesy of Hattula Moholy-Nagy
Metal, plastics, glass, paint, and wood, with electric motor, 59 7/16 × 27 9/16 × 27 9/16 in.
Harvard Art Museums/Busch-Reisinger Museum, Hildegard von Gontard Bequest Fund, 2007.105

PROVENANCE: Exhibition replica constructed in 2006, courtesy of Hattula Moholy-Nagy

EXHIBITED: London-New York 2006–2007; New York 2009–2010; Chicago 2010; Hayama-Kyoto-Kawamura 2011, no. III-090

REFERENCES: Lie 2007; New York 2009–2010, 274

Light Prop for an Electric Stage was originally given to the Busch-Reisinger Museum in 1956 by Sibyl Moholy-Nagy and arrived already with a number of mechanical problems and required extensive repair and the replacement of many of its original components. In the course of the 1950s and 1960s, with growing interest in machine, light, and kinetic art, *Light Prop* was frequently requested and loaned. However, *Light Prop* was rarely shown in operation because of concerns about its condition. Sibyl Moholy-Nagy worked with Howard Wise Gallery and Nan Piene [later Rosenthal] to authorize the production of two working replicas in 1970. Howard Wise was well known for his pioneering work promoting the art of new media. Nan Piene had written her master's thesis at Harvard on *Light Prop* and had published widely to promote light and kinetic art at the time. Unveiled in 1970, the two *Light Prop* replicas were shown at the Howard Wise Gallery in New York and later at the Venice Biennial in 1970. One replica was acquired by the Bauhausarchiv in Berlin and the other by the Van Abbemuseum in Eindhoven. These two replicas, however, share some of the mechanical problems posed by the original, making the frequent loan of these objects increasingly unsustainable. The Tate London worked with the Estate of Moholy-Nagy, the Busch-Reisinger, Van Abbemuseum, and the Bauhausarchiv to build a third traveling replica for their 2006 exhibition of *Albers and Moholy-Nagy*. This third iteration was made explicitly as a traveling exhibition replica intended to demonstrate the machine in motion.

15 ***A Lightplay: Black White Gray*** 1930
[filmed winter 1931; shown 1932 according to recent research by Jeanpaul Goergen],
DVD transfer of film, Estate of László Moholy-Nagy

REFERENCES: Stahli 2006; Madrid-Berlin-The Hague 2010–2011, 197–201, 246 (J. Goergen)

16 ***Z VII*** 1926
Oil on canvas, 37½ × 30 in., National Gallery of Art, Gift of Richard S. Zeisler, 2007.112.1

PROVENANCE: Artist; Sibyl Moholy-Nagy by inheritance; Rose Fried Gallery; Richard Zeisler, by purchase,1960, gift to National Gallery of Art, 2007

EXHIBITED: Brooklyn 1926–1927, no. 129; Bratislava-Brno 1934; London 1936–1937, no. 21; New York 1947, no. 40

REFERENCES: Tsai 2009; Tsai, Krueger, and Maines 2013

Z VII was one of four paintings included at the *International Exhibition of Modern Art* held at the Brooklyn Museum in the winter of 1926–27, organized by Katherine Drier for the Société Anonyme and was later sent back with the other paintings shown that Drier did not sell. It traveled extensively to a number of exhibitions throughout Europe in the 1930s, and the painting bears the evidence of its active exhibition history. The canvas was at one point torn, and Moholy repaired and repainted it using both traditional oil and enamel paints. This painting has been the subject of extensive collaborative technical study. See Tsai, Krueger, and Maines 2013.

RELATED WORKS: *Z I*, 1922, oil on canvas, Bauhaus Archiv, 2921; *Z II*, 1925, oil on canvas, Museum of Modern Art, New York, 18.1956; *Z III*, 1922, oil on canvas, Private collection; *Z IV*, 1923, oil on canvas, last known Marlborough Fine Art, no. *XLOL* 3449; *Z VI*, 1925, oil on canvas, Busch-Reisinger Museum, Harvard Art Museums (no. 10 above); *Z VIII*, 1924, oil on canvas, Nationalgalerie Berlin; *Z IX*, 1924, oil on canvas, Kunsthalle Mannheim

17 László Moholy-Nagy and František Kalivoda ***telehor*** issue 1–2 (1936)
Color offset print, 11⅝ × 8¼ in., National Gallery of Art Library, N1.T4

A complete color reprint of *telehor* is now available in a superb commentary edition. See Botar and Grubers 2013.

18 ***Dufay Color Photography (Light Filtering)*** 1935, from ***Vision in Motion*** 1st ed.
(Chicago: Paul Theobald & Co, 1947), 11 × 8 in., Santa Barbara Museum of Art Purchase

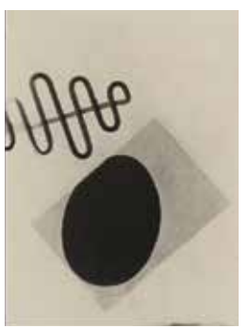
19 **Set designs for *Things to Come*** 1936
Gelatin silver prints, Estate of László Moholy-Nagy

EXHIBITED: Paris 1976–1977, 24, no. 123; Valencia-Marseille 1991, 361; Hayama-Kyoto-Kawamura 2011, V-068, V064

REFERENCE: Frayling 1995, 61, 72–75

20 **Prospectus and application form for the New Bauhaus American School of Design, Chicago** [1937]
National Gallery of Art Library

Designed by Moholy, this brochure advertising the New Bauhaus makes use of photographic stills of special effects never used from his work on the film *Things to Come* (1937). See Plate no. 19.



21 ***Photogram*** 1927
Gelatin silver print, 9 ¼ × 6 ³⁄₁₆ in., The J. Paul Getty Museum, Los Angeles, 84.XM.997.64

PROVENANCE: Arnold Crane, Chicago

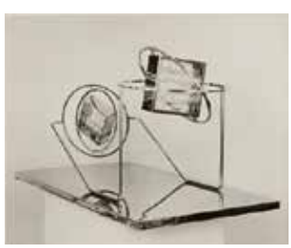
REFERENCES: Ware 1996, 64, no. 34; Molderings, Heyne, and Moholy-Nagy 2010, 139, fgm 147a

This is an image made initially by placing objects on photosensitive paper to produce a photogram that serves as a negative, from which this positive print was made. The forms found in this particular image — an ovoid and wave shapes — find their way into the paintings of Moholy's late career, especially cat. no. 22.

22 ***CH Space 6*** 1941
Oil on canvas, 46 ⅞ × 46 ⅞ in., Estate of László Moholy-Nagy

EXHIBITED: New York 1947, no. 92; Chicago-Santa Barbara-Seattle-New York 1969–1970; Paris 1976–1977, no. 133; London 2004; Frankfurt 2009–2010; Hayama-Kyoto-Kawamura 2011, no. V-003

Moholy often titled his paintings after the place where they were made; paintings that begin with the designation *CH* refer to work made during his time in Chicago. The forms found in this painting — the fluid ribbon and bright colored oval — are mainstays of his later paintings. Not only do they draw from the aesthetic vocabulary of his color photographs, but the curves recall his earlier experiments in photograms as well.



23 **"Gyros" Photograph Set** 1936
Gelatin silver prints, 9 ½ × 11 ½ in., Estate of László Moholy-Nagy

EXHIBITED: Valencia-Kassel-Marseille 1991, 360; 2011 Hayama-Kyoto-Kawamura, nos. IV-044 to IV-046

These photographs are of a special-effects mechanism Moholy built for use in the film *Things to Come*. The sculpture, consisting of mercury-filled glass tubes that spun against a highly reflective background, was exhibited in his London Gallery show in 1936–37, and his daughter remembers the object in their home in Chicago. The forms of this object are found in a number of his late paintings, including *CH XI (39)* (see cat. no. 24).

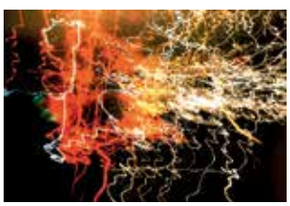
24 ***CH XI (39)*** 1939
Oil on canvas, 18½ × 25 1/16 in., Mills College Art Museum, Oakland, Susan L. Mills Fund, 1940.181

PROVENANCE: Purchased by Mills College Art Museum from the artist in 1940

EXHIBITED: Oakland 1940; Chicago 2010; Oakland 2011

REFERENCE: Oakland 2011, 15–17 (E. Mauermann)

CH XI (39), acquired by Mills College from the artist in 1940, demonstrates Moholy's use of techniques and forms explored in other media. Not only does he borrow from the serpentine shapes of his wire and glass-filled sculptures; he also inscribes directly on the painted surface of his canvas, using a technique he developed for his paintings on plastic.



25 **Kodachrome copy slides**
Estate of László Moholy-Nagy

PROVENANCE: Selected and produced by the Estate of László Moholy-Nagy

EXHIBITED: Valencia-Marseille 1991, 392; Berlin 2006; London-New York 2006–2007, no. 106.

REFERENCE: Fiedler and Moholy-Nagy 2006

Moholy experimented with color photography beginning in the early 1930s but because of the expense and complexity of the medium rarely printed his color photographs in his lifetime. Once in the United States, Moholy embraced the use of Kodachrome, which had been introduced to the market in 1935. According to his daughter, he had his color film developed commercially like any amateur photographer. The slides produced were used in his pedagogy, but they also played an important role in the continued development of his paintings. Jeannine Fiedler, working with Hattula Moholy-Nagy, in 2006 produced a superb catalog with detailed technical information on the surviving color slides. In addition, a selection of these slides was produced as Fujicolor prints by the Andrea Rosen Gallery in an edition of ten, authorized by the estate.

26 ***CH for R1 Space Modulator*** 1942
Oil on red Formica, 60 5/8 × 23 5/8 in., Estate of László Moholy-Nagy

EXHIBITED: New York 1947, no. 102 [as *CH F R-1*, medium given as oil on Bakelite]; New York 1957, no. 35; Paris 1976–1977 [as *Scene from my Light Play Black White Gray*], no. 138 [as *CHF Space-Modulator*, 1942]; Valencia-Marseille 1991, 335; London-New York 2006–2007, no.103; Frankfurt 2009–2010, 155; Hayama-Kyoto-Kawamura 2011, no. V-020; Winnipeg-Berlin 2014–2015

Moholy painted this work on Formica, and motifs present in this particular painting relate closely to stills of his film *Light Play, Black White Gray* but rendered in color. Its different titles speak to the location of its making: *CH* for Chicago; *F* for Formica; and *R-1* for red. A similar logic is at play in no. 27, *CH for Y Space Modulator*. The alternative title speaks to the ways in which Moholy considered his paintings in explicit dialogue with his film projects, even if not realized in color.

27 ***CH For Y Space Modulator*** 1942
Oil on yellow Formica, 60⅝ × 23⅝ in., Estate of László Moholy-Nagy

EXHIBITED: New York 1947, no. 103 [labeled as *CHF Y*, medium given as oil on board]; Valencia-Marseille 1991, 334; Hayama-Kyoto-Kawamura 2011, no v. 019; London-New York 2006–2007, no. 102; Frankfurt 2009–2010, 154; Winnipeg-Berlin 2014–2015

The motif in this painting bears close affinities with Moholy's early experiments in color photography in which he took as his object of experimentation translucent color plastic filters, for example in the Dufay photograph published in cat. no. 18.

28 ***Leuk 5*** 1946
Oil and pencil on canvas, 30¼ × 38 in., Smithsonian American Art Museum, Washington, D.C., Gift of Patricia and Phillip Frost, 1986.92.66

PROVENANCE: Artist; Sibyl Moholy-Nagy by inheritance; Remi and Marthe Loyson Gassmann, Chicago; Sotheby's New York, "Modern Paintings, Drawings and Sculpture," 5 November 1982, lot 290; Patricia and Phillip Frost; Smithsonian American Art Museum, by gift, 1986.

EXHIBITED: Chicago 1947, no. 20; Seattle 1948; Cambridge, Mass., 1950, no. 12; Colorado Springs 1950; Coral Gables 1983; Washington, D.C., 1990; Washington, D.C., 2001–2002, no. 61

REFERENCES: Washington, D.C., 1990, 133–35; Washington, D.C., 2001–2002, no. 61

29 **Untitled (*Space Modulator*)** 1946
Oil on Plexiglas, 14½ × 8½ in., McMaster Museum of Art, McMaster University 1995.032.0002LB

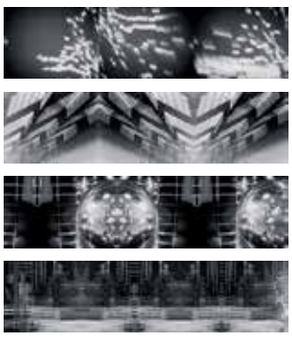
PROVENANCE: Acquired from the artist by Ralph Weir, 1946; acquired by Annely Juda Fine Art, London, by 1995; purchased by McMaster Museum of Art 1995

EXHIBITED: London-Düsseldorf 1995, no. 38

REFERENCES: Watson 1996, 78; Winnipeg-Berlin 2014–2015, 00

Untitled *(Space Modulator)* exemplifies Moholy's approach to painting on clear plastic supports in his late career. Moholy began by inscribing his design on both sides of the plastic. Borrowing from printmaking, he applied paint to certain inscribed areas and wiped the surface afterwards to embed scratched lines with residual color. In other areas, he contrasted thickly applied, highly textured paint with drier, stippled effects. Set at a distance from the backing board, the painting creates a range of light and shadow effects under different viewing conditions.

RELATED WORK: Untitled [1946], published in London-Bielefeld-New York 2006–2007, 142, no. 107



30 Jan Tichy ***Things to Come*** 1936–2012
Three-channel digital video projection, Edition 2 of 5, Richard Gray Gallery

EXHIBITED: Tel Aviv 2012–2013; Como 2013

In the winter of 1935, László Moholy-Nagy shot special effects for the British science fiction movie, *Things to Come*. He filmed explosions, glittering cascades of light, gyrating contraptions, and spinning glass globes to show future industry in action. Using a range of highly reflective metallic materials, translucent plastic sheets, glass cones, and tautly stretched wire, Moholy built cityscapes with dynamic spinning parts, open parabolic arcs, cantilevered forms, and crystalline skyscrapers. Innovative as these effects were, very few of Moholy's contributions were included in the movie, and he was never credited during his lifetime. Much of what survives of Moholy's contributions exists in the form of photographic stills (see cat. no. 19). However, a film canister with his unused special effects was found in the archives of the Denham Studios in the 1970s.

Jan Tichy's synchronized three-channel digital projection makes use of Moholy's once-lost film clips. Each cycle begins and ends with Moholy's original, played in its entirety in a single channel. In between, Tichy subjects Moholy's film segment to a number of transformations. Mirroring, reversals of positive and negative sequences, superimposition, and other techniques create profoundly different effects. The first cycle unfolds into luminous, syncopated waves of lights. Individual sheets of plastic and metal coalesce by the end of the second cycle into a cavernous and jagged interior. The third plays with globes and viscous liquid to suggest the fluid materials of a mysterious laboratory experiment. The final cycle starts with Moholy's mockup of the city of the future and through the tight doubling and trebling of images across the three screens, the model exterior becomes the dizzying stage set for abstract moving parts. Working over three-quarters of a century after these special effects were filmed, Tichy uses our present technology to recover Moholy's lost film and creates a vision of the world as future past.

SELECTED EXHIBITIONS

Berlin 1923
Moholy-Nagy and Péri. Galerie der Sturm, February 1923.

Weimar 1923
Freie Arbeiten der Meister, Gesellen und Lehrling des Staatlichen Bauhauses. Landesmuseum, 15 August–30 September 1923.

Brooklyn 1926–1927
International Exhibition of Modern Art. Brooklyn Museum, 19 November 1926–1 January 1927 (catalog by Katherine Drier).

Los Angeles 1927
Constructivist Drawings and Posters. Art Department of the University of California, Los Angeles, 1927.

Bratislava-Brno 1934
L. Moholy-Nagy. Kunstgewerbeschule, Bratislava, 2–11 May 1934; Dom Umeni, Brno, 1–16 June 1934.

New York 1936
Cubism and Abstract Art. Museum of Modern Art, March–April 1936 (catalog by Alfred Barr).

London 1936–1937
László Moholy-Nagy. London Gallery, 31 December 1936–27 January 1937.

Oakland 1939
Abstract Art Show. Mills College Art Gallery, 19 October–3 December 1939.

Oakland 1940
Moholy-Nagy. Mills College Art Gallery, 1940.

Los Angeles 1941
Moholy-Nagy, Stendahl Art Galleries, 1941.

New York 1947
László Moholy-Nagy Memorial: The Solomon R. Guggenheim Foundation Presents a Survey of the Artist's Paintings and Plastics. Museum of Non-Objective Painting, 15 May–10 July 1947 (catalog by Hilla Rebay).

Chicago 1947
L. Moholy-Nagy. Art Institute of Chicago, 18 September–26 October 1947.

Seattle 1948
Moholy-Nagy Memorial Show. Henry Art Gallery, University of Washington, 1948.

Cambridge, Mass., 1950
Works by Moholy-Nagy. Fogg Art Museum, Harvard University, 6–27 February 1950.

Colorado Springs 1950
Moholy-Nagy. Colorado Springs Fine Arts Center, 15–31 May 1950.

Cambridge, Mass., 1952
Gropius, Architect and Teacher: The Bauhaus Artists. Busch-Reisinger Museum, Harvard University, 2 January–9 February 1952.

New York 1957
László Moholy-Nagy, 1895–1946. Kleemann Galleries, October 1957 (catalog).

La Jolla 1960
The Galka Scheyer Collection: Klee, Nolde, Jawlensky, Moholy-Nagy, Schmidt-Rottluff, Schwitters, Archipenko, Kandinsky, Lissitzky, Feininger, Kirchner, Dix. Art Center in La Jolla, 5 July–14 August 1960.

Buffalo 1968
Plus by Minus. Albright-Knox Gallery, 3 March–14 April 1968.

Stuttgart-Tokyo 1968–1971
50 Years Bauhaus. Traveling exhibition organized by the Württembergischer Kunstverein, Stuttgart (catalog edited by Wulf Herzogenrath).

Chicago-Santa Barbara-Seattle-New York 1969–1970
László Moholy-Nagy. Museum of Contemporary Art, 31 May–13 July 1969; Santa Barbara Museum of Art, 2 August–21 September 1969; Seattle Art Museum, 21 November 1969–4 January 1970; Solomon R. Guggenheim Museum of Art, 20 February–19 April 1970 (catalog by Jan van der Marck and Thomas Messer).

Northampton 1970–1972
Nineteenth- and Twentieth-Century Paintings from the Collection of the Smith College Museum of Art. Organized by Smith College; circulated by the American Federation of Arts, 1970–1972 (catalog by Mira Matherny Fabian et al.).

Paris 1976–1977
László Moholy-Nagy. Centre national d'art et de culture Georges Pompidou, 18 November 1976–31 January 1977 (catalog by Hannah Weitemeier et al.).

Coral Gables 1983
The Russian Avant Garde and American Abstract Artists. Lowe Art Museum, University of Miami, 1983

New Haven 1984
Art for a New Era: Collection of the Société Anonyme, 1920–1950, Yale University Art Gallery, 25 April–26 August 1984.

Santa Clara 1986
The Artist and the Machine: 1910–1940. De Saisset Museum, University of Santa Clara, California, 17 January–16 March 1986 (catalog by Georgiana M. Lagoria).

Pasadena 1989–1990
Paths to Abstraction: Pioneers of Early Twentieth-Century Painting. Norton Simon Museum, 19 January 1989–14 January 1990.

Cambridge, Mass., 1990
The Fredric Wertham Collection: Gift of His Wife Hesketh. Busch-Reisinger Museum, Harvard University, 26 May–22 July 1990 (catalog by Emilie Norris et al.).

Washington, D.C., 1990
The Patricia and Phillip Frost Collection: American Abstraction, 1930–1945. National Museum of American Art, Smithsonian Institution, 8 September 1989–11 February 1990 (catalog by Virginia M. Mecklenberg).

Valencia-Kassel-Marseille 1991
László Moholy-Nagy. IVAM, Centre Julio González, Valencia, 11 February–7 April 1991; Fridericianum, Kassel, 21 April–16 June 1991; Musée Cantini, Marseille, 5 July–15 September 1991 (catalog by Catherine David and Corinne Diserens).

Pasadena 1994–1996
The Spirit of Modernism: Galka Scheyer in the New World. Norton Simon Museum, 17 November 1994–14 January 1996.

London-Paris-Düsseldorf 1995
1945: The End of the War. Annely Juda Fine Art, London, 28 June–16 September 1995; Galerie Denise René, Paris, 26 September–4 November 1995; Galerie Hans Meyer, Düsseldorf, 11 November–20 December 1995 (catalog).

Seoul 1996
Bauhaus Painters: Spirit of Modernism; Wassily Kandinsky, Paul Klee, Lyonel Feininger, László Moholy-Nagy, El Lissitzky, Oskar Schlemmer, Alexander Archipenko, Alexei Jawlensky, and Others, Ho-Am Art Museum, 8 February–28 April 1996.

Seattle 1997–1999
The Blue Four-Galka Scheyer Collection from the Norton Simon Museum. Henry Art Gallery, University of Washington, 17 July 1997–5 October 1999.

Washington, D.C., 2000–2002
Modernism and Abstraction: Treasures from the Smithsonian American Art Museum. National Museum of American Art, Smithsonian Institution, traveling exhibition, 7 January 2000–29 September 2002 (catalog edited by Miranda McClintic).

Washington, D.C., 2001–2002
A Century of Drawing: Works on Paper from Degas to LeWitt. National Gallery of Art, 18 November 2001–7 April 2002 (catalog by Judith Brodie and Andrew Robison).

Pasadena 2003
From Europe to California: Galka Scheyer and the Avant-Garde. Norton Simon Museum, 16 May 2003–13 October 2003.

London 2004
László Moholy-Nagy: A Life in Motion: Paintings, Sculpture, Drawings and Photography. Annely Juda Fine Art, 17 October–18 December 2004 (catalog by Hattula Moholy-Nagy et al.).

New York-New Brunswick 2006
Technical Detours: The Early Moholy-Nagy Reconsidered. Art Gallery of the Graduate Center, City University of New York, 1 March–22 April 2006; Jane Voorhees Zimmerli Art Museum, Rutgers University, 1 September–31 October 2006 (catalog by Oliver A.I. Botar).

Berlin 2006
Color in Transparency: Photographic Experiments in Color, 1934–1946 [= *Fotografische Experimente in Farbe, 1934–1946*]. Bauhaus Archiv, 20 June–4 September 2006 (catalog edited by Jeannine Fiedler and Hattula Moholy-Nagy).

London-Bielefeld-New York 2006–2007
Albers and Moholy-Nagy: From the Bauhaus to the New World. Tate Modern, 9 March–4 June 2006; Kunsthalle Bielefeld, 25 June–1 October 2006; Whitney Museum of American Art, 2 November 2006–21 January 2007 (catalog by Achim Borchardt-Hume et al.).

Cambridge, Mass., 2007
Light Display Machines: Two Works by László Moholy-Nagy. Busch-Reisinger Museum, Harvard University Art Museums, 21 July–4 November 2007.

New Brunswick 2007–2008
The Magyar Imagination: Selections from the Salgo Trust Donation of Hungarian Art. Jane Voorhees Zimmerli Art Museum, Rutgers University, 9 December 2007–20 March 2008.

Frankfurt 2009–2010
László Moholy-Nagy Retrospective. Schrin Kunsthalle, 8 October 2009–7 February 2010 (catalog edited by Ingrid Pfeiffer and Max Hollein).

New York 2009–2010
Bauhaus 1919–1933: Workshops for Modernity. Museum of Modern Art, 8 November 2009–25 January 2010 (catalog edited by Barry Bergdoll and Leah Dickermann).

Chicago 2010
László Moholy-Nagy: An Education of the Senses. Loyola University Museum of Art, 11 February–9 May 2010.

Madrid-Berlin-The Hague 2010–2011
László Moholy-Nagy: The Art of Light: Madrid: Círculo de Bellas Artes,1 June–30 August 2010; Berlin: Martin-Gropius Bau, 4 November 2010–16 January 2011; The Hague: Gemeentemuseum Den Haag, 29 January–1 May 2011 (catalog edited by Olivia Maria Rubio et al.).

Oakland 2011
The Summer Sessions 1933–1952: Visiting Artists at the Mills College Art Museum, Mills College Art Museum, 15 June–28 August 2011 (catalog edited by Stephanie Hanor and Lori Chinn).

Hayama-Kyoto-Kawamura 2011
Moholy-Nagy in Motion. The Museum of Modern Art, Kamakura and Hayama, 16 April–10 July 2011; The National Museum of Modern Art, Kyoto, 20 July–4 September 2011; Kawamura Memorial DIC Museum of Art, 17 September–11 December 2011 (catalog by Iguchi Toshino et al.).

Tel Aviv 2012–2013
Luma, Shpilman Institute for Photography, 24 May 2012–24 March 2013.

Como 2013
La citta nuova. Villa Olmo, 24 March–14 July 2013.

Winnipeg-Berlin 2014–2015
Sensing the Future: Moholy-Nagy, Media and the Arts. Plug In Institute of Contemporary Art, 7 March–2 June 2014; Bauhausarchiv 7 October–5 December 2015 (catalog by Oliver A.I. Botar).

SELECTED BIBLIOGRAPHY

Barnett 2002
Vivian Endicott Barnett. *The Blue Four Collection at the Norton Simon Museum*. New Haven and London: Yale University Press, 2002.

Botar and Grubers 2013
Oliver A.I. Botar and Klemens Grubers. *Telehor: Kommentarband/Commentary and Translations*. Zurich: Lars Müller, 2013.

Campbell 1976
Sara Campbell. *The Blue Four Galka Scheyer Collection*. Pasadena: Norton Simon Museum of Art, 1976.

Campbell Abdo 1989
Sara Campbell Abdo, ed. *Masterpieces from the Norton Simon Museum*. Pasadena: Norton Simon Museum of Art, 1989.

City Art Museum of Saint Louis 1970
City Art Museum of Saint Louis. "Among Recent Acquisitions: A Collage by Moholy-Nagy." In *Bulletin of the City Art Museum of Saint Louis* 5, no. 6 (March–April, 1970): 4–6.

Fiedler and Moholy-Nagy 2006
Jeannine Fiedler and Hattula Moholy-Nagy, eds. *Laszlo Moholy-Nagy: Color in Transparency; Photographic Experiments in Color*. Göttingen: Steidl Publishers, 2006.

Frayling 1995
Christopher Frayling. *Things to Come*. London: BFI, 1995.

Herbert 1984
Robert L. Herbert et al. *The Société Anonyme and the Dreier Bequest at Yale University: A Catalogue Raisonné*. New Haven and London: Yale University Press, 1984.

Lie 2007
Henry Lie. "Replicas of Lázsló Moholy-Nagy's 'Light Prop': Busch-Reisinger Museum and Harvard University Art Museums." *Tate Papers* no. 8 (2007) (www.tate.org.uk/research/publications/tate-papers/issue-08)

Molderings, Heyne, and Moholy-Nagy 2010
Herbert Molderings, Renate Heyne, and Hattula Moholy-Nagy, eds. *László Moholy-Nagy: The Photograms; Catalogue Raisonné*. Ostfildern: Hatje Cantz, 2010

Stahli 2006
Jan Stahli. *Filmische Sinneserweiterung: László Moholy-Nagys Filmwerk und Theorie*. Marburg: Schüren, 2006.

Tsai 2009
Joyce Tsai. "Excavating Surface: On the Repair and Revision of László Moholy-Nagy's *Z VII* (1926)." In *Bauhaus Palimpsest Bauhaus Construct: Fashioning Identity, Discourse, and Modernism*, edited by Robin Schuldenfrei and Jeffrey Saletnik, 142–62. London: Routledge, 2009.

Tsai, Krueger, and Maines 2013
Joyce Tsai, Jay Krueger, and Christopher Maines. "'Transparency and Light, Structure and Substance': Enamel Paints in László Moholy-Nagy's *Z VII* (1926)." *Journal of the American Institute of Conservation* 52, no. 4 (2013): 236–45.

Ware 1995
Katherine Ware, *In Focus: László Moholy-Nagy: Photographs from the J. Paul Getty Museum*. Los Angeles: J. Paul Getty Museum, 1995.

Watson 1996
Jennifer C. Watson. *The Levy Legacy: A Commemorative Booklet to Celebrate the Contribution of the Levy Family of Hamilton, Ontario, and the Exceptional Gifts of Dr. Herman Herzog Levy, OBE, to McMaster University*. Hamilton: McMaster University Press, 1996.

Weitemeier 1972
Hannah Weitemeier. *Licht-Visionen: Ein Experiment von Moholy-Nagy*. Berlin: Bauhausarchiv, 1972.

Wendermann 2009
Gerda Wendermann. "Die Freie Kunst in der Bauhaus Ausstellung, 1923." In *Klassik und Avantgarde: Das Bauhaus in Weimar, 1919–1925 (Jahrbuch Klassik Stiftung Weimar)*, edited by Hellmut Seemann and Thorsten Valk, 224–56. Göttingen: Wallstein Verlag, 2009.

CONTRIBUTORS

Joyce Tsai
is assistant professor of modern and contemporary art at the University of Florida, Gainesville.

Friederike Waentig
is professor of conservation at the Cologne Institute of Conservation Sciences / Institut für Restaurierungs- und Konservierungswissenschaft.

James Merle Thomas
is a 2014–2016 Provost's Postdoctoral Scholar in the Humanities at the University of Southern California.

PHOTOGRAPHY CREDITS

Photographs were in most cases provided by the institutions or individuals owning the works and are published with their permission; their courtesy and the generosity of the Estate of László Moholy-Nagy are gratefully acknowledged.