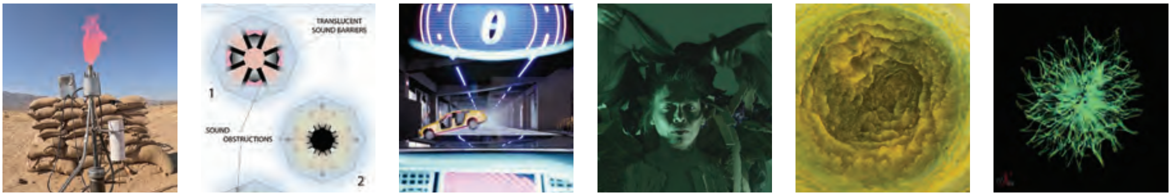
A Report on the LACMA Art + Technology Lab 2014–2025



We may be the producers or directors, or writers, or what have you, that are involved in this complex of work. But we are really performing in the greatest tradition of theatre, no time, no money, all impossible deeds, but somehow it gets across and some accomplishment comes from it.

— Ken Tyler, 1970

The spirit of invention of which Ken Tyler—master printer and a collaborating partner in the original 1967–71 program—spoke has continued to animate the work of the artist technologists of the LACMA Art + Technology Lab. This book tells the story of the Lab's first ten years.

All Impossible Deeds

All Impossible Deeds: A Report on the LACMA Art + Technology Lab 2014–2025

Edited by
Joel Ferree

With contributions by
Amy Heibel
Claire L. Evans
William Hackman
David Karwan

Los Angeles County Museum of Art
DelMonico Books • D.A.P.

p. 2 Agnieszka Kurant, *Chemical Garden*, 2021–ongoing (detail)

p. 4 Screenshot of *ECHOES* (featuring American Artist; MUXX; Jacqueline Kiyomi Gork and Rhett LaRue; Lawerence Lek; Jen Liu; Ronald Rael and Virginia San Fratello; and Sarah Rara), February 4–May 6, 2022

p. 6 ScanLAB Projects, *Post-lenticular Landscapes*, 2017

p. 8 American Artist, AI-generated image of the Mojave Test Area, hand-drawn diagram of GALCIT test replica by Dave Nordling

Contents

Sponsor's Statement

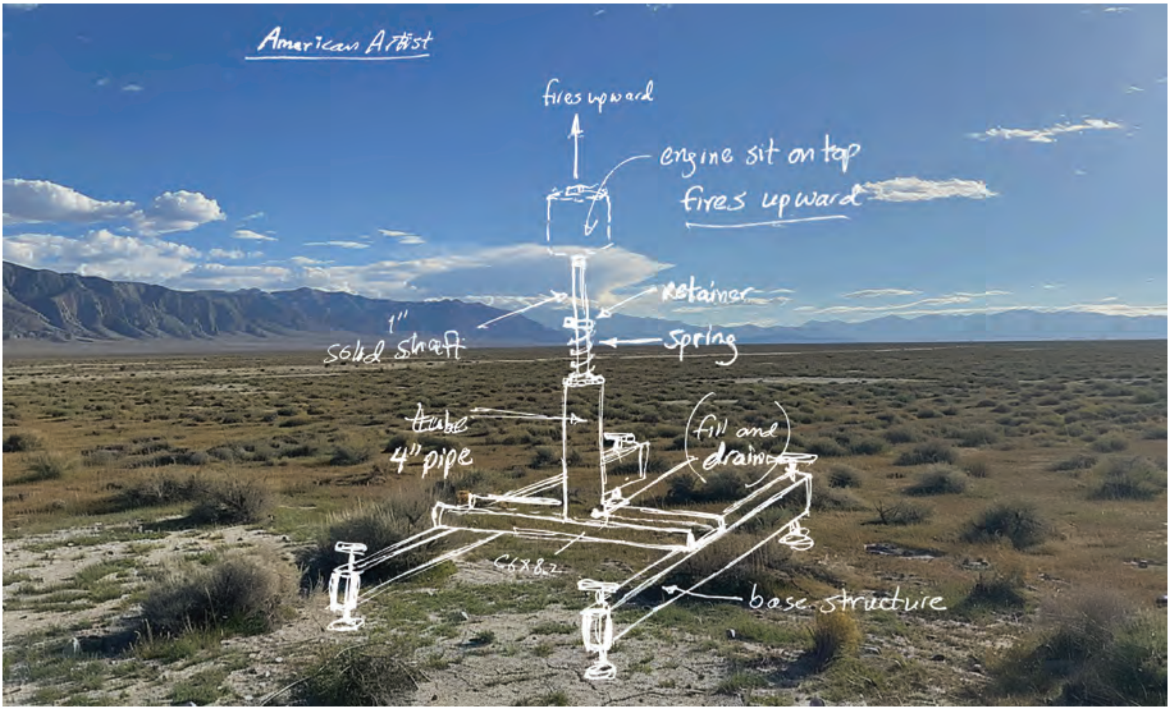
Art's engagement with technology is utterly transformative. Through art, technology moves beyond its role as a tool, becoming a powerful means of reframing and reimagining our contemporary world. The Art + Technology Lab is a cornerstone of our long-term partnership with LACMA, which began in 2015. Our commitment is driven by a shared mission to foster critical exploration at the vital intersection of art and technology. This partnership embodies our broader vision to create new opportunities for artistic experimentation and interdisciplinary research to empower artists and their communities.

For over a decade, the Art + Technology Lab has served as proof that artists and technologists can collaborate to examine the complex realities of innovation, while cultivating a crucial space for reflection. Guided by the collective curiosity and creativity of the participating artists and collaborators and bolstered by LACMA's dedication to facilitating an open and attuned environment, the Lab has become a unique ecosystem. It has evolved into a space where improvisation, the open exchange of knowledge, and engagement with the public are primary instruments of innovation.

We are delighted that this publication shares the stories that have shaped the Art + Technology Lab since its inception. As an archive of not only the outcomes but also the rich processes of collaboration, it stands as a testament to the Lab's importance as a platform for navigating our collective path forward. We, at Hyundai Motor, have been privileged to support the Lab's journey. We are thrilled to extend our partnership for another decade. The Lab will continue to serve as a pivotal force in our collaboration, and we eagerly await the new dialogues, discoveries, and practices yet to emerge from this crucible of creativity.

Euisun Chung
Executive Chair
Hyundai Motor Group

HYUNDAI


American Artist
fires upward
engine sit on top
fires upward
retainer
1"
solid shaft
spring
tube
4" pipe
fill and
drain
C6X8.2
base structure

Foreword

The intersection of art and technology has always been central to LACMA. Our founders had the foresight to understand that Los Angeles in the 1960s was poised to become a center of cultural and technological innovation. Embracing this potential, the museum initiated the Art and Technology Program, a radical experiment that paired artists with engineers and scientists at leading corporations throughout the region. The results were provocative, uneven, and groundbreaking—setting a precedent that has helped shape West Coast art movements ever since. The program's establishment, at the dawn of the art and technology movement, coincided with the launch of the East Coast's Experiments in Art and Technology project (E.A.T.), founded in 1967 by Billy Klüver, Fred Waldhauer, Robert Rauschenberg, and Robert Whitman.

More than four decades later, we revisited the program's legacy with the launch of a new Art + Technology Lab, asking ourselves what it would mean to foster that same spirit of experimentation in a vastly different environment. Silicon Valley now dominated the landscape, attracting young entrepreneurs driving the rapid emergence of new developments in science and engineering, and digital versus industrial technologies. But while technology was accelerating at unprecedented speeds, investment in truly experimental work in the arts was rare. At a time when the art world often favored the marketable and the finished, we wanted to consider interventions that would allow artists to test the limits of both technology and imagination. As an encyclopedic museum, LACMA could serve as a stable platform on which appropriate risk-taking could unfold.

The Lab became a "safe-to-fail" rapid prototyping environment—a place where we deliberately deemphasized the finished work of art in favor of encouraging artists to test the edges of art and technology. The museum served as a conduit between two worlds, both of which value experimentation and iterative methods, where every "failure" is just one ingredient in the eventual realization of an idea. In light of the complexities and opportunities within an increasingly fluid technology sector, we prioritized the independence of the artist, using our legal and logistical infrastructure to provide support within the climate of the museum. We also encouraged our corporate partners to engage in a two-way dialogue. Rather than placing artists within corporations and hoping for the best (as was largely the case with the original program), we invited leading executives and innovators into the museum, offering a behind-the-scenes view at all that we do to generate and preserve culture. They responded to the invitation with tremendous generosity and commitment.

Forward-thinking companies—including Google, SpaceX, Accenture, Daqri, and our presenting sponsor, Hyundai Motor Company—embraced the Lab wholeheartedly, collaborating not only with artists but also with one another across the boundaries of art, technology, and private industry. When Hyundai Motor came on board in its second year, they recognized LACMA's unique position among major U.S. museums in its deep connections to Pacific Rim cultural networks on the West Coast. Led by Euisun Chung, Executive Chair of Hyundai Motor Group, their own passion for innovation and for supporting projects that take purposeful risks made them the perfect partner in shaping the trajectory of Art + Technology, allowing us to bridge the experimental projects in the Lab and major exhibitions of technology-based art in the museum's main gallery spaces.

I am deeply grateful for the vision and generosity of Hyundai Motor and all our sponsors, whose support has not only allowed Art + Technology to flourish at LACMA but helped redefine Los Angeles's role as a hub of creative exchange.

Michael Govan
CEO and Wallis Annenberg Director
Los Angeles County Museum of Art

Redux: The Art and Technology Program in the Twenty-first Century

Amy Heibel

Amy Heibel and Michael Govan leading a discussion in the Art + Technology Lab program space, 2014

In 2012, LACMA's director, Michael Govan, asked me a seemingly offhand question: What could we do with the library? As the vice president of technology, the Balch Art Research Library wasn't under my purview, but I responded with a spontaneous idea: What if the library became the physical and conceptual home of a relaunch of the museum's Art and Technology Program of 1967–71? A space where books and emerging technologies could coexist, where artists could experiment freely, and where outcomes weren't tied to exhibitions or finished works but to exploration itself. "In an art museum, everything we do should be driven by art," Michael—who very often challenged us to upend institutional convention—told me. What would it mean to truly attend to that idea?

At the time, just a few years after the advent of the iPhone, museums were responding to rapid changes in consumer technology. Devices could tell us how long a museumgoer stood in front of a David Hockney painting. A mobile app allowed us to manipulate the skylights in our exhibition pavilion such that the director could be in Paris and adjust the amount of midday sun shining on a painting exhibition in L.A. Our conservation lab was using lasers, accelerometers, transducers, and thermocouples. And yet, all of this was subordinate to supporting exhibition spaces for (mostly) handmade objects. What if we brought the means—technology—closer to the ends—art?

Museum work might be thought of as embodying Hegel's metaphor of the owl of Minerva: deriving, preserving, and presenting insight into the past, like the goddess of wisdom's companion taking flight at dusk. The Art + Technology Lab inverts this logic, operating in a speculative, future-oriented register. The original Art and Technology Program was our model for this approach. Launched in 1967 by Maurice Tuchman and his colleagues Jane Livingston, Gail Scott, and Betty Asher, the program paired artists such as Claes Oldenburg, Andy Warhol, and Robert Irwin with corporations for purposes of collaboration. It led to new and deepened artist relationships and, eventually, an exhibition.

However, à la Hegel, the true significance of the program emerged only in time. Most fascinating was the unedited documentation of the speculative and often unsuccessful artist pursuits in the program. In some cases, a project begun (but not completed) at LACMA gave root to work that emerged only decades later. This was the case with James Turrell, who pursued a concept with collaborator Robert Irwin related to visual perception that ostensibly led to nothing, at least in material terms, when a disagreement between them derailed the project. Nearly half a century later, LACMA hosted a retrospective of Turrell's work, the entirety of which may fairly be said to derive from those early explorations into visual phenomena. Unfinished projects—which in fact comprised most of the original Art and Technology engagements—were regarded as failures when the project ended in 1971. Yet by art historical measures, LACMA's early and speculative investment in these artists paid enormous dividends.

There were problems with the original program, including the near-total absence of women artists and the alliance, in the midst of the U.S. military presence in Vietnam, with corporations engaged in the war. One had to wonder, at the start of the twenty-first century, whether the Art and Technology Program of the late 1960s was a relic of an era of American capitalism when corporations were both naive and secure enough to undertake a tame confrontation with bad-boy artists who smoked grass.

But in 2012—a moment wedged between the Occupy movement and the rise of Trump—we wondered: What would museum audiences make of a cultural institution openly pursuing creative input from companies listed at the top of the NASDAQ? What would artists make of tech elite who saw themselves as cocreators in generating new works of art? What would the institution's curators make of spending money on a program that didn't lead to an exhibition, or even produce a tangible thing at all?

Fundraising for the new program, which we named the Art + Technology Lab, was a bootstrap operation. We started with Google, where a poet and programmer on staff was open to considering our ideas. He was joined by a data security expert who held a PhD in art history and whose dissertation just happened to cover the original program at LACMA. They listened attentively, gave input, and helped us gain a sense of our target corporate demographic: the makers, more so than the marketers, of tech.

Buoyed by the intellectual green light at Google, we approached executives at SpaceX, NVIDIA, and Accenture. We asked potential partners what they felt they could gain by participating in the program. As it turned out, it wasn't name recognition they valued (they either had plenty, or didn't want it in the first place) or old-fashioned accolades for giving to the arts. Instead, what they wanted was intellectual and creative stimulation for their top talent. They wanted the PhDs and programmers on their payrolls not to get bored. That, I felt sure, we could deliver.

We worried that the technologists who contributed to the program would want to dictate which artists we selected and what kind of work they produced, but that concern was misplaced. I found that people who create technology products ask "how?" more often than "why?" And so Michael, Joel, and myself, along with a rotating cast of curators, were given the full trust of our partners to select artists for the program. They didn't balk when we asked them to help artist and poet Kirsten Mosher connect geographical antipodes using masses of data, or when Tavares Strachan proposed to make and launch a satellite, subject to myriad government regulations, commemorating the first Black astronaut. Nor were they offended when we told them that Swiss artist Annina Rüst would be building a protest robot from household cleaning supplies that would disseminate data about the exclusion of women in the art and the technology sectors—even when her critique put their own companies in the line of fire.

Then Hyundai Motor Company decided to sponsor the program with a multimillion-dollar gift, and they were welcomed by the first round of corporate partners. We had expected that these organizations would be sending early-career staffers to these meetings—but, in fact, their executives chose to attend. They were remarkably generous with their time, knowledge, talent, and facilities. When Joel asked Hyundai Motor to send us a brand-new car that we intended to hand over to ScanLAB to disembowel and turn into a digital diorama using laser scans of Yosemite, we received efficient instructions about where to pick up the vehicle.

The most controversial decision that we made, in contradistinction to the original program of the 1960s, was to issue an open call for artist proposals. The original program had been, in part, a strategy to attract big-name contemporary artists to LACMA, which had been established as a separate institution only in 1965. Those artists were selected from a curatorial wish list. But by 2012, the museum had an entire curatorial engine overseeing a collection of more than 150,000 works of art and a steady flow of exhibitions, including exceptional curatorial work in modern and contemporary art. We didn't need a renegade program to engage art stars and populate our collection.

The decision to open up to proposals from lesser-known creators maximized the impact that the program had on the artists whom we chose, and ensured that we would be taking appropriate risks. The Lab had money to give away—up to $50,000 of straight cash to each artist in the program, not including the potential for millions more of in-kind support. That $50,000 might represent just a fraction of the price tag for a single work of art by a famous artist, but it could be the entire annual income for a lesser-known mid-career one. As well, we figured that an emerging artist would be more willing to undertake a project that might fail spectacularly and in public.

The most difficult part was convincing the applicants that we genuinely did not want to fund the presentation of finished works of art. The second most difficult part was convincing them that we were not looking for ever more things to pack into exhibition galleries. We wanted to gamble on the creation of previously unthinkable projects—projects that might produce only a concept, or a bit of open-source computer code, or a prototype that might later lead to imitation and iteration.

We asked the artists for half-baked proposals—projects they were willing to share as works in progress. It was remarkably hard to convince the artists that we meant it. In the absence of robust public funding, artists must compete to sell objects on the market—which tends to lead to a certain consistency of product, as well as an urgency to exhibit work in the right venues to establish value. None of that begets impractical experimentation with raw materials emerging from private industry, which is more or less what we were seeking. I came to see our year-long collaborations as a sort of psychotherapy for artists, helping them individuate, at least for the duration of the project, from the marketing pressures that surrounded them.

What was in it for the museum was a fresh relationship with the communities we serve, and a way to involve our visitors in dialogue (and, in some cases, in the actual creative process) during the making of new artistic works. When we were fundraising for the project, we often heard from tech company leaders, somewhat apologetically, that they didn't go to art museums, because they preferred the energy of less formal, often underground culture venues. For those who regard museums as arbiters of taste and feel restricted by the etiquette of gallery-going (speak quietly, don't touch anything, ask polite questions, act like you get it), we offered a vivid alternative.

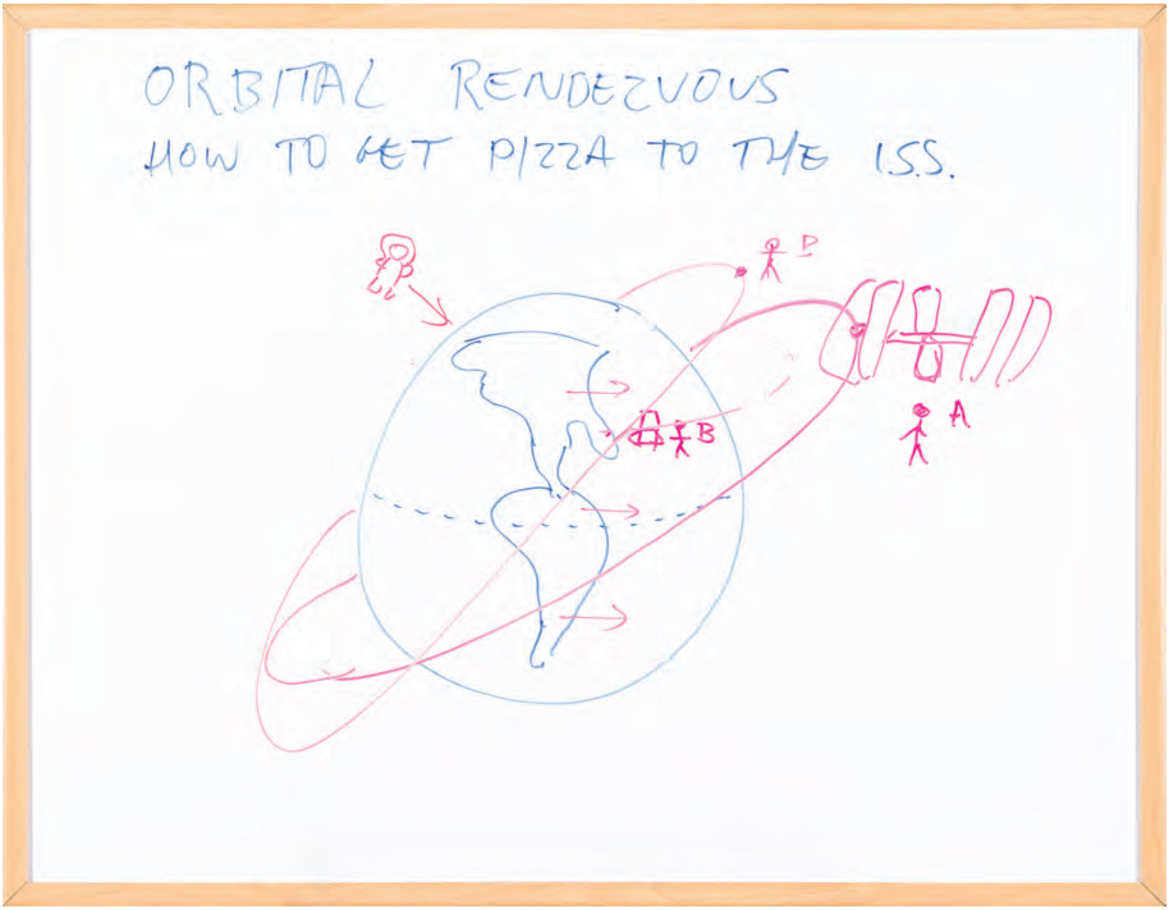
The renovated library where we presented these projects during our first decade had a concrete floor, a wall of glass letting in bright natural light, and a door to the public park just outside. Often, during our events, people visiting the nearby La Brea Tar Pits would just wander in. Joel organized artist workshops in which members of the public used blowtorches to create circuit boards, carved wooden prototypes of imaginary mobile devices, or submitted their bodies to 3D scans that became part of their own imaginary "digital funeral." Fairly often, a participant would suddenly look up mid-event and ask, "What is this place?" with no idea that they had come in through the back door of one of the largest art museums in the country.

Throughout, we operated as if we'd be shut down at any moment, as if we were getting away with something. I suppose that sounds coy and disingenuous now, with a decade of institutional and corporate support behind us, but it's true. The legacy of the Lab's first decade, I hope, is that it models a way in which museums can be brokers in cultural collaboration—a generative and prolific force for the creation of revelatory things. I hope that it reflects Michael's belief that, in an art museum, our perspective on everything—including technology—should begin with art and artists. In a cultural moment when it's easy to feel compelled to draw opinions about unimaginable novelties (self-driving cars, artificial intelligence, the U.S. Space Force) far before the owl of Minerva has flown, artists make more sense than most, as do inventive minds in science and technology. They are acclimated to the liminal state in which we find ourselves, and in which the new Art + Technology Lab was conceived: in the productive chaos of iteration, critique, dissemination, and reinvention.

Amy McCabe Heibel has worked with museums for thirty years, developing innovative technology-based projects.

“All Impossible Deeds”: A Decade of Art + Technology

Joel Ferree



Dry-erase board from Tavares Strachan’s Chalkboard Conversations public program, 2015

If the fool would persist in his folly
he would become wise.
—William Blake

In 2013, Amy Heibel, LACMA's associate vice president of web and digital media, and I began relaunching the museum's storied Art and Technology Program (1967–71) as the Art + Technology Lab. Amy had secured the corporate funding necessary to remodel the Balch Art Research Library—transforming it into both a research center and the program's physical home—and to sustain a cycle of artist grants for two years.

At that time, Los Angeles appeared to be carving out its own identity distinct from the dominance of the Bay Area and Silicon Valley. The startup energy of Silicon Beach was in full bloom from Venice to Santa Monica. Everywhere one looked, technological effervescence was bubbling up. iPhones were growing larger—many of us had only recently abandoned our Blackberries—just as global adoption of 4G networks was accelerating. Facebook acquired WhatsApp. IBM opened its Watson supercomputing platform for cloud development. Makerspaces and public libraries buzzed with 3D printers. *Curiosity*, the Mars rover, had found evidence of ancient water. SpaceX, one of our soon-to-be technology partners, had begun offering commercial launches. Within a year, Apple would debut the Apple Watch, Amazon would introduce Alexa, and Tesla would roll out autopilot.

It was the heyday of what could now be called the "Soft Tech" era—an age when technology companies marketed themselves through optimism and possibility rather than disruption or control. Google's Venice Beach campus had a practice space where employees could jam on drums and guitars between meetings; its cafeteria rivaled nearby restaurants. The culture of technology was exuberant, and its energy carried into the early conception of the Lab. Many organizations were not only willing to support our program but eager to do so. When we published our first call for proposals in late 2013, the response from artists and the press alike was overwhelming. Some of this was nostalgia for the museum's original program, whose catalogue had become a kind of art and technology grail, but it also reflected the optimism of the time—a sense that art and innovation could move forward together.

Although the environment was collegial, relaunching the Lab was not without difficulty. We were working in the long shadow of the original program. The first iteration had ended in controversy and was widely regarded as a failure; only decades later was it reinterpreted as a prescient and even heroic experiment. Its mythology was immense. By contrast, our new program had nothing yet to show—only an idea, a logo, and a refurbished library.

The museum's institutional context also posed challenges. In 2013, LACMA was operating at a near-manic tempo, mounting ambitious exhibitions in rapid succession and enjoying consistent national attention. Even the installation of Michael Heizer's *Levitated Mass* (2012)—a 340-ton boulder whose transit across Los Angeles Country required closing streets—had been transformed into a civic spectacle. The museum projected an image of boundless capability. To launch a fragile, experimental initiative within that environment felt precarious, if not quixotic.

Beginner's Mind

The program structure of the Lab was elegant in theory: annual grants of up to $50,000, supplemented by in-kind support from the museum and corporate partners. Each fall, our board of technology advisors would collaborate with museum staff to draft the request for proposals during the winter months. Awards were announced in spring, with projects beginning in late summer or fall. While the design was sound, there was no existing blueprint for the Lab's internal processes.

Early on, we misread the nature of what we were creating. The Lab was not simply a grant-making mechanism; it was a laboratory in every sense—a space defined by experimentation, uncertainty, and continuous negotiation. Our initial posture, one of confidence and curatorial authority, soon proved inadequate. The artists' projects demanded a degree of flexibility and humility that few museum workflows could easily accommodate.

Annina Rüst's *A Piece of the Pie Chart* (begun in 2014) required hundreds of edible pies, a robotic arm, and logistical patience. Tavares Strachan's *ENOCH* (begun in 2014) aimed to launch a commemorative satellite into orbit. These undertakings had little in common beyond their ambition and refusal to conform to museum conventions. The absence of structure, at first disorienting, would become the program's greatest strength.

Over time, the Lab's process clarified. Much of that clarity came not from internal policy, but from the artists themselves. Through dialogue and trial, a rhythm emerged—one that valued patience, humility, and trust. Each project required starting from scratch, a fresh inquiry into its own terms of possibility.

The model that developed echoed the ethos of early research institutions, such as Bell Labs and Xerox PARC, where discovery emerged from interdisciplinary collaboration rather than rigid procedure. The Lab adopted a similar "beginner's mind," learning by doing. A conversation between artist Julia Christensen and Dr. Anthony Freeman of NASA's Jet Propulsion Laboratory crystallized this approach for me. Describing a mission to a planet forty light-years away, Freeman observed: "It's like building a bridge—but you don't know what's on the other side." The metaphor resonated deeply. Each project was a bridge to an unknown shore.

This approach required loosening expectations. Projects were not evaluated solely by their outcomes, but by the quality of their inquiry. The absence of fixed deliverables allowed artists to work iteratively and conceptually, opening pathways that might otherwise remain unseen. The Lab learned that its role was not to direct but to accompany—to hold space for discovery rather than prescribe it.

The success of this approach depended on relationships. Many of our technology advisors—engineers, designers, and executives—were extraordinarily generous, extending both expertise and institutional capital to support the artists. Collaboration, we found, flourished less through formal agreements than through personal chemistry and shared curiosity.

Adolescence

As the Lab gained confidence, its processes quickened. Projects unfolded across years, but the capacity to pivot swiftly when necessary became an asset. Gemini G.E.L. founder Ken Tyler's description of producing Claes Oldenburg's *Icebag* sculptures during LACMA's original Art and Technology Program captured this spirit perfectly: "We are really performing in the greatest tradition of theater, no time, no money, all impossible deeds, but somehow it gets across and some accomplishment comes from it" (see p. 328).

That theatrical metaphor still holds. The Lab's work often unfolded in conditions of creative pressure and institutional constraint. The museum's traditional timescales—designed to protect and present objects—were often ill-suited to the volatile tempo of technological experimentation. Where curators and conservators work with hindsight and stability, the Lab operated in a state of live improvisation, navigating projects whose forms and futures were still uncertain.

From the outset, this ethos was built into the program's DNA. The Lab's open calls explicitly encouraged "uncertainty and ambiguity" as necessary conditions for genuine exploration. This inversion of the artist-museum relationship—positioning the museum not as final arbiter but as co-investigator—proved transformative. The Lab became a conduit between the provisional space of the studio and the structured framework of the institution, using technology as the medium of exchange.

Changes

As the decade progressed, the culture around technology darkened. By 2016, enthusiasm had given way to skepticism. The optimism of the Soft Tech era was replaced by growing anxiety over surveillance, digital addiction, and the manipulation of public discourse. Artists in the Lab anticipated and reflected this turn.

Michael Mandiberg examined the commodification of attention and labor; Jonathon Keats reimagined human-machine integration; Gabriel Barcia-Colombo explored the digital persistence of identity after death. These works, each in their own way, illuminate the moral and psychological weight of living within ubiquitous systems. The Lab's context in Los Angeles—simultaneously the capital of illusion and of infrastructural power—made it a fitting site for such inquiries. Artists found in the city's hybridity a mirror for the contradictions of the technological present.

Simultaneously, the Lab's internal role evolved. What had begun as a semiautonomous experiment became an informal research and development arm for the museum. Its projects, often small in scale but conceptually ambitious, allowed LACMA to test emerging technologies—virtual and augmented reality, blockchain, and others—without assuming institutional risk. Experiments that began in the Lab informed later museum initiatives, such as Alejandro G. Iñárritu's conceptual virtual reality installation, *CARNE y ARENA (Virtually present, Physically invisible)* (2017), and *LACMA × Snapchat: Monumental Perspectives* (2021–24), an AR collaboration. The Lab's 2022 project with EPOCH Gallery and UNCOPIED—minted as NFTs on the Algorand blockchain—helped shape the museum's subsequent acquisition and conservation protocols for blockchain-based art.

From the start, the Lab's artists engaged technologies originally conceived for market expansion, labor optimization, or the management of belief systems. Yet within its framework, these same tools could be recontextualized and reimagined. The 2018 Facebook–Cambridge Analytica revelations only intensified this critical stance, prompting artists to deploy technological means to interrogate the very infrastructures that produced them. Projects such as Strachan's *ENOCH*, Curtis Tamm's sonic investigations, and Nancy Baker Cahill's *Substrate* (begun in 2022)—which used augmented reality to rethink the extractive logics embedded in global digital networks—reframed the relationship between science, culture, and memory.

Following 2020, with the combined impact of the COVID-19 pandemic and global uprisings for racial justice, this engagement deepened. Sarah Rosalena's exhibition *Standard Candle* (2023) at the historic Mount Wilson Observatory above Pasadena (curated and produced by the Lab) interrogated the colonial epistemologies undergirding Western astronomy. American Artist's *The Monophobic Response* (2024) reimagined rocket history through the lens of Octavia E. Butler's speculative fiction, drawing uncanny parallels between the 2024 she envisaged in her novel *Parable of the Sower* (1993) and the political landscape of that same year.

Taken together, these projects affirmed that the Lab's mandate extended beyond facilitating innovation. It had become a site for rethinking technology's role in shaping social, political, and ecological realities.

A Laboratory of the Possible

The present moment—defined by infrastructural technologies, algorithmic governance, and accelerating extraction—marks a decisive turn toward what might end up being called the "Hard Tech" era. The optimism that accompanied the Lab's early years has given way to a more precarious reality, one in which artists and institutions alike must navigate volatility, scarcity, and consolidation. Nowhere is this shift more apparent than in the rise of artificial intelligence (AI).

Artist projects such as john gerrard's *Neural Exchange* and Lauren Lee McCarthy's *Auto* provide early signals of how artists might approach AI—not merely as a tool but as a contested site of cultural and technological meaning. *Neural Exchange* stages a neural network as a choreographic generator, raising questions about authorship, training data, and the imaginative capacities we project onto machines. *Auto* interrogates the idea of autonomy by transforming the social space of a driverless vehicle into an encounter "driven" by vulnerability and human behavioral cueing. Both projects demonstrate how artists can critically engage AI systems and tease out assumptions about the human labor and social dynamics embedded in these technologies.

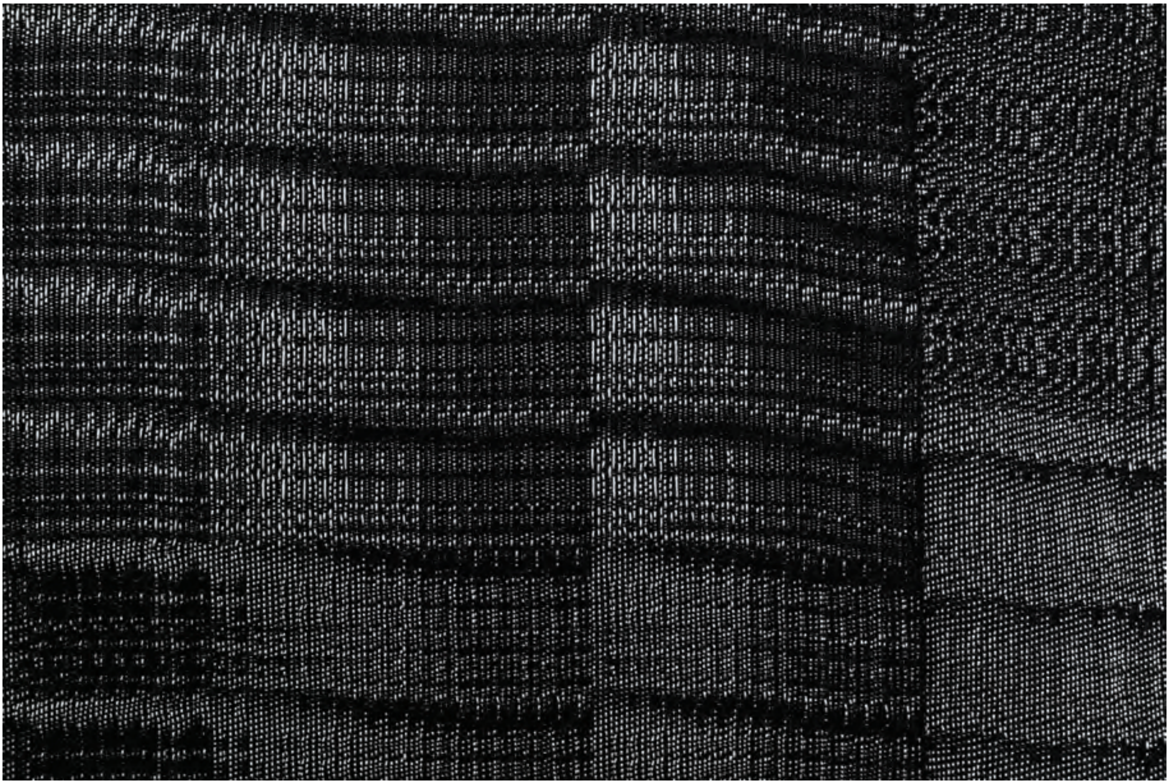
Future Lab artists will further complicate, dissect, or subvert AI technologies as they become increasingly intertwined within our civic, cultural, and personal infrastructures. Yet even as AI occupies the foreground of current technological dialogue, it is important to acknowledge that the next major shift—the one not yet visible—will inevitably define the Lab's future. Just as we could not anticipate the rise of large language models in the early 2010s, the current moment is unlikely to capture the contours of the next ten years. The Lab's strength lies in its ability to remain agile and responsive, to sense what is emerging and to create conditions under which artists can work with—and against—technologies whose purposes are not yet fully understood. Iterative, artist-led, and relational, the Lab's processes allow us to move with the shifting terrain of technological and social upheaval. As Butler wrote in *Parable of the Sower*: "God is Change." Today the Art + Technology Lab stands as both a program and a proposition: that museums can be laboratories of the possible, capable of accommodating experimentation and ambiguity without losing their core commitments to care, scholarship, and public engagement. In an era when technological systems shape nearly every dimension of life, the Lab's approach offers a model for institutional agility. Its collaborations remind us that responsiveness is not a concession to volatility but a form of cultural intelligence—a means of staying attuned to change while holding space for reflection.

What began as an experiment in partnership has evolved into a practice of adaptation. The Lab continues to affirm that in the age of hard technology, it is the softer, more human capacities—curiosity, openness, and trust—that enable meaningful creation and critical thought to endure.

Joel Ferree is the program director of LACMA's Art + Technology Lab.

Seeing Beyond the Visible

Claire L. Evans



Sarah Rosalena, *Standard Candle*, 2023 (detail)

Spearheaded by LACMA's curator of modern art Maurice Tuchman, the museum's original Art and Technology Program (1967–71) enlisted the participation of seventy-six artists and forty Southern California corporations. Although many of these companies operated in aerospace and defense—a "rogue's gallery of the violence industries," to quote critic Max Kozloff's famously scathing 1971 *Artforum* review[1]—many employed industrial manufacturing processes potentially appealing to artists: commercial sign making, steel manufacturing, industrial ceramics, and electronics, to name a few.

Half a century later, most of these industrial processes have been offshored. What remains in the wake of American manufacturing's decline are technology companies, bound in their own darkening ways to government contracts and policies. While the artists of the first Art and Technology Program, almost entirely white men, were largely bemused spanners in the corporate works—R. B. Kitaj remembered his time at Lockheed, spent walking down "endless corporate corridors," as "*so* funny, *so* ridiculous"[2]—their inheritors eye more warily the political and emotional stakes of their proximity to power.

In a postmortem of the Art and Technology Program, Tuchman noted that many participating artists would have demurred had he invited them a few years later in the "climate of increased polarization" of the early 1970s.[3] By the time LACMA exhibited the fruits of the program, the escalation of the Vietnam War had soured things. As the critic Jack Burnham put it, "much of the art world believed by then that there was or is a nefarious connection between advanced technology and the architects of late capitalism."[4]

But Tuchman was more pragmatic. Citing the Italian Futurists, the Russian Constructivists, and the Bauhaus, he explained that artists had always had "a collective will" to express new ideas using "the materials that only industry could provide."[5] This is somewhat at odds with his own account of the Art and Technology Program, which recounts in great detail the personality clashes, mutual bafflement, and occasional hostility it engendered between artists and their industrial sponsors. Nevertheless, it's a fair reflection of the economic calculus that still drives art's entanglement with industry. Although plenty of technologies unimaginable to the original cohort—3D printing, robotics, digital imaging, creative code, virtual reality, generative AI—have since been "democratized," the resources, materials, and access required to execute major artworks remain elusive.

Still, that Tuchman struggled so much to sell his idea to artists, corporations, and the public seems quaint today. By the launch of the second iteration of the program, the Art + Technology Lab, it was hardly unusual for a technology company to have an artist-in-residence program or to extend its patronage in the form of resources, marketing spends, or grants to artists. Google's "20% time" rule, for example, offered its own employees the leeway to work on personal projects on company time, making creative collaborations more viable. In fact, until the 2018 Facebook–Cambridge Analytica scandal pulled the curtain on Silicon Valley's dark entanglement with politics, the intersection of art and technology was a sunny place to be.

The years since have been stormier, but not unproductive. Plenty of compelling, subversive, and earnestly experimental work has emerged from the Lab over the last ten years. It's all interesting in its own right, but taken as a whole, this archive also serves as an exegesis of the decade. As a record of a tumultuous, transformative period in technology—to say nothing of the many cultures it ensnares—the Lab's output is uniquely enlightening. It traces the hopes, fears, critiques, and occasional subversions of a unique cohort of artists navigating, as we all do, a rapidly changing world.

AI, Data, and Networks

A lot can happen in a decade. Ten years carries a seed to a sapling; wears the body down; shifts the Overton window; bears a computer from unboxing to obsolescence. But in no domain has one decade worked so hard, or wrought so much, as in the field of artificial intelligence. The period from 2014 to 2024 was a century in AI time: it saw the ascension of deep learning, the invention of transformer architecture, the crash landing of ChatGPT onto an unprepared world, a tsunami of venture capital, and, in its wreckage, countless intellectual property lawsuits, editorials, and strongly worded open letters from concerned creatives.

But artists working with nascent AI technologies at the beginning of that decade were, by and large, optimistic about their potential for their practice. After learning how to train a neural network for his Lab project *Neural Exchange* in 2016, john gerrard marveled that given enough data and computational power, there "is no real limit" to the potential of such networks. "What I sense I am seeing," he said, looking at the choreographed movements that the neural network produced for one of his 3D models, "is this strange feeling that I am equipping my engine… with a kind of imagination."[6]

gerrard echoed a basic awe that many early adopters felt at the time. But he also sketched the Faustian bargain of creative AI: imagination in exchange for power and data. The source of the power in this transaction is unambiguous. In 2014 as today, it lay with the technology companies with the server brawn to train large models and the economic incentive to mainstream the generative tools that these models produce. The source of the data, however, is more enigmatic—often deliberately so: Who owns it? Who is accountable for it? What biases lurk within?

These questions of data provenance have busied several Lab projects since Gerrard's. In 2018, Tahir Hemphill used the Hip-Hop Word Count—his own database of 200,000 hip-hop songs, court cases, and scholarly writing on rap—as training data for the neural network that served as the basis of his project *Implications of a Rap Neural Network*. Rashaad Newsome, for the first iteration of his ongoing project *Being*, built a cloud-based humanoid agent trained on radical texts from the likes of bell hooks, Paulo Freire, and Cornel West. "Robots can at best be mirrors for their creators," Newsome explained. Unlike standard virtual assistants of the time, his *Being* had the capacity to "go rogue," taking breaks from visitor interactions to vogue and read theory.[7]

In Newsome's vision, creating an AI interlocutor with inherent agency was a "radical act of love" and a gesture that undermined colonial logic.[8] In Silicon Valley, where AI is often marketed as a consquence-free servant class empowered to do little else but book family vacations, clean up spreadsheets, and summarize overlong books, agency has a different valence. The purported convenience of AI agents, although largely at odds with the tools themselves—which are prone to hallucination, sycophancy, and factual error—is used by the technology industry as a carrot. The inevitable stick that follows is the threat of Artificial General Intelligence, or AGI, an ostensibly world-altering tier of AI that will soon, according to its boosters, render all human pursuits obsolete. Thankfully, over the last decade, artists have rejected this master-slave binary, preferring to question whose interests it truly serves. They have tracked AI's steady drift from transparent, open-source research to consolidated, opaque product offering—a change that has been facilitated by the persistent misrepresentation of AI as agential, oracular, even borderline sentient. The pseudomagical presentation favored by many Silicon Valley companies deliberately obscures what's truly interesting, and potentially transformative, about AI: the opportunity it gives us to better understand, and make peace with, our own past. As the artist and theorist James Bridle observes, all computation re-encodes the past. Datasets representing the historical state of things serve as models of "the way things are," and this static conception of reality is then projected into the future by predictive AI models without any meaningful deviation or accounting for the likely possibility of divergence or change. "Computation projects a future that is like the past," Bridle writes, "which makes it, in turn, incapable of dealing with the reality of the present, which is never stable."[9]

Art, like reality, is a dynamic system: the vectors it follows aren't cleanly extrapolative, with each choice proceeding logically from the last. An artist might set out to make biomimetic robots but finish, after a long series of false starts, deviations, and pandemic-determined restrictions, by producing a sound and light installation echoing the song of a lonely whale—as Diana Thater did with her Art + Technology Lab project *Yes, there will be singing* (2020). Training an AI model is an opportunity to inject some of this dynamic realism into a static image of the past, and in the process make meaningful course corrections to our cultural trajectories. But such a process, which shifts agency to the builders of AI systems, undermines the bluntly predictive quality of AI as a product, rendering it ambiguous, unpredictable, and fallible. Just like us.

Of course, this presents new opportunities—not for industry, but for those artists comfortable in the gray wilderness of ambivalence. With her 2025 Lab project *Auto*, Lauren McCarthy highlights how our exchanges with automated systems turn us into automatons ourselves. In her driverless car, it's unclear who's driving who: the passengers, following ride instructions from an oblique system, or the system itself, issuing the instructions that set the ride into motion? As always, when we cede control, we slough off a bit of our own agency and lend it, for the sake of convenience and expediency, to the system. The system doesn't require agency to function, but the illusion remains powerful—even empowering—

for its users. Automation is often as much a performance as a technology, a willingness to accept machine output at face value rather than understanding it as a product extrapolated from available data.

During the second half of the Lab's first decade, some participating artists began to shift their interest from this output to the data itself and the relationships it enables. Nancy Baker Cahill's *Substrate* (2022–25) visualizes decentralized networks to protect community data by borrowing from mycelial networks and old-growth forests. Gala Porras-Kim's *Expansive Data Fields* (begun 2023) examines how artworks are categorized and labeled in museum collection databases and suggests alternative archival taxonomies. These projects underline the role of institutions such as museums, archives, and libraries in preserving cultural memory—and offer, not coincidentally, methods for resilience against the persistent data-scraping of AI bots.

As Porras-Kim's work reveals, the more complex a database, the truer it is to life. The more difficult, too, it is for an AI model to parse. Even something as regimented as a museum's collections database resists a single interpretation. There are always other data fields that could be added to further contextualize the objects that such a database represents, and thus determine the fate of their use and interpretation—even their survival in the decades to come.

Nature and Sensing

Microscopy is the science of seeing. Its history is inextricable from art: As seventeenth-century microscopists Antonie van Leeuwenhoek and Robert Hooke peered through hand-ground glass lenses at the living world, glimpsing for the first time the breathtaking complexity of fleas, bacteria, and botanical structures, Dutch artists were using camera obscuras, mirrors, and other optical devices to produce still lifes and other works of staggering realism, painting the world as it newly appeared to them.

In both art and science, lenses changed how we see. Microscopes, telescopes, and later cameras opened up new visible realms beyond human scale and time. Today we can peer into the realm of electrons and the deep time of the universe. But at these extremes of human perception, images are less literal. We see the cosmos in data, reconstituting images from the readings of lasers, electron beams, and the sensitive nanoscale tips of scanning probes.

In modern microscopy, scientists don't see through microscopes as much as with them. To be rendered legible to these technologies, samples are stained, frozen, impregnated with heavy metals, tagged with reactive dyes, and sliced wafer-thin. Often, the final picture is as much an artifact of its preparation as a picture of how the sample might appear in nature: The act of looking has altered it irrevocably.

Something similar is at play in photography. As we reach the upper ceiling of what is technically possible with light sensors, improvements in photography are increasingly computational. The sensors in smartphone cameras don't just capture light; they repeatedly sample the light information in a given environment, average multiple exposures, reduce noise, conduct HDR processing, and compose the resulting data into a final image. This image doesn't represent reality as much as it approximates, through software, how the end user might expect reality to appear.

This can sometimes make for a quite jarring disconnect. In 2020, the Chinese smartphone manufacturer Huawei's P30 Pro smartphone premiered a "moon mode" that algorithmically superimposed crisp images of the moon over its users' blurry nighttime shots. This blatant distortion inspired controversy at the time, but today it's commonplace for smartphone cameras to rely on algorithms and AI models to selectively enhance scenes. Images have never been more subjective, and with the rise of generative image models, it's likely that our sense of what constitutes a "real" image will continue to erode.

It is against this backdrop of algorithmically mediated reality, in a world that increasingly sees in data, that artists now operate. Every method for making an image has its tradeoffs. Tristan Duke, forging his camera lens out of glacier ice in order to photograph that very same glacier as it calves into the sea, exchanges resolution for a deeper kind of focus. Kyle McDonald, building a low-light camera rig capable of capturing the elusive *te lapa* light flashing used by Polynesian voyagers at sea, exchanges the flat expansiveness of the digital camera for a specific wavelength. Kelly Akashi, who originally trained as a photographer, exchanges fidelity to the image for a more formal representation when she works from CT scans of *Datura* plants and devil's claw seed pods.

These artists understand that there are no authentic images, only intentional ones. How we choose to measure and represent the world is a choice, whose outcome is dependent on our objectives: we see what we look for. Of course, most things really worth seeing—the sublime, the ancestral, the nonhuman, deep time—are entirely beyond our capacity to represent. This does not prevent us from trying, or from bringing our technologies to bear on the problem. The question is whether or not those technologies reveal anything that isn't already latent in the world itself, to the trained eye. James Turrell, who walked away from his own Art and Technology collaboration with Robert Irwin in 1969, perhaps put it best: "We're very physical. When we want to go into the universe, we can't look at a rock.… We have to actually go to the moon. We're so literal."[10]

Turrell was responding to a tendency he perceived, in Western culture specifically, to quantify by technology things that human beings can already sense through meditation, or by honing their sensitivity to the world. "Technology isn't anything outside us," he observed.[11] We can see the cosmos in a rock, if we look closely enough. His cynicism about measurement, which was really a faith in the human perceptual apparatus, is well-placed in our age of big data and soulless optimization, but it draws a needlessly restrictive boundary around artists' toolkits. Technology has opened up new scales and modes of perception, and new ways of representing the world's many faces.

Agnieszka Kurant, in her ongoing project *Artificial Society / Collective Tamagotchi*, transmutes algorithmically mediated inputs from participants across the world to generate an ecosystem of sculptural mounds—organisms of embodied data whose form borrows from the organizational phenomena of social insects. This is not an image or a sculpture so much as it is a model, a collective representation of disparate subjects. What it captures cannot be seen in any conventional sense, but it nonetheless exists.

The same could be said of thought, code, radio signals, memory, the perceptual experiences of other animals, the future, and politics and other complex systems. All the most interesting things are invisible, and will remain so. But they can still be experienced, represented, and even understood in different ways—in data, or, as Turrell would have it, through the profound contemplations of art.

Claire L. Evans is a writer and musician exploring biology, technology, and culture.

1 Max Kozloff, "The Multimillion Dollar Art Boondoggle," *Artforum* 10, no. 2 (October 1971): 76.

2 R. B. Kitaj, quoted in Art and Technology Program of the Los Angeles County Museum of Art and Maurice Tuchman, *A Report on the Art and Technology Program of the Los Angeles County Museum of Art 1967–1971* (Los Angeles County Museum of Art, 1971), 160.

3 Maurice Tuchman, "Introduction," in *Report*, 17.

4 Jack Burnham, "Art and Technology: The Panacea That Failed," in *Myths of Information: Technology and Postindustrial Culture*, ed. Kathleen Woodward (Coda, 1980), 210.

5 Tuchman, "Introduction," 9.

6 john gerrard, in "John Gerrard in Conversation with Adam Kleinman," in Adam Kleinman, ed., *John Gerrard: Neural Exchange*, exh. cat. (Los Angeles County Museum of Art, 2017), 32 (PDF available at https://www-images.lacma.org/s3fs-public/techlab/2018-11/171018_NeuralExchange_Publication.pdf).

7 Rashaad Newsome, in Joel Ferree, "Rashaad Newsome's 'Being,'"*Unframed*, Los Angeles County Museum of Art, September 11, 2019, https://unframed.lacma.org/2019/09/11/Rashaad-newsome%E2%80%99s-being.

8 Newsome, in Ferree, "Rashaad Newsome's 'Being.'"

9 James Bridle, *New Dark Age: Technology and the End of the Future* (Verso Books, 2019), 44.

10 James Turrell, quoted in *Report*, 140.

11 Ibid.

ScanLAB Projects, *Post-lenticular Landscapes*, 2017

Art + Technology Projects

Rashaad Newsome, *Being*, 2019–ongoing, Artificial Intelligence installation with sound

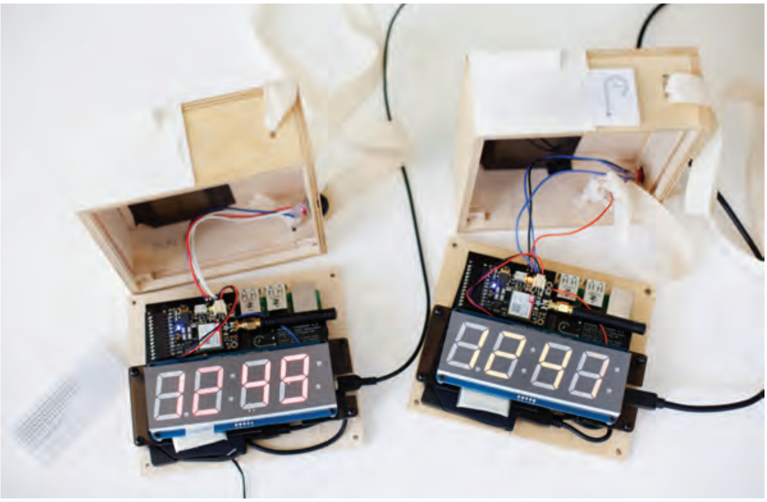
Taeyoon Choi
E Roon Kang

Awarded: Year 1 (2014–15)
Project Dates: 2014–15

Taeyoon Choi and E Roon Kang's project *In Search of Personalized Time* investigated what the artists characterize as "time based on perception and consensus." The project proposed a rebellion against the globally synchronized twenty-four-hour clock, exploring more personal, idiosyncratic ways of measuring our days and sharing alternative "consensus times" with the people close to us—what they call "an attempt to live in unreal time in a real-time world."

Over the course of a year, the artists held small workshops at LACMA, as well as in New York, Boston, and Seoul, treating time as a malleable material and inviting participants to reflect on what "personalized time" meant to them. Using handmade materials—balsa-wood boxes, LEDs, crude motors, and paper circuits—participants created Personal Timekeepers to express their own sense of time.

Following the workshops, the artists collaborated with developer Jon Moeller to build a set of fully functional Personal Timekeepers: wooden handheld devices that each contained a seven-segment display, an input button, an antenna, a Raspberry Pi microcomputer, a GSM module, and a rechargeable battery. Though they resembled old-style museum audioguides, they functioned quite differently, serving as prompts for a performance-based event both for registered participants and curious museumgoers drawn to the devices' blinking LED displays and the possibly puzzling behavior of their users.



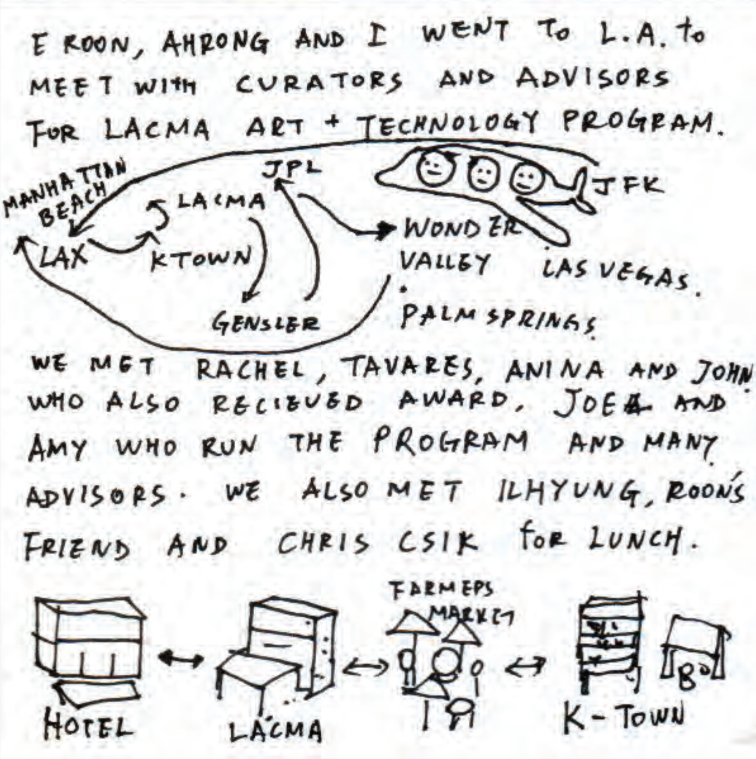
Workshop participants create
Personal Timekeepers, 2015

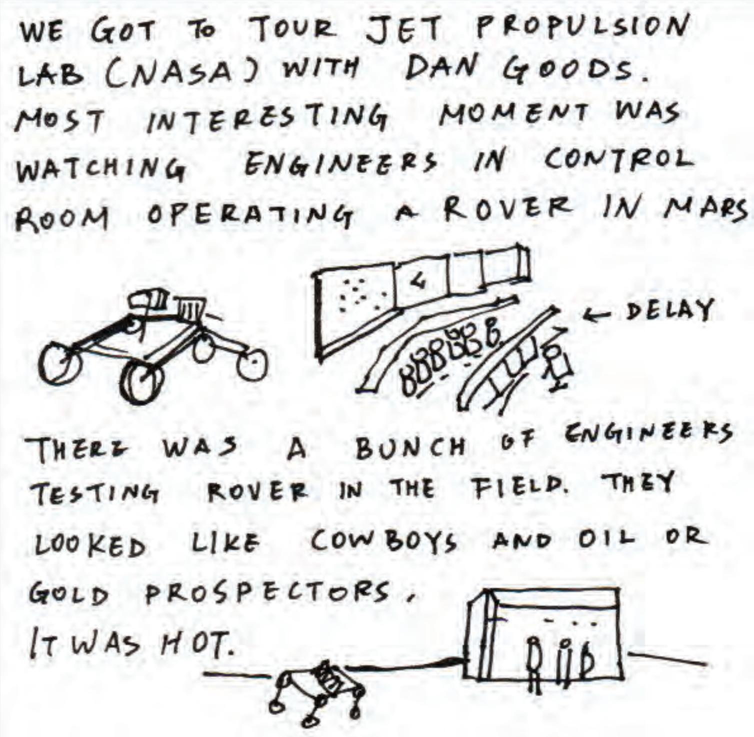
Each participant received a short list of suggested activities to help them measure moments of personal significance using only their intuition. As participants engaged with these moments, their timekeepers adjusted accordingly: minutes passed more slowly or quickly in response to the user's inputs. The devices were networked to an online server and website that visualized the participants' evolving relationship with time. Participants were instructed to return to the Art + Technology Lab when their Personal Timekeeper displayed the time 3:30 pm—a moment that, by design, arrived differently for each individual.

Artists' Reflections

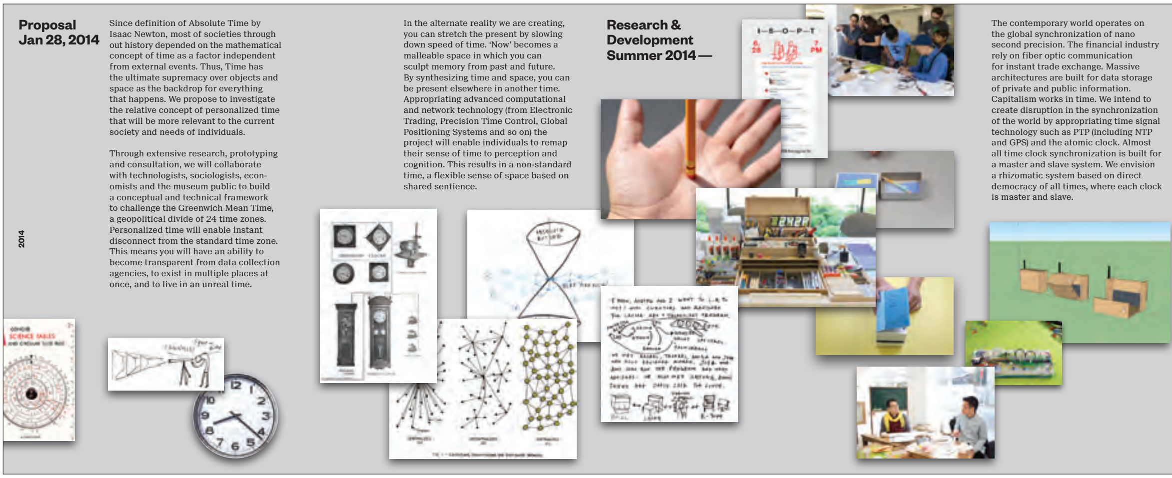
What is time, really? The fight to control the metrics of time remains a vital and deeply political question. We are artists and designers originally from South Korea who have engaged with this theme over the past years through our individual artistic practices, research, and teaching. In 2014, we were both independently working for a biennial there while living in New York City, coordinating with colleagues in South Korea through Google Hangouts—at inconvenient hours for everyone involved. These meetings took place in what we came to call *elsewhen*: a time zone aligned with neither Eastern Standard Time nor Korea Standard Time, but a negotiated temporal space intelligible only to those present. Living through the friction between standardized time and this improvised third zone sparked a question for us: Can time be grounded in lived, personal experience rather than fixed by planetary movement?

This question sparked our first collaboration, *In Search of Personalized Time*. Over the course of two years, we held multiple events in New York, Los Angeles, and Seoul. Among these was the Timekeeper Invention Club, where we invited participants to design their own systems of time—whether





Drawings by Taeyoon Choi, 2014



Proposal Jan 28, 2014

2014

Since definition of Absolute Time by Isaac Newton, most of societies through out history depended on the mathematical concept of time as a factor independent from external events. Thus, Time has the ultimate supremacy over objects and space as the backdrop for everything that happens. We propose to investigate the relative concept of personalized time that will be more relevant to the current society and needs of individuals.

Through extensive research, prototyping and consultation, we will collaborate with technologists, sociologists, economists and the museum public to build a conceptual and technical framework to challenge the Greenwich Mean Time, a geopolitical divide of 24 time zones. Personalized time will enable instant disconnect from the standard time zone. This means you will have an ability to become transparent from data collection agencies, to exist in multiple places at once, and to live in an unreal time.

In the alternate reality we are creating, you can stretch the present by slowing down speed of time. 'Now' becomes a malleable space in which you can sculpt memory from past and future. By synthesizing time and space, you can be present elsewhere in another time. Appropriating advanced computational and network technology (from Electronic Trading, Precision Time Control, Global Positioning Systems and so on) the project will enable individuals to remap their sense of time to perception and cognition. This results in a non-standard time, a flexible sense of space based on shared sentience.

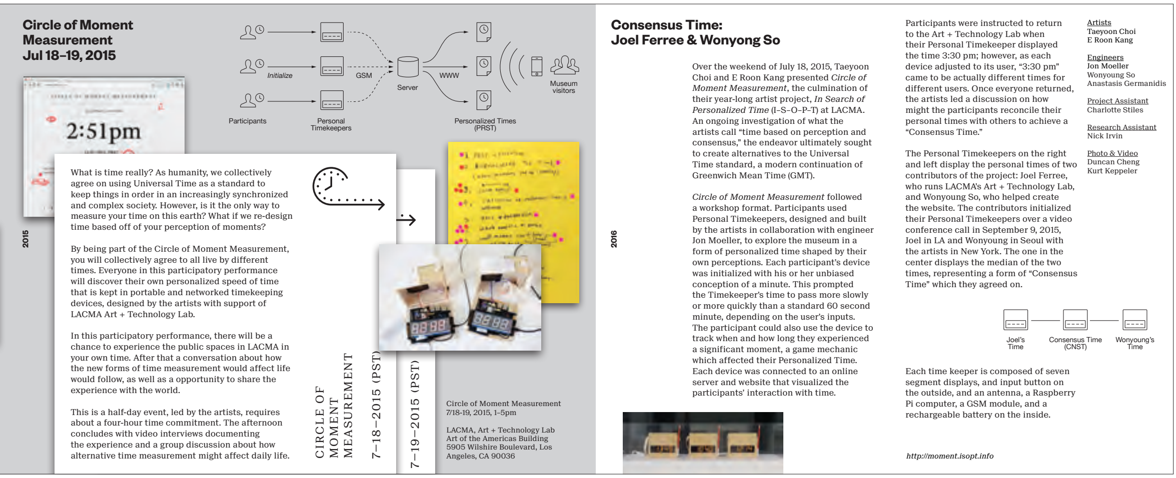
Research & Development Summer 2014 —

The contemporary world operates on the global synchronization of nano second precision. The financial industry rely on fiber optic communication for instant trade exchange. Massive architectures are built for data storage of private and public information. Capitalism works in time. We intend to create disruption in the synchronization of the world by appropriating time signal technology such as PTP (including NTP and GPS) and the atomic clock. Almost all time clock synchronization is built for a master and slave system. We envision a rhizomatic system based on direct democracy of all times, where each clock is master and slave.

based on the flowering cycles of plants, daily rituals, or incremental progress toward personal goals.

In the summer of 2015, we organized Circle of Moment Measurement, a participatory workshop at LACMA featuring a custom-made timekeeping machine. The Personal Timekeeper would advance based on an individual's subjective sense of a minute by extrapolating it. We view these "personalized times" as the core artistic output of the project: material expressions of temporality shaped by individual experience. Three of these Personal Timekeepers, an artifact carrying that temporal worldview, were later acquired by LACMA.

Brochure documenting Circle of Moment Measurement workshop, July 18–19, 2015



Circle of Moment Measurement
Jul 18–19, 2015

Participants
Initialize
Personal Timekeepers
GSM
Server
WWW
Personalized Times (PRST)
Museum visitors

2:51pm

2015

What is time really? As humanity, we collectively agree on using Universal Time as a standard to keep things in order in an increasingly synchronized and complex society. However, is it the only way to measure your time on this earth? What if we re-design time based off of your perception of moments?

By being part of the Circle of Moment Measurement, you will collectively agree to all live by different times. Everyone in this participatory performance will discover their own personalized speed of time that is kept in portable and networked timekeeping devices, designed by the artists with support of LACMA Art + Technology Lab.

In this participatory performance, there will be a chance to experience the public spaces in LACMA in your own time. After that a conversation about how the new forms of time measurement would affect life would follow, as well as a opportunity to share the experience with the world.

This is a half-day event, led by the artists, requires about a four-hour time commitment. The afternoon concludes with video interviews documenting the experience and a group discussion about how alternative time measurement might affect daily life.

CIRCLE OF MOMENT MEASUREMENT
7–18–2015 (PST)
7–19–2015 (PST)

Circle of Moment Measurement
7/18-19, 2015, 1-5pm

LACMA, Art + Technology Lab
Art of the Americas Building
5905 Wilshire Boulevard, Los Angeles, CA 90036

2016

Consensus Time:
Joel Ferree & Wonyong So

Over the weekend of July 18, 2015, Taeyoon Choi and E Roon Kang presented *Circle of Moment Measurement*, the culmination of their year-long artist project, *In Search of Personalized Time* (I–S–O–P–T) at LACMA. An ongoing investigation of what the artists call "time based on perception and consensus," the endeavor ultimately sought to create alternatives to the Universal Time standard, a modern continuation of Greenwich Mean Time (GMT).

Circle of Moment Measurement followed a workshop format. Participants used Personal Timekeepers, designed and built by the artists in collaboration with engineer Jon Moeller, to explore the museum in a form of personalized time shaped by their own perceptions. Each participant's device was initialized with his or her unbiased conception of a minute. This prompted the Timekeeper's time to pass more slowly or more quickly than a standard 60 second minute, depending on the user's inputs. The participant could also use the device to track when and how long they experienced a significant moment, a game mechanic which affected their Personalized Time. Each device was connected to an online server and website that visualized the participants' interaction with time.

Participants were instructed to return to the Art + Technology Lab when their Personal Timekeeper displayed the time 3:30 pm; however, as each device adjusted to its user, "3:30 pm" came to be actually different times for different users. Once everyone returned, the artists led a discussion on how might the participants reconcile their personal times with others to achieve a "Consensus Time."

The Personal Timekeepers on the right and left display the personal times of two contributors of the project: Joel Ferree, who runs LACMA's Art + Technology Lab, and Wonyoung So, who helped create the website. The contributors initialized their Personal Timekeepers over a video conference call in September 9, 2015, Joel in LA and Wonyoung in Seoul with the artists in New York. The one in the center displays the median of the two times, representing a form of "Consensus Time" which they agreed on.

Joel's Time
Consensus Time (CNST)
Wonyoung's Time

Each time keeper is composed of seven segment displays, and input button on the outside, and an antenna, a Raspberry Pi computer, a GSM module, and a rechargeable battery on the inside.

http://moment.isopt.info

Artists
Taeyoon Choi
E Roon Kang

Engineers
Jon Moeller
Wonyoung So
Anastasis Germanidis

Project Assistant
Charlotte Stiles

Research Assistant
Nick Irvin

Photo & Video
Duncan Cheng
Kurt Keppeler

At the heart of the project is a central inquiry: How might we intervene in the dynamics between universal, personal, and collective temporalities to reconsider what constitutes the "present"? We plan to expand this work in the coming years—both as a research inquiry and as a curatorial endeavor—by inviting more people into the conversation. Through organizing public programs, designing collaborative experiments, and building frameworks, we hope to cultivate a broader discourse around temporal agency and challenge the dominant culture of chronometry to create space for lived temporalities.

John Craig Freeman

Awarded: Year 1 (2014–15)
Project Dates: 2014–15
Key partner: DAQRI

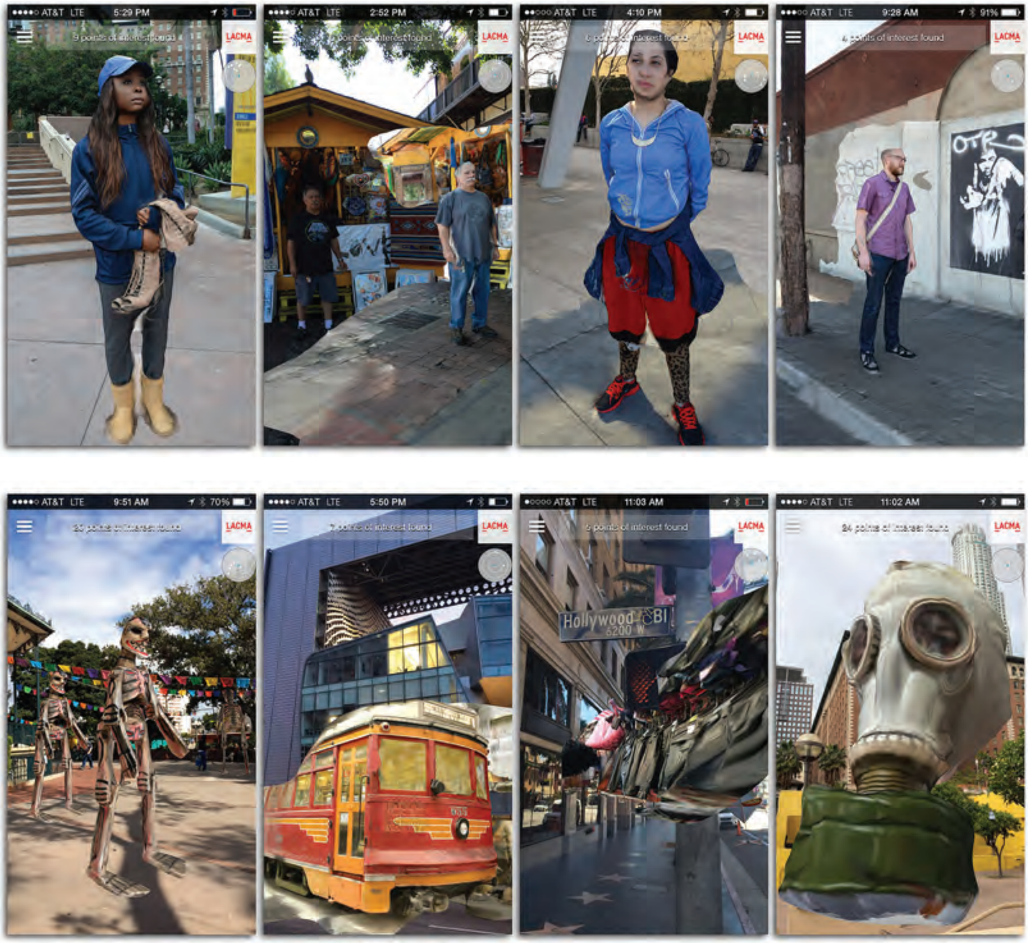
John Craig Freeman began his *EEG AR: Things We Have Lost* project in 2012, based around asking residents of different cities a simple question: What have you lost? The responses—ranging from trivial items to profound losses—revealed a story about the city itself. In Liverpool, where the artist first conceived the project, the responses included wedding rings, childhood toys, and departed relatives. In Coimbra, Portugal, in the midst of an economic crisis, respondents spoke of losing financial security. A group of teenagers in Basel, Switzerland, said that they had lost time. In each case their responses were recorded, along with the GPS coordinates of the locations where the conversations took place, and transformed into virtual objects and avatars placed throughout the city using augmented reality (AR) and photogrammetry, a technology by which three-dimensional models are stitched together from multiple two-dimensional images.

In spring 2015, the project was tested at LACMA before being deployed citywide. In a series of experimental performances, the Art + Technology Lab was transformed into a clinic-like space open to the public. Visitors were outfitted with Melon headbands provided by DAQRI, an AR company founded by Brian Mullins that collaborated with Freeman. These wireless devices used electroencephalography (EEG) to measure the brain activity of wearers, who were asked to focus deeply on something they had lost. When the software

Top
Geolocated AR avatar created and documented on location in Hollywood, 2015

Center and bottom
AR avatars at various locations around Los Angeles, 2015


EEG AR: Things We Have Lost
EEG
AR
LACMA, Art + Technology
John Craig Freeman


LACMA
4 points of interest found
Hollywood Bl
6200 W

detected a consistent brainwave pattern, it triggered a call to a database to instantiate a virtual object—randomly selected from a database of lost objects—that then appeared in front of the wearer via AR.

Artist's Reflections

Spring 2015 found me and my team of Emerson College research assistants walking the streets of Los Angeles. We'd approach strangers with a disarmingly simple question: *What have you lost?* The responses in L.A. were as diverse as the city itself. A woman in Silver Lake told us about losing her sense of purpose after her children left home. A man near MacArthur Park described losing his homeland when he immigrated thirty years ago. I'll never forget the older gentleman who paused thoughtfully before answering. "The years, I would imagine," he began with a chuckle, "but we've got a bit of sense of humor to compensate for it, hopefully." His expression shifted to something more philosophical as he continued, "Probably wisdom and experience to compensate for the loss of youth." Then with perfect comic timing, he pointed to his mouth and ran a hand through his hair: "A few teeth. The color of my hair." We both laughed, and in that moment, I realized how this project created space for people to reflect on loss not just with sadness, but with humor and grace. Each story became data—GPS coordinates marked exactly where these conversations occurred. Back at the Art + Technology Lab, we translated these losses into virtual objects and avatars, creating a digital layer of collective memory mapped precisely onto the physical geography of Los Angeles.

Visitors to the museum's plaza could explore a captivating collection of virtual lost objects through mobile AR viewing devices—essentially screens on wheels. These digital artifacts, positioned at specific GPS coordinates, included a worn leather jacket symbolizing lost fame, an extinct thylacine representing vanished species, a solitary rowboat embodying the fear of mortality, and L.A.'s iconic Red Car trams evoking nostalgia for a bygone L.A. era. Each virtual object emerged from interviews with L.A. residents about tangible and intangible things they had lost, creating a citywide network of collective memory that transformed public spaces into landscapes of shared loss and reflection. These moments of connection—where technology becomes invisible and the human experience takes center stage—are why I create.

The most profound aspect of this work isn't the technology itself—the augmented reality, the EEG components that allowed viewers to interact with lost objects using brainwave activity. It's how technology can make the invisible visible, and can transform public spaces into galleries of collective memory. Each city's version of *Things We Have Lost* creates a unique cognitive map. Los Angeles revealed itself as a city of personal reinvention, where losses often marked transitions—former careers, past relationships, abandoned dreams—but also as a place where new beginnings emerged from these very losses.

Read more about John Craig Freeman's work in mapping narratives of loss at www.lacma.org/art/lab.

Annina Rüst

Awarded: Year 1 (2014–15)
Project Dates: 2014–17

With *A Piece of the Pie Chart* (2014–17), Annina Rüst directly confronted one of the most criticized aspects of LACMA's original Art and Technology Program: the absence of women. This shortcoming was starkly illustrated on the cover of the 1971 publication (see p. 254), which features a grid of all-male photographic portraits of the program's participants (this publication lists seventy-six "Participating Artists," but only two, Channa Davis and Aleksandra Kasuba, are women—and it appears that they submitted proposals but were not selected to realize their projects). Inspired by the theatrical interventions of feminist precursors such as the Guerrilla Girls, Rüst's project culminated in April 2015 with a participatory exhibition/performance at LACMA that tackled the persistent issue of gender equity in the worlds of art and technology with biting wit.

Artist's Reflections

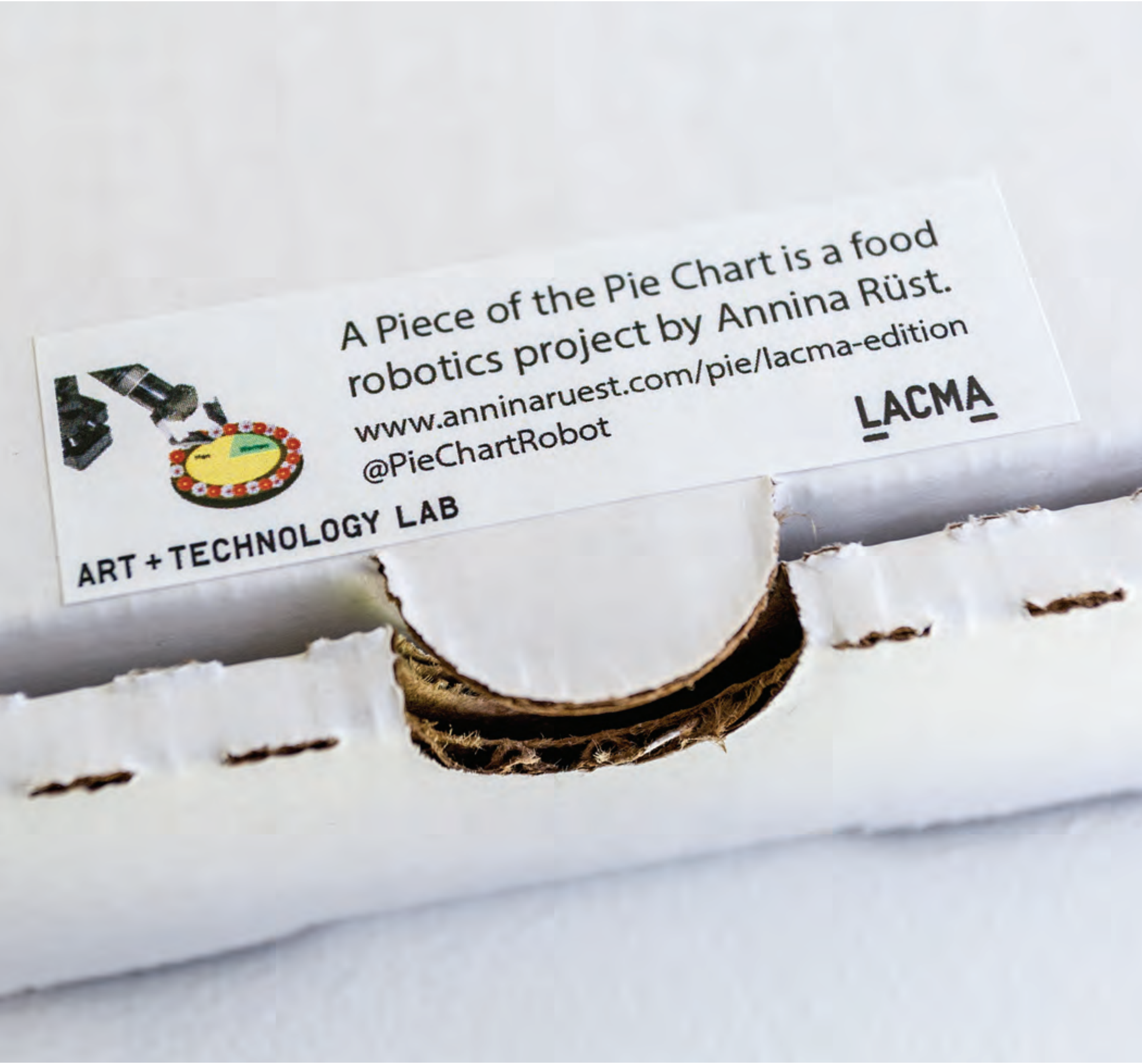
When I submitted my proposal to the first cycle of Art + Tech Lab, I researched the original LACMA Art and Technology Program. The program was criticized for excluding women and people of color even though many had applied. As a result, it became the subject of feminist protests at the time. One group that protested was the Los Angeles Council of Women Artists (LACWA). On June 15, 1971, they published the "Los Angeles Council of Women Artists Report." The title references Maurice Tuchman's 1971 publication, *A*

pp. 37–39
A Piece of a Pie Chart, 2015


A Piece of the Pie Chart
WAGNER


Warning
DO NOT EAT THIS LABEL!
LACMA
ART+TECH Lab
Grant Recipients 2014
2 women | 4 men

Annina Rüst


A Piece of the Pie Chart is a food robotics project by Annina Rüst.
www.anninaruest.com/pie/lacma-edition
@PieChartRobot
LACMA
ART + TECHNOLOGY LAB

Report on the Art and Technology Program of the Los Angeles County Museum of Art. They wrote: “As many women as men enrolled in the art schools of this country, but the number of women who achieve recognition is negligible.” They then meticulously put forth gender data on one-person and group exhibitions from 1961 to 1971. They found a single one-person exhibition by a woman (Dorothea Lange) among fifty-two by men. The percentage of women in group exhibitions at LACMA within the same time span was 4 percent. LACWA published an appendix of data along with a list of demands as part of their report. They also threatened to sue LACMA but eventually found an agreement with LACMA. As part of the agreement, LACMA committed to hosting the exhibition *Women Artists: 1550–1950*, curated by Linda Nochlin and Ann Sutherland Harris, which opened in December 1976.

My contribution to the first cycle of Art + Tech Lab was *A Piece of the Pie Chart*, a robotic installation that protests the lack of women in art and technology spaces with data and baked goods. It is a food robot that places pie charts onto real, prebaked pies. It then takes a picture of the pie and posts it to social media. It also prints an address label that exhibition visitors can use to package and mail the pie to the art and tech venues where the data originated. Besides making the project and installing it at the Art + Tech Lab, I cohosted two events at LACMA with artist Micol Hebron. She is a feminist artist and the director of the Gallery Tally Poster Project. In *Gallery Tally*, Hebron crowdsources gender data from top contemporary art galleries and, together with other artists creates posters using the data. These posters are then exhibited. Together, we hosted a workshop on feminist data visualization at LACMA. Among the attendees was Ann Isolde, an artist who was part of the artist group protesting LACMA in the 1970s. She became an impromptu cofacilitator of the workshop, connecting historic feminist protest of the 1970s and 1980s with the present.

My grant period at LACMA is now over ten years ago. Over this stretch of time, the United States witnessed a rise in popularity of diversity, equity, and inclusion initiatives between 2020 and 2022, which were in part prompted by protests following the murder of George Floyd. In 2025, at the time of this writing, these initiatives are being rolled back at many institutions in the U.S. in the wake of the 2024 presidential election. The gender ratio of LACMA Art + Tech over ten years has been twenty-one women, twenty-eight men, and six non-binary/genderqueer. In the greater art world, gender diversity continues to lag. I recently reread the LACWA Report and it is clearly assertive, data driven, and focused on getting results. Some would call this "aggressive." The LACWA report is a document reflecting institutional critique that has not lost relevance. It can serve as a reminder to institutions in art and tech to keep working toward diversity, equity, and inclusion. The artists in LACWA were ahead of their time back in 1971. The document they wrote more than fifty years ago can still serve as a guiding light to tech companies, art institutions, and to individual artists like me.

Read more of Annina Rüst's examination of women in Art + Tech at www.lacma.org/art/lab.

Tavares Strachan

Awarded: Year 1 (2014–15)
Project Dates: 2014–21
Key Partner: SpaceX

Tavares Strachan's *ENOCH* (2014–21) brings together hidden histories, ancient Egyptian funerary practices, biblical traditions, Shinto rituals, and advanced technologies—including 3D printing and a satellite launch—to celebrate the life of Robert Henry Lawrence Jr. (1935–1967), the first African American astronaut selected for a national space program. Lawrence, an accomplished Air Force pilot and the first astronaut with a doctorate degree, developed a technique that would become a critical maneuver for space shuttle landings. He died in 1967 while training a junior pilot at Edwards Air Force Base in California, never realizing his dreams of space travel. Even though NASA commemorated his many contributions on the fiftieth anniversary of his death in 2017, Lawrence remains largely absent from the wider narrative of space exploration.

To celebrate Lawrence's legacy, Strachan created a 24-karat-gold canopic jar capped by the astronaut's bust, suggesting the ancient Egyptian practice of preserving the organs of the deceased for the afterlife. The jar was blessed at a Shinto shrine in Fukuoka, Japan, where it was recognized as a container for Lawrence's soul and identified in the ritual blessing as "Robert Lawrence—ENOCH." The name evokes the biblical figure Enoch, who, according to Jewish, Christian, and Muslim texts, ascended to the afterlife without ever experiencing mortal death. The object thus evokes multiple religious traditions, emphasizing

Tavares Strachan, *ENOCH (Display Unit)*, 2018, bronze, 24k gold, steel, and sacred air blessed by Shinto priest, 30 × 10 × 10 in., Isolated Labs, created in collaboration with LACMA as part of the Art+Technology Lab initiative the potential of a person's spirit to endure.

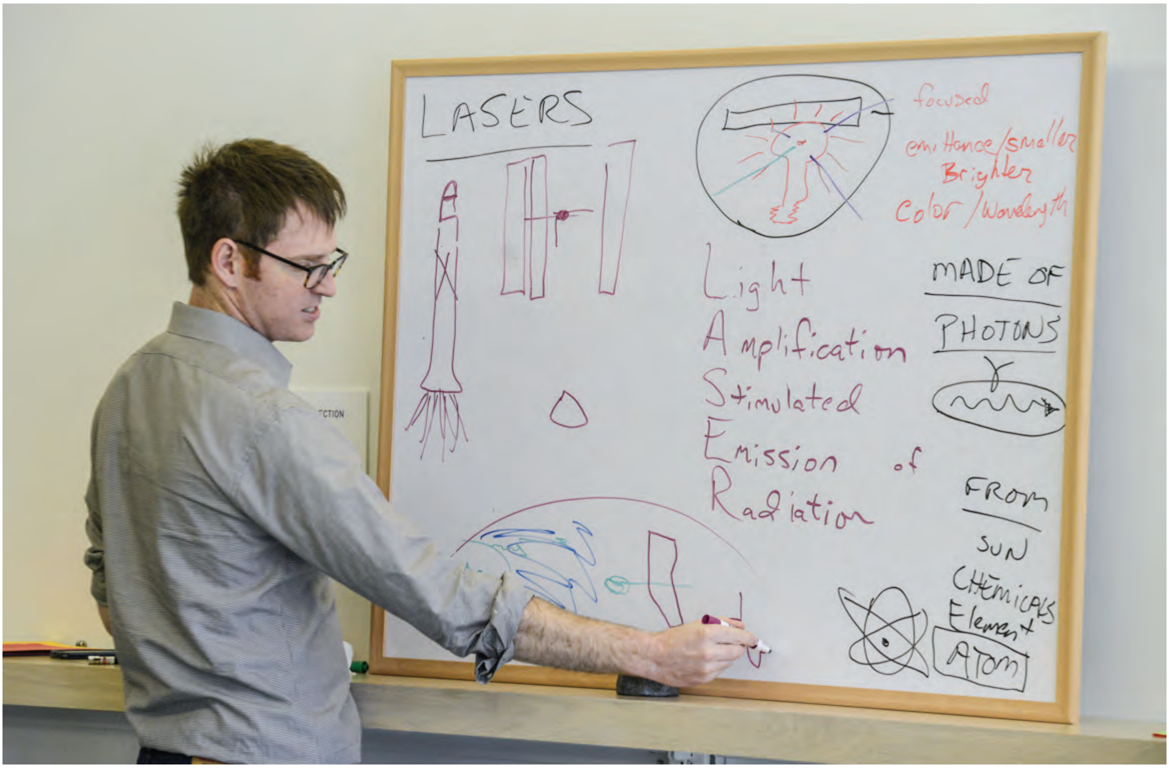
In May 2014, shortly after being named as one of the Art + Technology Lab's first grant recipients, Strachan met with SpaceX President and COO Gwynne Shotwell, an advisor to the Lab, to explore how technology could expand his art practice. Under the aegis of the artist's own Bahamas Aerospace and Sea Exploration Center (B.A.S.E.C.), Strachan had previously launched small-scale rockets using natural resources from his home country—such as glass from beach sand and fuel from sugarcane—and collected their fallen remnants to exhibit as sculpture. Encouraged by Shotwell to pursue a project in space, he embarked on a project that evolved into two parts: the *Chalkboard Drawings* (2015) and *ENOCH*.

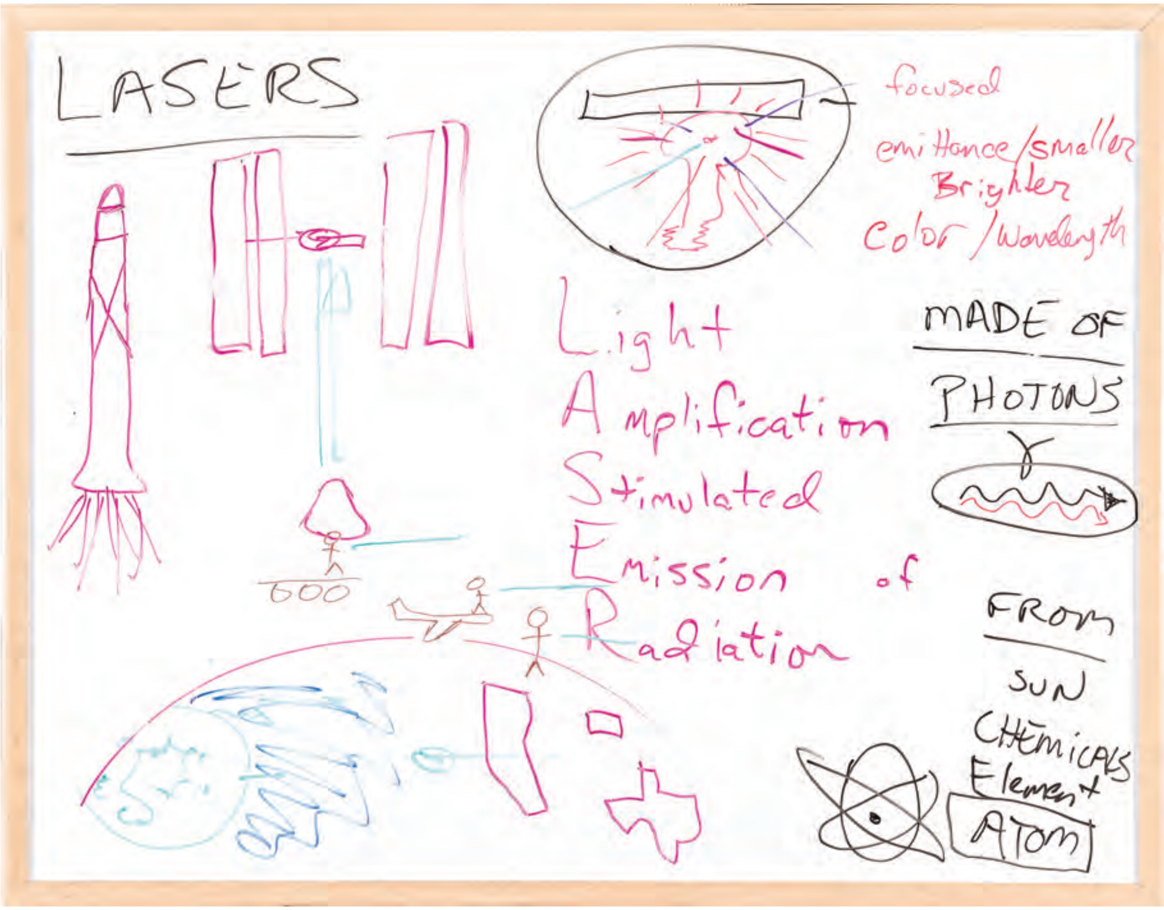
For the *Chalkboard Drawings*, SpaceX engineers discussed interstellar space with a group of children, ages seven to ten, using dry-erase boards to illustrate scientific concepts. Strachan then interpreted and annotated these drawings, which were incorporated into artworks embossed in large slabs of chalk.

Designing the *ENOCH* spacecraft presented early challenges. Strachan initially considered making the canopic jar from glass or ceramic, and he produced prototypes from those and other materials. However, Andrew Kalman at Pumpkin, Inc., a spacecraft manufacturer, advised using materials more capable of withstanding the rigors of escaping earth's gravity. Walter Holemans, of Planetary Systems Corp., suggested 3D-printing the jar in titanium or stainless steel. Ultimately, Strachan chose to 3D-print the sculpture in bronze, then plate it in 24-karat gold.

After resolving design and regulatory issues with help from Tim DeBenedictis of Southern Stars Group, a company that develops astronomy software and has supported small spacecraft missions, *ENOCH* was successfully launched on December 3, 2018, aboard a SpaceX Falcon 9 rocket as part of Spaceflight's SSO-A:

Chalkboard Conversations
public program, 2015


LASERS
focused
emittance/smaller
Brighter
Color/Wavelength
Light
Amplification
Stimulated
Emission of
Radiation
MADE OF
PHOTONS
FROM
SUN
CHEMICALS
Element
ATOM



Dry-erase board from Chalkboard
Conversations public program, 2015

SmallSat Express mission from Vandenberg Air Force Base in California. As part of the satellite, a 3U CubeSat, the sculpture of Lawrence circled the earth for three years in a sun-synchronous orbit and then reentered the atmosphere on December 21, 2021. “For me,” Strachan told the *Los Angeles Times*, “it’s important to ensure that when someone has done something incredible, that the level of storytelling is aligned with the nature of the act, hence the audacity of putting an object into space and trying to get his energy back into the cosmos.” A gallery dedicated to Lawrence and the *ENOCH* project was included as part of the exhibition *Tavares Strachan: The Day Tomorrow Began*, on view at LACMA from October 12, 2025 to March 29, 2026.

Southern Stars Group engineer Tim DeBenedictis tests the satellite deployer

U.S. Department of Transportation
Federal Aviation Administration

Commercial Space Transportation

800 Independence Ave., S.W., Rm 331
Washington, D.C. 20591

November 2, 2018

Mr. Timothy DeBenedictis
Southern Stars
404 Bryant Street
San Francisco, CA 94107

Dear Mr. DeBenedictis:

On April 27, 2018, we received your request for a Payload Review and Determination for the ENOCH payload and informed you by letter on May 7, 2018, that we were initiating our review. In accordance with 14 CFR § 415.51, the Federal Aviation Administration (FAA) reviewed the payload to determine whether it would jeopardize public health and safety, safety of property, U.S. national security or foreign policy interests, or international obligations of the United States.

Southern Stars provided the following information:

Payload Name

ENOCH

Payload Class

Passive 3U CubeSat

Physical Dimensions

11 x 11 x 34 cm; 3.06 kg

Payload Owner/Operator

Tavares Strachan (artist), funded by Los Angeles County Museum of Art (LACMA)

Orbital Parameters, for Parking, Transfer, and Final Orbits

Sun-synchronous, circular orbit @ 575 km altitude, 97.75° inclination, 10:40 AM LTDN.

opposite
First page of FAA authorization letter for *ENOCH*, 2018

above
Spaceflight rendering of *ENOCH* in space

Artist's Reflections

At the time of my work with LACMA's Art + Technology Lab, I was deeply invested in Egyptology, and ancient Egyptians' interest in technology and the afterlife. *ENOCH* pays homage to Robert Henry Lawrence Jr., an astronaut who didn't get to go into space as he died in a training exercise. I wanted to make a work that was going to embody his story. Since ancient Egyptians were so interested in the afterlife, I thought it would be a perfect metaphor to use the visual language of the canopic jar to design this satellite around.

Rachel Sussman

Awarded: Year 1 (2014–15)
Project Dates: 2014–15

Rachel Sussman, whose work ranges from photography to writing, received an Art + Technology Lab grant in 2014. That same year she published a book titled *The Oldest Living Things in the World*—the culmination of a ten-year quest to photograph organisms that had been continuously alive for two thousand years or more, which had involved intensive research, collaborations with scientists, and travel to every continent. Her investigations for this project inspired her to expand her explorations beyond geologic time into cosmic time. As she has written, "I realized that I wanted to explore our human experience of time in the context of space: space as the source of our deepest past, i.e., the ultimate source of life on Earth, and space as vision for the future, including the commercial race for space and the notion of populating space stations and other planets, should we, as current trends suggest, ultimately make the Earth uninhabitable." For her residency at the Lab, she proposed to research deep time and deep space to inform the creation of new bodies of work.

In the spring of 2015, Sussman visited facilities engaged in space exploration, including NASA's Ames Research Center. As she has noted, "I spent time at SpaceX, NASA JPL, CERN, and NASA Ames, meeting with scientists and percolating project ideas with the goal of making concept-based installation work that is both felt and understood—for instance, a 17-mile walk that follows the loop of the underground Large

top
Hangar One, Moffat Federal Airfield, 2015

bottom
Rachel Sussman at Ames Research Center

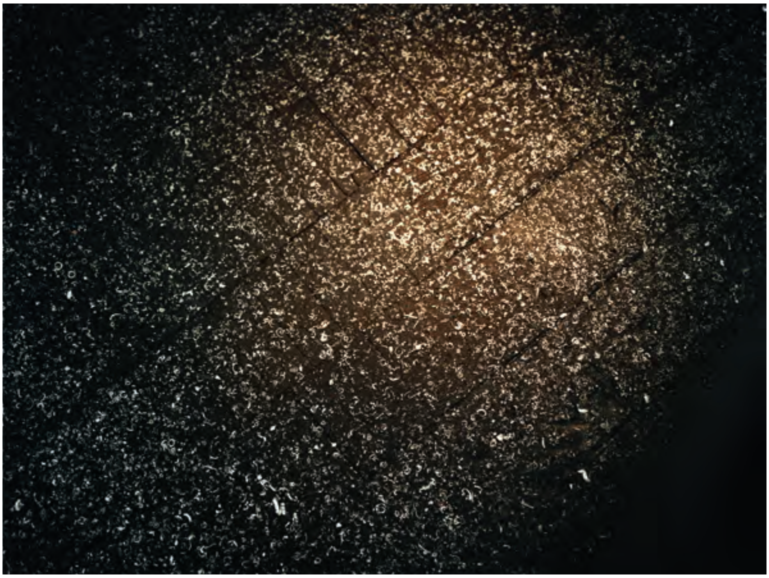

NASA
AMES RESEARCH CENTER
NASA RESEARCH PARK

Hadron Collider at CERN, serving as a metaphorical 13.8-billion year path from the big bang to the present." She returned to Ames to produce two photographic series: *This Used to Be the Future*, pictures of the facility accompanied by a short essay she wrote, and *The Poetics of Space*, which also includes pictures of other sites. Founded in Northern California in 1939 as the second home of the National Advisory Committee on Aeronautics (NASA's precursor), Ames sits in what later became Silicon Valley. Though still an active facility, it is, according to Sussman, "a living time capsule, in varying degrees of disrepair." As seen in her photographs, obsolete computers—long past any possibility of upgrade—still run equipment in the machine shop. A decommissioned nuclear missile sits in a parking lot. A replica of the International Space Station lies under a tarp next to a sandy lot filled with aircraft engines, metal tanks, and old lasers. Looming over everything is Hangar One, built in the 1930s to house dirigibles and constructed from lead, PCBs, and asbestos—materials that have been leaching into San Francisco Bay for decades. Google recently leased the hangar to test airborne internet connectivity projects inside its vast interior. As Sussman reflected of Ames's jet-age architecture and archaic technology, "I approached Ames with an eye for architecture, landscapes, and poetic details, all the while thinking: *this used to be the future*."

Artist's Reflections

Working with the Art + Technology Lab was not just delightful, it was ideal for an artist: to have doors opened to explore wherever my intuition took me, to have my expenses taken care of, and to be free from the burden of delivering specific results. That is as unusually nurturing in the art world as it is invaluable to the creative process.

The time I spent at the Jet Propulsion Laboratory



Rachel Sussman, *Space Shavings/ Machine Shop Floor*, 2015

and NASA Ames in particular was enriching in ways that still touch me over a decade later. Getting to spend the night at NASA Ames with authorization to roam around the campus after dark was thrilling. A 3.1-billion-year-old rock with signs of some of the earliest life on earth given to me by an astrobiologist on the Mars rover team is profoundly grounding, inspirational, and spiritual.

In addition to leading to my photography series *The Poetics of Space* and *This Used to Be the Future*, my time at the Lab sowed seeds for work for years to come, including my large-scale handwritten timeline installation *(Selected) History of the Spacetime Continuum* (2017), which begins before the Big Bang and extends 10^{100} billion years into the future; *Cosmic Microwave Mandala* (2017), a sand mandala depicting the Cosmic Microwave Background, otherwise known as the baby picture of the universe; and *Time Loop (For CERN)* (2015), an unrealized installation spanning seventeen miles, two countries, and 13.8 billion years. The freedom and access afforded me by the Lab opened the doors into my deeper exploration of time, space, and the nature of consciousness.

Cayetano Ferrer

Awarded: Year 2 (2015–16)
Project Dates: 2015–ongoing

Many of the objects in a museum's collection are scarred, damaged, or otherwise incomplete; the older the object, the more likely it has suffered the ravages of time. This has long posed a problem for those who preserve and display such items, and standards of practice have varied greatly. In the eighteenth and nineteenth centuries, it was common to reconstruct objects—such as Greek or Roman sculptures—by imagining how they appeared at the time of their making. Over the twentieth century, a new orthodoxy emerged, holding that conservation should be minimally invasive, reversible, and clearly distinguishable from the original.

Recognizing that presentation shapes how objects are perceived and understood, Cayetano Ferrer conceived *Object Prosthetics* to examine existing conservation and display strategies and explore new approaches using current technologies, such as 3D scanning and fabrication. Working from LACMA's collection archive, Ferrer studied institutional framing devices, such as reconstructions, cases, architecture, and exhibition design. As this work was underway, the museum announced its plans to replace its original 1965 buildings as well as a later addition. "It became clear that the space where I was scanning was itself going to become fragmentary," he recalled. "I became interested in working that transformation into the project. This developed into an artwork called *Extraction*, which involved working with the demolition

top
Extraction IV (31 July 2020 01:03 PM), 2020, steel-reinforced concrete, 32 × 282 × 55 in., courtesy of the artist and Commonwealth and Council

bottom
*Extraction V (*3 August 01:32 PM), 2020, steel-reinforced concrete, 50 × 175 × 40 in., courtesy of the artist and Commonwealth and Council

team to cut large sections of the Ahmanson building."

Ferrer was also invited to work with the Santa Barbara Museum of Art's permanent collection of Greek and Roman antiquities, designing stylized pedestals for rarely exhibited architectural fragments such as columns and capitals. After consulting with architect Philippe Paré, an advisor to the Art + Technology Lab, he created experimental displays for a temporary exhibition. In parallel, Ferrer visited museums and collections to document objects and acquire plaster casts for physical infill experiments, including examples from the Art & History Museum in Brussels, and produced vacuum-formed molds for an exhibition in Buenos Aires.

Artist's Reflections

To dismember: an act of the world upon a body, pulling apart a structure. To re-member: an act of mind, a pulling of scattered things back into the fold of thought. A powerful symmetry lies in the pairing. It suggests a natural law of psychic gravity, that for every act of fragmentation, there is an equal and opposite urge toward reconciliation. This impulse haunts a constellation of human enterprises: archaeology, assemblage, kintsugi, archival research, dream analysis, and film editing. It's a compelling fiction.

Nowhere is this fiction more concretely staged than in the museum: an engine for reassembling the world's fragments. The work grouped under the title *Object Prosthetics* began as an inquiry into this process: tracing the violence on objects before they arrived in the collection, examining their subsequent repairs, and developing speculative prosthetic support systems that reject neutrality and engage tensions between fragments and their display systems. Under this umbrella, a sequence of works emerged from collection research, from

Greek and Roman architectural fragments to conceptual restorations of exhibition spaces. Eventually, attention shifted from the objects themselves to the very architecture that housed them—a framework that was, itself, subject to fragmentation.

As a site, the Los Angeles County Museum of Art is an archive of fragmentation and a testament to the will to reconcile. The asphalt seeps the museum sits on, it turns out, have exceptional preservation chemistries, creating the largest known concentration of Ice Age fossils on earth. This condition of natural preservation was the impetus for the site's cultural use when the original owner donated to the county. The building itself, then, has always been in dialogue with the act of recovery. In 2020, this dialogue became literal. The research developed into a choreographed dismemberment with the museum's demolition team, a project titled *Extraction*. The goal was to salvage architectural elements of the William Pereira–designed campus before its destruction, preserving them for a future public setting, and highlight the transformation and decontextualization.

During this process, the architectural became anatomical. "They look so much like bones," a colleague remarked, seeing the multi-ton fragments of the column resting in the studio. A sketch, unearthed in the Pereira archives at the University of Southern California, revealed the building's ghost: the original design for LACMA was for a "Museum of the La Brea Fossils," conceived as a vessel for the very bones still being pulled from the ground. The concrete fragments were, in a sense, fulfilling a latent destiny, becoming the monumental fossils of a modernist era, extracted from the same historical soil.

Read Cayetano Ferrer's further observations regarding the connections between the architectural, institutional, and geological at www.lacma.org/art/lab.

Gabriel Barcia-Colombo

Awarded: Year 2 (2015–16)
Project Dates: 2015–16

When Gabriel Barcia-Colombo's grandfather died, his family traveled from the United States to Spain for his memorial service. José Rubia Barcia (1914–1997) was a celebrated Spanish author and poet, and at his funeral a bronze bust was unveiled in his honor. The bust evoked none of Barcia-Colombo's memories of his grandfather. "It was the strangest experience to be at a public memorial for someone that I knew so intimately and yet feel a complete disconnection from his own image," the artist recalled. This disconnect—between public commemoration and private memory—became the conceptual foundation for the Hereafter Institute, which debuted at LACMA in August 2016.

The project transformed portions of the museum into an elaborate fictional operation exploring death and memorialization in the digital age. Visitors began in the Bing Theater lobby, where assistants in white lab coats led them through a check-in process. After signing releases, they proceeded to the Pavilion for Japanese Art to discuss their online presence and learn about three options for posthumous data: Continuation, Deletion, or Memorialization. The assistants also informed visitors about Facebook's "legacy contact" setting, which allows users to designate someone to manage their profile after death. Visitors then stood on a turntable for a 3D body scan to create an animated avatar.

Ephemera from the Hereafter Institute

In the Art + Technology Lab, participants donned VR headsets to view digital memorials that Barcia-Colombo had created for three deceased individuals, including his grandfather at a writing desk and an aunt shopping in beloved flea markets. Voiceovers by the artist and his sister accompanied the scenes with personal reminiscences. The experience culminated in a screening room where visitors encountered their own memorialization. A dark-suited mortician delivered a eulogy incorporating real facts from the visitor's life—childhood home, high school, workplaces, family members—while the screen behind him cycled through recent Facebook posts. The visitor's avatar then walked into frame and headed toward the horizon, flanked by flower arrangements.

Artist's Reflections

What happens to your digital presence when you die? What sort of cultural rituals and services surrounding death will come about with the advent of technology such as virtual reality, data visualization, and holography? The Hereafter Institute is a fictional company somewhere between a high-end tech startup and funeral parlor which creates research-based installations and speculative design objects based on the concept of death and memorialization in the digital age. The project explores how future death memorials and rituals will deal with an abundance of personal data as well as increasing access to new media technology. What happens to our personal data when we die?

The Hereafter Institute at LACMA saw hundreds of guests experience digital memorials in a guided tour led by Hereafter Specialists. We were able to take over quite a large portion of the LACMA campus and convert it into the tour grounds for the Hereafter Institute. Although the company is fictional, the interactive installation work featured in each Hereafter Institute tour is very real. As part of the tour, specialists present multiple digital preservation options, including 3D body scanning, wearable memorialization, and the embedding of personal data into everyday objects. The goal is to help visitors honor, recognize, and celebrate their digital presence.

The tour culminated in a simulated funeral crafted individually for each visitor based on their own personal online data. Reactions to the Hereafter Institute were incredibly emotional. Some visitors said the experience helped them accept their own mortality, while others wanted to purchase the services of the Hereafter Institute as if it were a real tech company startup. After the tour was done at LACMA, I was invited to visit a large Los Angeles funeral home that wanted to incorporate virtual reality and data memorials into their services. The Hereafter Institute is meant to be an emotional experience that encourages a more open discussion about death in our society. Now when I look back at the Hereafter Institute, I see part of the old museum that no longer stands, and, in a sense, the documentation of the Institute actually memorialized LACMA itself.

Participant in the Hereafter Institute, 2016


VIVE

Nonny de la Peña
Alex Rivera

Awarded: Year 2 (2015–16)
Project Dates: 2015–16

Nonny de la Peña is a journalist, documentary filmmaker, and pioneer in what she has termed "immersive journalism"—a mode of narrative that uses virtual reality (VR) technology to immerse viewers, enabling them to feel a more powerful emotional connection to the stories she tells. For example, in her projects, viewers can virtually experience being within the walls of a detention center or an internment camp. Alex Rivera is a filmmaker whose work explores themes of globalization, migration, and technology. His first feature film, the award-winning *Sleep Dealer* (2008), is a cyberpunk thriller set on the U.S./Mexico border, which envisions "a strange—but not unimaginable—future of cybraceros, coyoteks, and disembodied border-crossers." De la Peña and Rivera partnered to create *Reaching the Shore* (2016), which they describe as a linear virtual reality experience based on the Mexican writer Guillermo Lavín's 1994 short story, "Llegar a la orilla" (Reaching the Shore; translated in *Cosmos Latinos: An Anthology of Science Fiction from Latin America and Spain* [2003]). With the support of the Art + Technology Lab, they completed production of the 360 spherical video for the project. During an event at LACMA on September 17, 2016, members of the public donned VR headsets to view a ten-minute-long version of the narrative.

In their adaptation—filmed both in Los Angeles and in and around Tijuana—de la Peña and Rivera used VR technology to immerse viewers in the near-future

top and middle
Production shots, *Reaching the Shore*, 2016

bottom
VR screenshot from *Reaching the Shore*, 2016


PRUEBAS
DE
PRODUCTO
產品測試

world of Fragoso, a low-income worker in a maquiladora (factory) on the border, and his young son José Paul. Fragoso volunteers to become a product tester at the factory, which manufactures VR "pleasure chips" inserted into the base of the neck that transform illusions into reality for wealthy American consumers. However, he becomes addicted to the chips. Instead of buying his son the bicycle he wants for Christmas, Fragoso purchases a low-quality pleasure chip on the black market for himself, which melts into his neck and burns him. José Paul then decides to steal a chip to experience what it's like to ride the bicycle he could never afford. At the story's end, on the verge of becoming addicted himself, he contemplates whether he should continue to use the chip. "'I really have to think it over,' he said to himself.' 'I'll have to think it over.'"

One of the technologies that de la Peña and Rivera used to create *Reaching the Shore* is 360-degree video, also known as immersive, spherical, or surround video. This technology captures an entire spherical view of an environment with an omnidirectional camera, allowing viewers to investigate a scene in all directions and even pivot from the central action to focus on other details. *Reaching the Shore* combines 360-degree live action with computer-generated imagery and stereoscopic sound. At first viewers witness a linear and unalterable narrative unfold, but once a character inserts a chip, viewers can interact in the scene. Amy Heibel, a cofounder of the Lab, has observed that the effect "was like a dream, perhaps in part because of the surreal setting, the welcome stretches of silence between dialogue, and the unpredictable transitions."

De la Peña and Rivera have suggested that through virtual reality, viewers "essentially inhabit the life of a Mexican factory worker as he struggles to navigate his conflicting roles in the world, as 'worker,' as 'father' and as someone who has become addicted." By feeling that they have a deeper stake in the struggles of Fragoso and his son, viewers might gain a more profound insight into the impact of issues like addiction, poverty, and our complicated "relationship as technology consumers with the factory workers who make our technology consumption possible," as the artists have remarked.

Artists' Reflections

Alex Rivera: In the early days of virtual reality, there was a "border" between two forms: one driven by 360 video, and the other driven by spatial game engines. With our project, we wanted to tell a story that blended both forms. LACMA brought an array of tech-forward partners to the table who expanded our minds and conversations and who helped us create a piece that transcended those borders.

Nonny de la Peña: Making stuff is hard and this was no exception. From troubleshooting not-ready-for-prime-time 3D software, to problems with our bespoke 2D film camera, the LACMA grant allowed us an opportunity to fearlessly query what the medium could do while still focusing on what we wanted to convey. In fact, this project challenges viewpoints about the border while reflecting on the technologies deployed there, a theme which resonates even more deeply in today's climate.

Jonathon Keats

Awarded: Year 2 (2015–16)
Project Dates: 2015–17
Key Partners: Hyundai Motor Company; Gensler

Jonathon Keats developed a series of projects at the Art + Technology Lab that focused on wearables—electronic devices fused into clothing, accessories, or even the skin that gather and process data and function as extensions of the body. Although he initially focused on fashion, he worked with advisors from Hyundai Motor, SpaceX, NVIDIA, and Gensler to extend his "thought experiments" beyond this realm.

Keats's *Superego Suits* (2015) integrated bio-sensors and robotics into garment design, blending neuroscience with fashion to explore technologically augmented identity. He was particularly inspired by neuroscience research suggesting that our sense of self is influenced by *interoception*—the internal awareness of bodily functions like heartbeat and breathing. He applied research showing that a subject's sense of selfhood could be manipulated by altering their perception of their vital signs to hypothetical wearables.

"I started thinking about what wearables might do in the future, as they become more technologically advanced and deeply embedded in our lives," he has explained. "I wondered how they might fundamentally alter people's sense of self and what that would mean for individuals and society." Will we become more extreme versions of ourselves? Might we selectively try on other personae? Will technology further entrench egotism, facilitate empathy, or redefine

Jonathon Keats's prototype elevator shoes with motorized heels

personality itself? And will it happen so subtly that nobody questions the significance of these changes?

Keats developed prototypes testing these questions. Elevator shoes with motorized heels, for example, adjusted the wearer's height in response to the gaze of others: Depending on whether the wearer was looking up or down at other persons, the mechanism made them taller or shorter—elevating or diminishing their physical (and psychological) stature and probing their beliefs about personal agency.

Keats also collaborated with Elizabeth Brink, principal and studio director at Gensler, a global architecture, design, and planning firm, on *The Neuroscientific Workplace* (2015–16). He assembled a work cubicle in the Lab with a crude mechanical interface whereby each person's breathing caused the other's clothing to glow and adjusted overall light levels. Ultraviolet paint was applied to the cubicle's interior so that "as you breathe in and out your whole workspace glows in time with you, so that you enter your work."

With John Suh and his team from Hyundai Motor, Keats explored automotive applications in *Roadable Synapse* (2015–17). Eschewing the industry's fascination with self-driving cars, he suggested that powerful cultural and psychological forces may instead encourage deeper identification with vehicles—a symbiotic relationship similar to what has emerged with smartphones.

"I am neither for nor against technology in the abstract," Keats has remarked. "To have any real impact on our technological future, we need to consider technology collectively in pursuit of reasoned consensus. We need to critically examine the limitations of a neuroscientific understanding of our minds and our willingness to merge our deepest selves with the latest technologies."

Artist's Reflections

Arriving at LACMA on June 25, 2015, I found myself seated across the table from John Suh, vice president at Hyundai Motor. Not knowing what to say, having never owned a vehicle of any kind and barely able to drive, I struck up a conversation by telling him that the car of the future would most definitely not be autonomous. He looked at me quizzically and asked what I foresaw instead, politely leaving aside the fact that every industry insider was counting down the months before self-driving cars would be ubiquitous. I had come to the Art + Technology Lab with a project that proposed to apply neuroscience to fashion—allowing the wearer of a garment to change how she perceived herself by modulating interoception—so the human brain was very much on my mind at

Jonathon Keats (left) with Hyundai Motor Company engineer Ryan Ayler

the time. I informed John that the future was bionic, drivers perceiving vehicles as extensions of their bodies and their vehicles being controlled with brain-computer interfaces. He nodded and gave me an engineer. A couple years later, we presented a concept car on LACMA's central plaza.

Admittedly, it wasn't that easy. Persuading John that I was serious took multiple meetings, and the research-and-development process owed as much to the engineer Ryan Ayler as to me. Much depended on a rented laser cutter and a borrowed glue gun. And we never managed to get our hands on a brain-computer interface, let alone to build one. Nonetheless, the *Roadable Synapse* (as I dubbed the prototype) instantiated the concept convincingly enough to land articles in the *San Francisco Chronicle* and *Wired*. As self-driving cars took to the road in increasing numbers, my contrarian vision settled in some small way into the historical record. The *Roadable Synapse* was not a car any more than my *Superego Suit* was a garment. Both were created as thought experiments. The Lab provided me with the means to conceive and build philosophical instruments.

Read more about Jonathan Keats's experience building his prototypes at www.lacma.org/art/lab.

Nana Oforiatta Ayim

Awarded: Year 2 (2015–16)
Project Dates: 2015–16

Nana Oforiatta Ayim is a writer, filmmaker, and artist based in Accra, Ghana. In 2002 she founded ANO Institute of Arts and Knowledge in Accra, an organization that develops new models of knowledge inspired by the cultural traditions of the Akan-speaking people of West Africa, a large ethnolinguistic group residing primarily in Ghana. In 2009, when she began her PhD research at the School of Oriental and African Studies at the University of London, she conceived the idea of creating a pan-African cultural encyclopedia in order to document the "stories of innovation, of knowledge, of technology" she was discovering. Subsequently, as she conducted research for a major pan-African exhibition celebrating African independence, she became more committed to realizing this vision. Determined to avoid the single authoritative editorial voice embodied in other encyclopedias, she was inspired to structure her project according to an Akan cultural practice known as "the Ayan, drum poetry, which is allusive, elliptical, and cyclical, and in which what is left out is as important as what is pronounced."

In 2015, Oforiatta Ayim received an Art + Technology grant to launch *The Cultural Encyclopaedia*—a large-scale documentation project distributed on an open-source digital platform that is dedicated to mapping the trajectories of cultural production across the African continent. Envisioned as a series of fifty-four volumes—one for each African nation—it aims to bring together leading thinkers from each country to collect,

preserve, and share knowledge around local cultural practices and traditions. The project's goal is to reorder existing knowledge, narratives, and representations of Africa, enabling critique and collaboration through the increased availability and accessibility of information, thus facilitating deeper questions and more comprehensive answers. In this way, it functions as both a companion to and a critique of traditional museum databases.

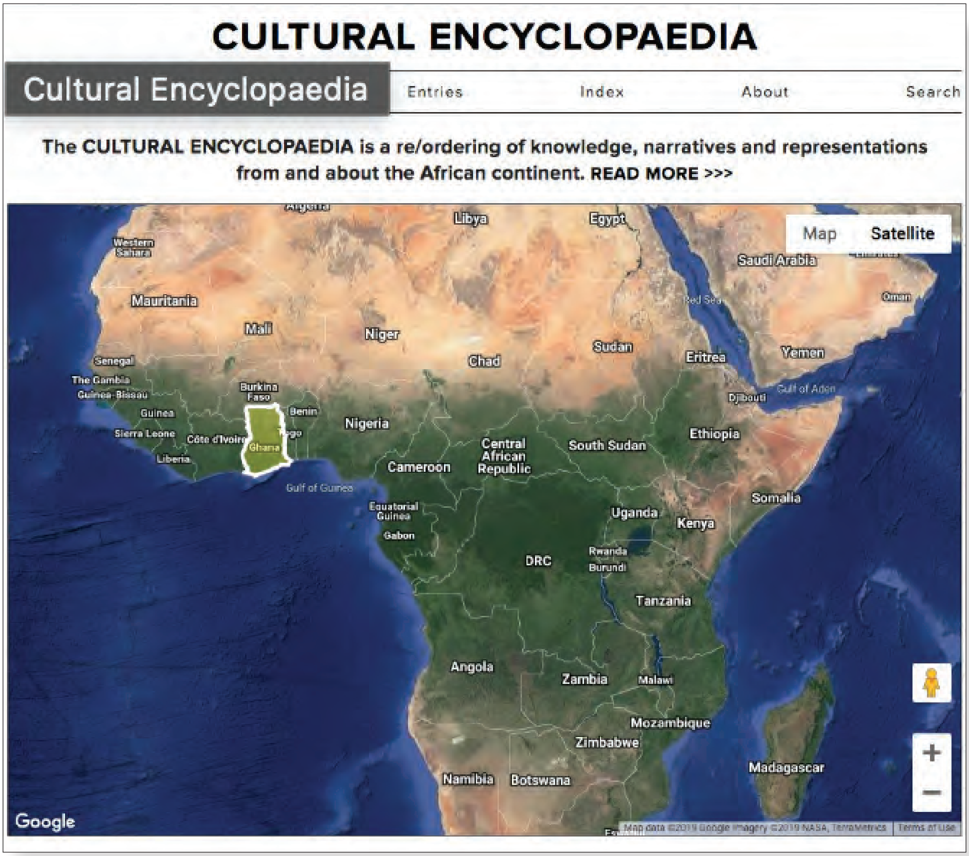
Exterior and interior of living history hub by Nana Oforiatta Ayim in Accra, Ghana

For the first volume, which focuses on Ghana, Oforiatta Ayim assembled a team of experts in fields ranging from literature to music who convened in a ten-day workshop in St.-Louis, Senegal. In Ghana, they documented performances, oral histories, photographs, objects, and more, using mobile kiosks that Oforiatta Ayim designed specifically for this project, which she calls living history hubs or moving museums, as well as through online portals. As part of her work, she explored Accra's labyrinthine streets (originally designed to help residents evade slave traders) and began production of a 27-minute film titled *Agbako* (2015), which means *untold*. In this film, she documents the construction of her first moving museum in Jamestown, the oldest district in Accra, with architect DK Osseo-Asare, as well as the district's vibrant street culture.

Oforiatta Ayim also created the *Cultural Encyclopaedia* website, which is organized into various conceptual categories and is continually evolving, reflecting traditional African practices in passing down history. For example, Akan historical narratives are not told from a single authoritative perspective, but are multilayered, collaborative, and open-ended, offering a more expansive approach to storytelling. "*The Cultural Encyclopaedia* does not aim to be definitive," Oforiatta Ayim has stated. "It seeks to preserve subjectivity and relativity, and it places technology at the core of a new forum of cultural knowledge and exchange."

Artist's Reflections

When I first had the idea for the online Pan-African *Cultural Encyclopaedia*, I wasn't sure where to start. It was a wildly ambitious project that I knew would take a lifetime to execute in the way that I saw it. An online platform that would showcase past, present, and future cultural expression from all fifty-four countries



Screenshot of *Cultural Encyclopaedia*

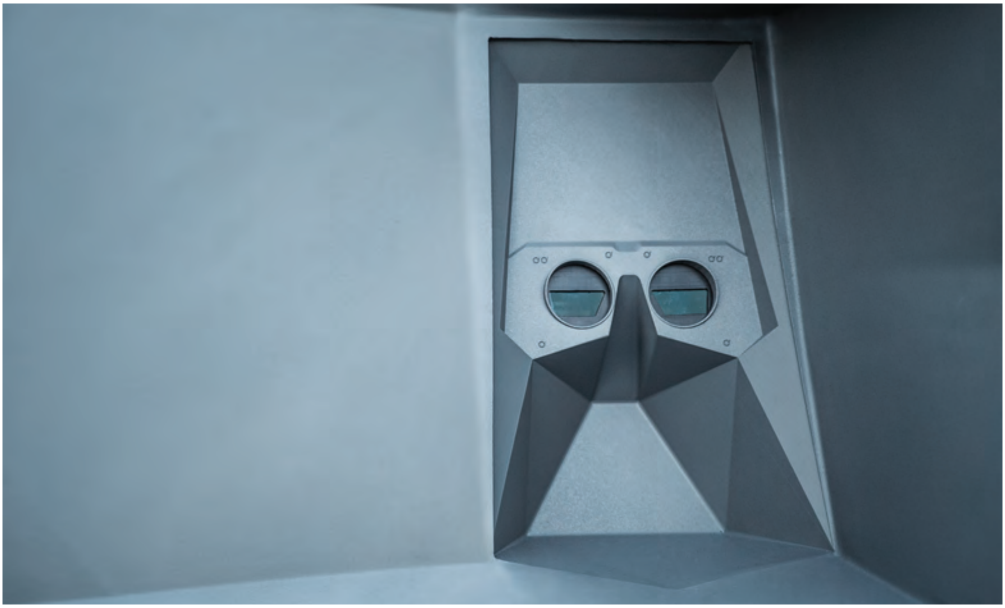
of the continent as well as its diasporas. It was the grant from the Art + Technology Lab that ensured that it moved from dream to reality. It enabled us to create a platform, gather research, and experiment. Ten years later, we've refined the platform, its methodologies, and technologies, and are finally rolling it out to other African countries; developments in technology have allowed us developments in aspects, such as language and translations, as well as interactivity and networking that before seemed unreachable. This was always going to be a slow project; it was always important to do it in-depth, and with the care and intentionality that these subjects deserved. It was the Art + Technology grant that set this in motion and which also set the tone to make this possible.

ScanLAB Projects

Awarded: Year 2 (2015–16)
Project Dates: 2015–17
Key Partner: Hyundai Motor Company

How do you reimagine one of the world's most photographed landscapes? In the 1870s, Eadweard Muybridge looked to Yosemite as a setting to test his pioneering photographic techniques. Those early expeditions have been replicated throughout history, most famously by Ansel Adams. Under the guidance of Will Trossell and Matthew Shaw, ScanLAB Projects retraced the steps of those pioneers of American landscape photography. Instead of cameras, however, the ScanLAB crew hauled laser scanning equipment to Yosemite National Park to execute a series of experiments in terrestrial 3D scanning, a form of imaging that captures dense, accurate 3D data about object surfaces. Alluding to the lenses used in the kind of mid-twentieth-century 3D photography familiar from postcards and novelties, they called their project *Post-lenticular Landscapes* (2017).

Over fifteen days in spring 2016, the team ventured into Yosemite and a series of key locations, including Vernal and Nevada Falls. The logistics of taking high-tech equipment into a comparatively inaccessible environment mirrored the epic nature of the early pioneer photographers. Hyundai Motor provided the expedition with a Santa Fe SE 4×4 SUV that the crew retrofitted into a traveling studio. Although ScanLAB had been working with laser scanning for several years, Yosemite, with its rugged terrain and dramatic waterfalls, presented new challenges. Rangers provided the team extraordinary access and unique vantage

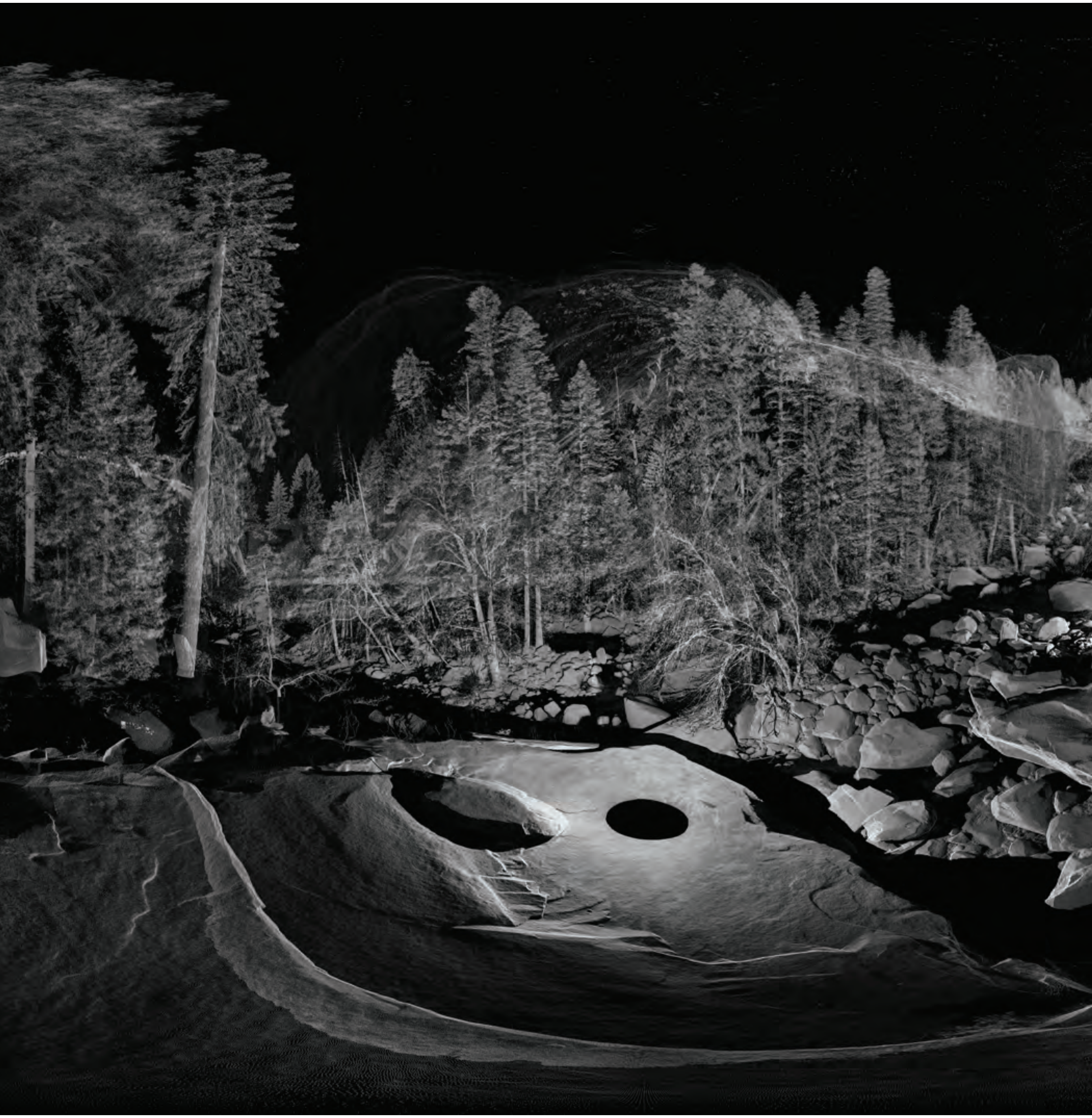


Exterior, ScanLAB Projects, *Post-lenticular Landscapes*, 2017

pp. 76–77
Interior, ScanLAB Projects, *Post-lenticular Landscapes*, 2017

points. Camping out beside one of the waterfalls, for example, the crew had the opportunity to scan moving water for the first time, with stunning results. Altogether, they captured over 150 ground-breaking scans.

Once the expedition was completed, the ScanLAB crew transformed the SUV into a digital diorama on



view at LACMA from April 6 to 18, 2017. By peering within its stripped-out interior, viewers could observe a high-fidelity hologram of Yosemite Valley floating within the vehicle's interior. Through eyeholes cut into its sides, they could glimpse a slowly rotating digital effigy of the landscape. Millions of precisely measured points hovered in space to form a ghostly apparition of mountains, forests, cliff faces, and tumultuous waterfalls. The following fall, ScanLAB transported the diorama to Paris for the Biennale Némo. LACMA presented a short documentary film by the artists about the project in summer 2017.

Artists' Reflections

LACMA's support in 2016 did more than fund a project—it validated our commitment to ambitious, technology-enabled expeditions and reflections in significant landscapes. Through our work, we invite viewers to perceive the world around them with renewed depth and perspective, seeing familiar places through the revelatory lens of emerging technologies.

We harbored a desire to immerse ourselves in America's spectacular landscapes, with Yosemite emerging as our natural focus. The valley's storied relationship with photography created a compelling historical parallel—we saw clear connections between the pioneering use of early photography and our experimental application of 3D scanning technology. Both represented technological innovations that transformed how humanity documents and interprets natural wonders.

Our Yosemite expedition in summer 2016 departed from conventional photographic documentation methods. Rather than cameras, we carried the latest terrestrial laser 3D scanning equipment into the valley. The culmination of this work—a high-fidelity 3D hologram of Yosemite Valley—was exhibited at LACMA in spring 2017. Unusually for that time, we brought our entire interdisciplinary team to the field. Our practice thrives on the collaborative energy between architects, craftspeople, photographers, engineers, documentary filmmakers, and software developers. Having everyone on-site created an unprecedented opportunity for cross-disciplinary exchange in the presence of such an iconic landscape.

Each day brought new challenges and discoveries as we camped under the star-studded sky, cooked over open fires, and packed lunches for long days of trekking the trails. It meant we connected deeply as humans with the landscape we were recording digitally. Dawn would find us hiking to vantage points before the crowds arrived, lugging equipment up the trails in the cool morning air. Setting up a scan often meant positioning our equipment on precarious rocks or out on ledges with the best view of the valley and the river. And it became an exercise in patience and hope—hope that the battery would last the whole way through, else the day's hike and scan would have all been for nothing.

The influence of the Lab's initiatives continues to resonate deeply in our work, long after the completion of the initial project. The skills we developed, the perspectives we gained, and the creative boundaries we pushed have become foundational elements of our artistic approach. In an era where digital experiences often dominate and the internet is increasingly flooded with generative AI and synthetic realities, our technologically, enhanced yet reality-based art serves as a reminder of the profound beauty and complexity of the physical world. We embrace our digital craftsmanship and commit to using our tools for investigation, precision, equity, sustainability, and truth.

Read more about SCANLab's Yosemite expedition and more recent work at www.lacma.org/art/lab.

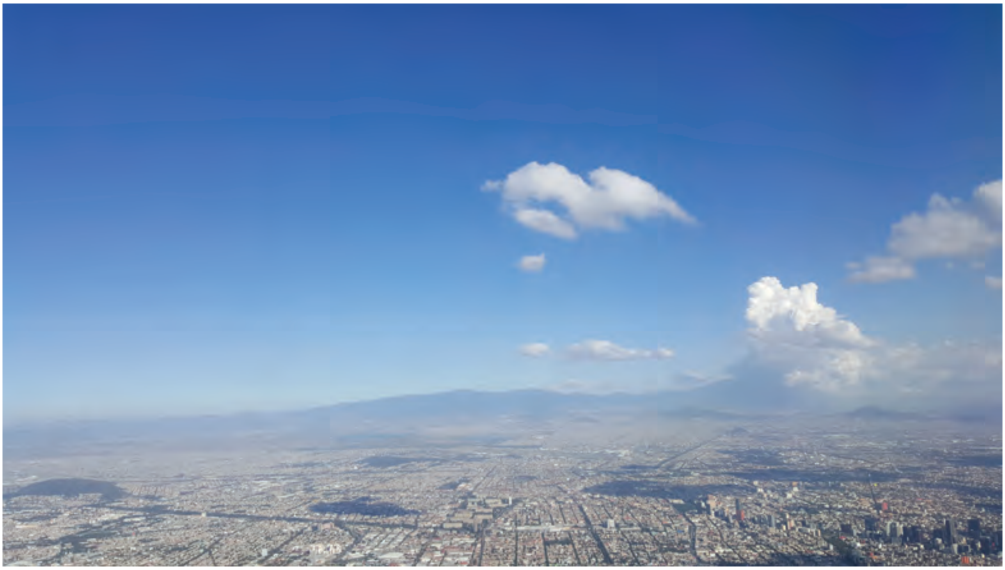
I. R. Bach

Awarded: Year 3 (2016–17)
Project Dates: 2016–19
Key Partner: Griffith Observatory

While camping in the mountains surrounding the Valley of Mexico on January 27, 2009, I. R. Bach witnessed something he couldn't explain: strange flashing lights that appeared spontaneously in the darkness. His project, *I Want to Know* (2016–19), which includes the performance *Chronos* (2019), became an investigation into that encounter: part fieldwork, part performance, part inquiry into the nature of perception itself.

Bach made multiple expeditions into the countryside outside Mexico City, documenting the mysterious lights. But rather than simply recording the phenomenon, he decided to re-create it, transforming viewers into witnesses of an ambiguous event. Working with Griffith Observatory, he conceived a light performance visible from the balcony of LACMA's Broad Contemporary Art Museum (BCAM).

After exploring various technologies—heliostats, convex safety mirrors, large Mylar balloons—Bach chose the simplest solution: hand-held signal mirrors that could be modulated by the operator. These mirrors, capable of reflecting sunlight across distances of tens of miles, became instruments for creating a large-scale drawing in light. On September 21, 2019, following an open studio event in which visitors could discuss the project with Bach, guests were invited to the BCAM balcony, from which Griffith Observatory is visible. On the slope below the observatory, three volunteers positioned at the vertices of an imaginary



top
Aerial view of Mexico City looking towards the mountains, 2018

bottom
Vantage point overlooking Teuhtli volcano, 2016

equilateral triangle reflected sunlight toward the museum for fifteen minutes, creating pulses of light across the Los Angeles basin—an echo of Bach's original mountain encounter, now transferred to the urban landscape. The projects that comprise *I Want to Know* are collected in a publication of the same title, with an introduction by Joel Ferree and texts by the artist.

Artist's Reflections

Bringing *Chronos* to life was as much a story of problem-solving as it was of cosmic alignment. From the outset, connecting the sun's reflection at Griffith Observatory to the vantage point on BCAM's balcony turned out to be a matter of fate. After several trials, we finally settled on the most straightforward but surprisingly effective solution: military-style signaling mirrors used during World War II to signal airplanes. These mirrors have a window that pinpoints the target with precision, so volunteers placed in strategic points on the mountain below the observatory could reflect the sun toward LACMA.

Yet even with the right technology, nature—and art—has its own plans. When I first scouted the vantage point on the BCAM balcony, the line of sight to Griffith Observatory was crystal clear. However, when the time came for the performance, Robert Irwin's *Primal Palm Garden* (begun 2010), an artwork

left
I. R. Bach, *Entity AMHQ170506-040142-01,* Amatlán de Quetzalcóatl, 2017

right
Chronos test at Griffith Observatory, view from BCAM balcony, 2018

pp. 84–85
Test at Griffith Observatory, 2017

incorporating over one hundred palms, cycads, and ferns, which had been unnoticeable during my initial visit, had grown to block the view! It was a humbling moment that prompted us to find a new spot. Then, on the first attempt to perform *Chronos*, clouds rolled in and masked the sun at the critical moment. All I could do was wait for the second attempt, which succeeded, completing the connection. It was not until after the fact that *Chronos* created another alignment, this time autobiographical, as it connected two moments in my own life: Two years later I moved to Los Angeles and found myself living in Los Feliz, right where the triangle of light had appeared back in 2019. A coincidence, since it was my wife who had chosen the site.

My participation at the Art + Technology Lab was to be a closure of sorts. As fate had it, my insatiable curiosity and interest in technology led me to a career shift toward science. The synchronization of light and sound at ultrafast speeds paved the ground toward a technological breakthrough to combat cognitive decline. Yet, the equilateral triangle that once connected the Griffith Observatory and LACMA made the jump into science as a flickering light vehicle for people to connect with their own memories.

Looking back, I see *Chronos* not just as a feat or an omen, but as a reminder that life, no matter how thoughtful its planning, is ultimately shaped by the unpredictable. Trees grow, clouds gather, and sometimes the simplest solutions triumph. And yet, in that moment, when the mirrors caught the sun just right—*Chronos* became more than a little miracle. It spanned a bridge across life itself—an unpredictable journey full of unexpected alignments.

Read more about I. R. Bach's *Chronos* and its relationship to his first artwork, *Tonos*, at www.lacma.org/art/lab.


I. R. Bach

john gerrard

Awarded: Year 3 (2016–17)
Project Dates: 2016–17
Key Partners: NVIDIA, Google

Artificial neural networks mimic the network of neurons in the brain, allowing computers to learn from observational data. Feed a machine a training set of one hundred cat images, and it can learn to identify cats in future images. For his project *Neural Exchange (Leaf Covered Figure)* (2017), john gerrard explored what happens when machine learning is applied not to recognition but to generation—specifically, to creating new choreographic gestures.

gerrard originally proposed to use gaming technology to render a large-scale image in real time. After he arrived in Los Angeles, however, Brian Mulford from Google, Bryan Catanzaro from NVIDIA, and John Suh from Hyundai Motor Company discussed neural networks with him. Mulford introduced him to an open-source machine learning platform called TensorFlow, which streamlines the process of using machine learning to develop models from uploaded data.

Realizing that this technology could have a transformative impact on his practice, gerrard switched gears and decided to use TensorFlow to develop a choreographic generator with his team, which included his longtime programming collaborator Helmut Bressler. The evolution of the project, however, surprised him: "What I sense I am seeing is this strange feeling that I am equipping my engine—via the NN [neural network]—with a kind of imagination. I frame that imagination through the kind of actions that are captured; however, looking at the *Leaf Covered Figure* perform—as I am doing now—something else is emerging."

Stills from *Neural Exchange (Leaf Covered Figure)*, 2017




gerrard learned about leaf-covered figures in British folklore through Robert Graves's classic book, *The White Goddess: A Historical Grammar of Poetic Myth* (1948). These figures are related to the so-called Green Man, whose visage, with foliage growing from his mouth and covering his face, can be seen in carvings on medieval British and European cathedrals. Inspired by these sources, around 2003 gerrard made a series of photographs of a character performed by his sister Esther Gerrard, covered in leaves and seemingly lost. Then he put the character away until he began developing his project at the Art + Technology Lab.

With the Lab's support, gerrard created a training set of choreographic movements for this character by scanning a model dressed in a motion capture suit embedded with sensors. His search for a vocabulary of motion began with militaristic exercises that one might see in a battle simulation game. Then he investigated the choreographed sequence of movements in karate known as kata. After deciding that these movements were too aggressive, he turned to the ballet dancer Esther Balfe, who executed four core dance movements hundreds of times, which the sensors captured as coordinates in space and time—data. These data were fed into TensorFlow, which analyzed them and generated new movements. As these AI-created movements were added back into the training set, the system evolved, producing an ever-expanding vocabulary of motion. The result: a 3D digital figure capable of performing "live," its movements generated in real time by the neural network.

gerrard then merged this cutting-edge technology with the imagery of the Leaf Covered Figure. In summer 2017, he traveled to the Wienerwald, a forested area outside of Vienna, where he photographed an actor costumed in fresh leaves—oak, beech, ash, and sycamore. Using these photographs, Max Loegler, the modeler on his team, created virtual leaves and twigs.

Video still of *Leaf Covered Figure* in the woods outside Vienna

This imagery was integrated with the neural-network-driven figure, resulting in a hybrid entity in which archaic folklore and algorithmic intelligence converge. The artist has remarked: "In essence, the figure is a mythic/historic one whose presence recalls the fundamental exchange between the sun, vegetation, and humanity. The neural network evokes an exchange again between the organic world—in this case the mammalian brain—and the human population, in that the neural network copies and mimics the functioning of the brain, and in so doing has unlocked an extraordinarily powerful new methodology."

Neural Exchange (Leaf Covered Figure) premiered at LACMA on November 1, 2017. The virtual character performed live by continuously executing a sequence of movements generated by the choreographic generator—a performance that theoretically could continue perpetually, as its "imagination" continues to generate new movements. A catalogue titled *John Gerrard: Neural Exchange* was published on the occasion of the performance.

Kovács/O'Doherty

Awarded: Year 3 (2016–17)
Project Dates: 2016–20

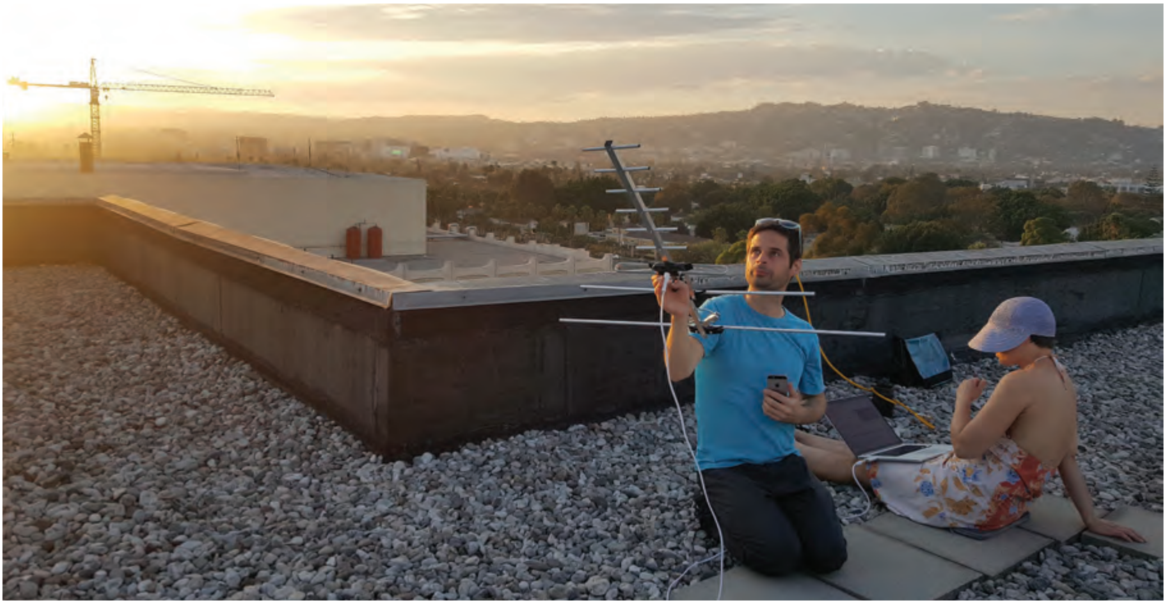
Kata Kovács and Tom O'Doherty, based in Berlin, have worked collaboratively as Kovács/O'Doherty since 2011. For *Signal Tide* (2017), they searched for a reliable, real-time signal from an abandoned satellite and transformed it into audio. Designed and built at Lincoln Labs at MIT in Cambridge, Massachusetts, in the early 1960s, LES-1 (LES stands for Lincoln Experimental Satellite) was launched in 1965 and ceased transmitting in 1967. However, at some point in the intervening half-century, it unexpectedly began emitting a signal again, as an amateur radio enthusiast discovered in 2013.

The artists stumbled across LES-1 a couple of years before they began their project at LACMA. O'Doherty has described it as "a piece of space junk that nonetheless seemed like it could be regarded… poetically or metaphorically." Over time they envisioned creating a work about this "lonely traveler that has been orbiting the earth for many decades." They were inspired by other artists who had imagined working with satellites, such as Chris Burden and Trevor Paglen.

In Berlin and the countryside outside of Brandenburg, the artists built antennae with technical support from Kris Slyka to track LES-1's signal. In Los Angeles they spent many hours on LACMA's rooftops and in the Malibu hills trying to track the signal again. The culmination of their research was a sound and extraterrestrial radio installation located next to the museum's

Chasing after signals from the LES-1 satellite on rooftops of LACMA's campus during research for *Signal Tide*, 2017





sbe

Pavilion for Japanese Art that combined LES-1's live signal with a generative musical score inspired by Sacred Harp singing.

This style of Christian choral music emerged in the nineteenth century in the region where LES-1 was built. Kovács has observed that the artists were mostly interested in songs "that were not so concretely religious [but] could be taken in a very poetic and metaphoric way, just talking about traveling and time passing and death and resurrection." In early 2017 they traveled to Montreal to record new interpretations of these songs with musicians from Massachusetts and Quebec, which featured a rich overlapping of voices and instruments, influenced by the layered style of their musical collaborators, David Bryant, Drew Barnet, and James Hamilton.

From September 21 to 24, 2017, the artists presented *Signal Tide* to the public. The installation was active only when LES-1 passed over Los Angeles; the beginning and end of these transits determined activation times. LES-1's signal was transmitted to a row of ten spherical blue speakers, suspended overhead from a cable, in real time; the sound moved progressively through the speakers from west to east, following he satellite's arc across the sky. Music derived from Sacred Harp singing played from speakers on the ground. The sound enveloped visitors as they engaged in what the composer Pauline Oliveros, a source of inspiration for the artists, described as deep listening.

Although each iteration of the work was different, the structure was the same: a call-and-response between the satellite's wavering signal overhead and the music rising from the bed of speakers resting on the ground. Visitors were serenaded for about half an hour, the amount of time it took LES-1 to make a full pass across the sky above LACMA. *Signal Tide—Two Passes*, a special audio mix of the score, was released in 2020.

top
Recording session of Sacred Harp singing, The Pines Studio, Montreal, 2017.

bottom
Signal Tide live performance, 2017

Artists' Reflections

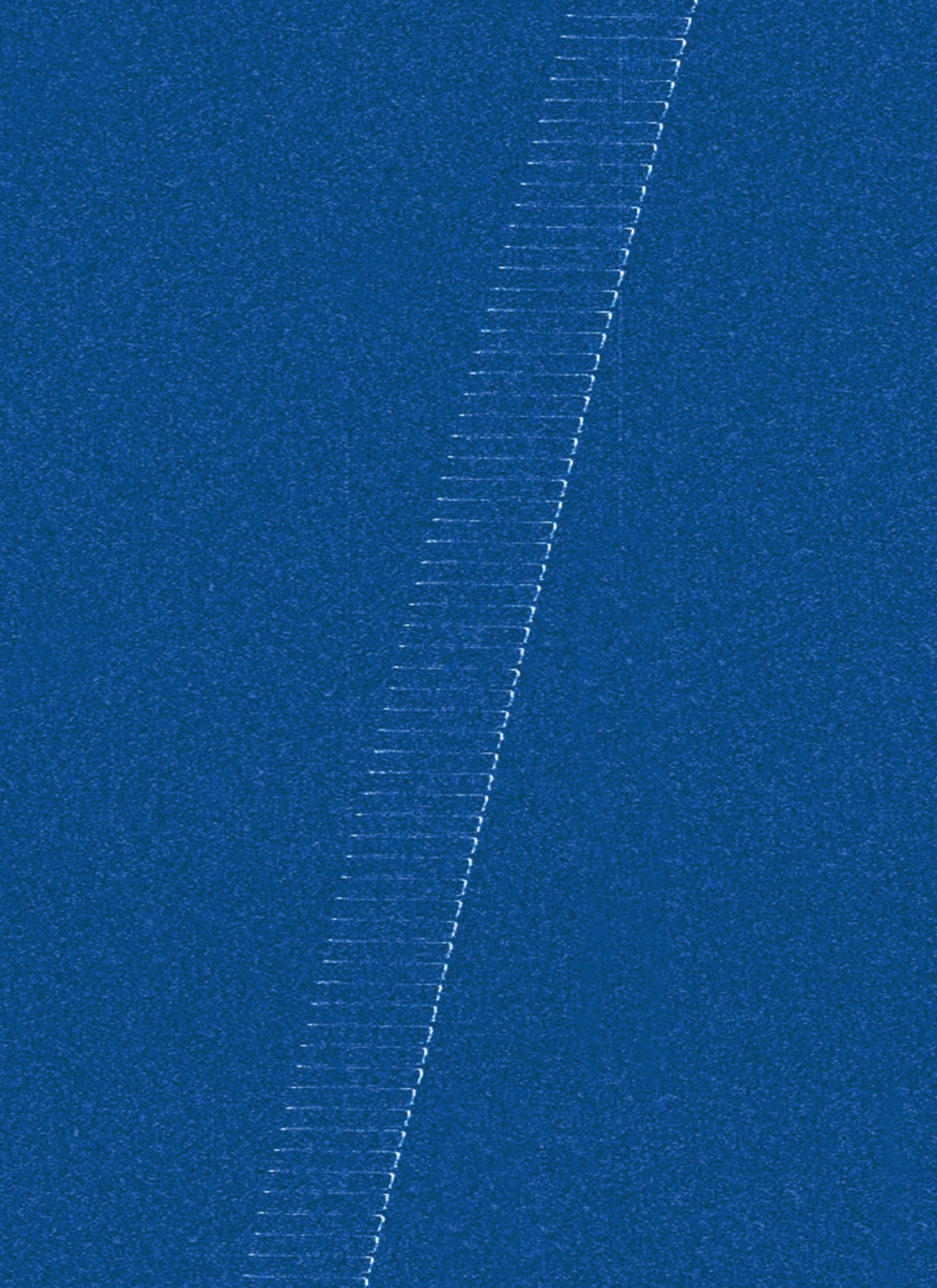
A few years after our project, we went to see Sun Ra Arkestra, when they played in Berlin in 2022. Afterwards, we talked a little bit about the metaphorical potential of outer space. Sun Ra spent decades presenting an artistic conception of outer space as a site of collective liberation. A place where exploitation is overcome, where earthly shackles are transcended. This vision is at the core of the delphic space-jazz mythology of the still-active Arkestra.

Outer space, for Sun Ra, offered transcendental possibilities. However, outer space, in the ideological frameworks of entities like SpaceX or Blue Origin, is a somewhat different proposal. It is a place for combining *Star Trek* aesthetics with neoliberal economics. Space is the final frontier—but the frontier is simply another place to get rich, a nebulous boundary between the mystery of the unknown and the zone of property rights. But there is a more insidious foreclosure here, which is the slow sealing-off of space as a site of liberation and as-yet-unrealized emancipatory possibility, whether practical or poetic.

Sun Ra's hypnotic vision relied on the idea that space had not been bent to the will of capital. That was self-evident in the 1960s, and was still true up until perhaps a few years ago. Let's say 2021 or so. But now, we seem to be facing an era when outer space is becoming just another neoliberal extraction zone, where NASA will pay companies to mine the moon, and startups chase asteroids for critical minerals.

Read more of Kata Kovács and Tom O'Doherty's reflections on the changing poetics of outer space at www.lacma.org/art/lab.

Waterfall plot view of an excerpt of the signal from the LES-1 satellite, June 2017, shows "dips" in the signal approximately every four seconds, speculated to be caused by the satellite "tumbling" (spinning around its own axis) as it orbits the earth



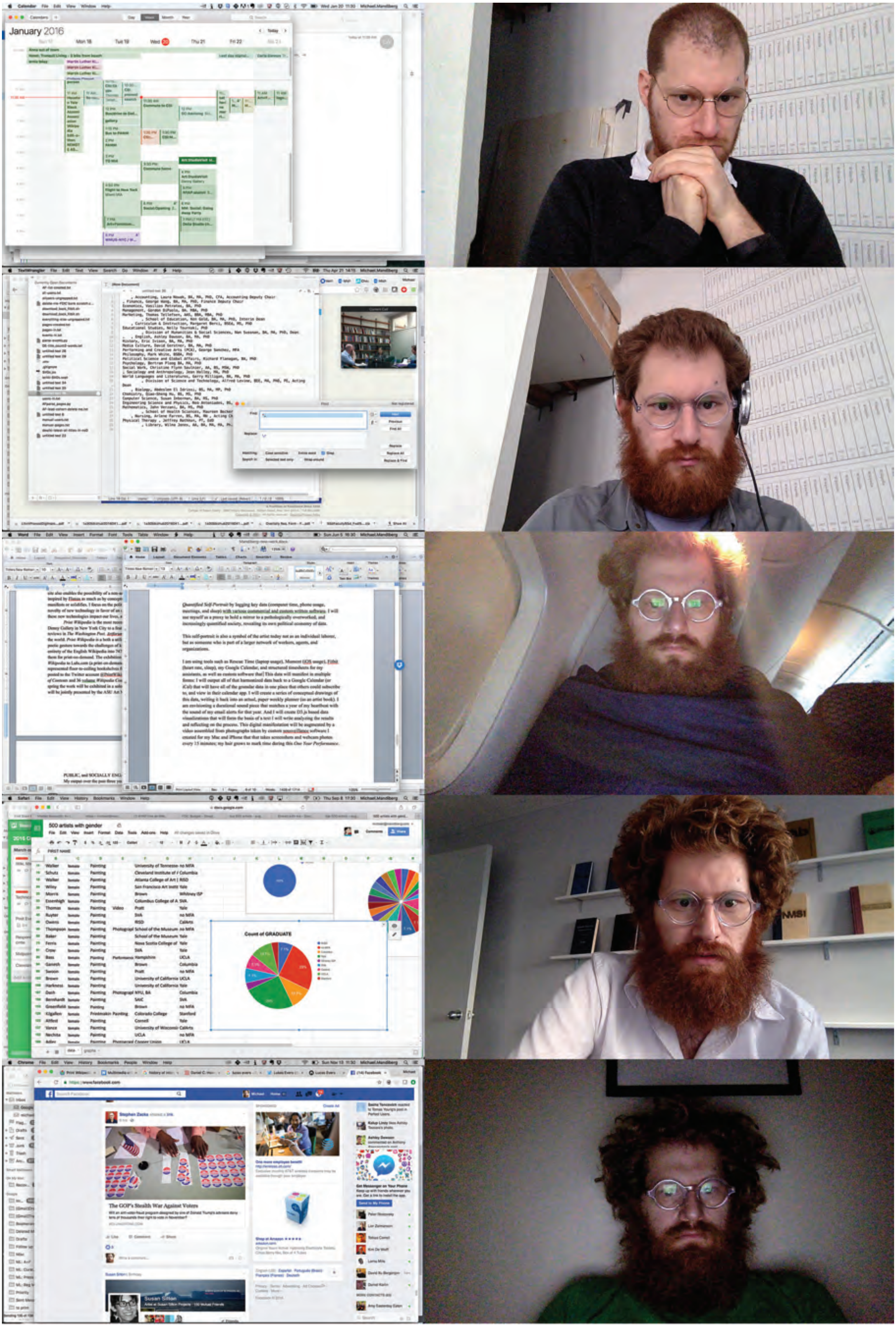
Michael Mandiberg

Awarded: Year 3 (2016–17)
Project Dates: 2016–17
Key Partner: Google

Through the multiple components of his project *Workflow*, Michael Mandiberg examined the changing nature of labor in the digital age. The first component, *Quantified Self Portrait (Rhythms)* (2016–17), was a yearlong sonic installation in the elevators of LACMA's Pritzker Parking Garage. It transformed a year of the artist's heart-rate data into sound, converting into audio biometric rhythms, which were heard along with the synchronized notification chimes of incoming emails on his computer from the same year.

Companies that employ digital labor often monitor remote workers using surveillance software. In *Quantified Self Portrait (One Year Performance)* (2016–17), Mandiberg turned this technology on himself, documenting a year of daily work as a proxy for the experience of employees in an overworked and increasingly quantified society. He shaved his head and face at the outset, so that the passage of time could be visibly marked by the gradual regrowth of his hair and beard. The resulting three-channel HD video documenting the performance is a frenetic, roughly seven-minute flow of webcam images and screenshots captured by tracking software every fifteen minutes over the course of the year. These visuals are paired with brief textual reflections on what the artist learned each day of the performance. Installed at LACMA's Ray's & Stark Bar from February 16 to August 8, 2017, the work functions not as the record of an individual laborer, but also as a portrait of the artist within a larger

Stills from channels 1 and 2 of *Quantified Self Portrait (One Year Performance)*, 2016–17, three-channel HD video documenting a yearlong performance, channels 1 and 2, 6:50; channel 3, 50:10


January 2016
500 artists with gender
Count of GRADUATE
The GOP's Stealth War Against Voters

Stills from *Postmodern Times*, 2016–17

opposite
Recording Mandiberg's heartbeat, December 12, 2016. Mandiberg is on the bicycle; T. K. Broderick is making the recording

A-SIG
R3
cervélo

network of workers, systems, and organizations.

A third component of *Workflow* is *Postmodern Times* (2017), a shot-by-shot re-creation of Charlie Chaplin's 1936 film *Modern Times*, reimagined through crowdsourced labor. Mandiberg commissioned workers on Fiverr.com, a digital employment market-place, to reenact each scene from the film, which portrays the struggles of workers during the Great Depression. Each segment of Mandiberg's film brings together clips produced by various workers, resulting in a fragmented, chaotic version of the original that reflects the precarious, decentralized conditions of digital labor and gig work today. *Postmodern Times* premiered at LACMA on December 19, 2017.

Artist's Reflections

As part of the Art + Technology Lab program, I was asked to write progress reports each time I requested a disbursement of funds from my grant account. I used my reports almost as a form of journaling. These reports were a place to articulate my decisions, and chart out my next challenges. This was particularly important for this project because I was working towards installing it at LACMA and thus had so much to communicate to Joel Ferree, who became a key advisor and collaborator, without whom I could not have achieved the project's goals. The reports began with a summary of the very first visit I made to LACMA:

> In June I visited Los Angeles to meet with the other grantees, museum staff, and advisers. During my informal presentation, I shared the key development that happened between the date of my application and my acceptance: one project had become two projects. I applied with a project about digital labor; I proposed to remake Charlie Chaplin's film "Modern Times" by parceling it out shot-by-shot to digital

laborers on online gig-economy marketplaces. I also developed a second interrelated project about digital labor; I had begun tracking all of my own labor, in an effort to understand the material and philosophical ramifications of what I do.

It was a testament to the program that the Lab welcomed this development, understood the way the projects were two sides of the same coin, and supported both projects as I worked on them in tandem.

The reports are full of so many technical details! These included roadblocks, like when my progress with the Chaplin film was thwarted by an overeager moderator (or moderation filter?) on the digital labor platform I had been using, guidance I received from the LACMA program's technical advisors about choosing programming languages, or problem-solving the nuances of power supplies and their relationship to speaker placement. My final report ends with a reflection on my overall experience in the program. I wrote:

> Working with LACMA on Workflow has been amazing. Art + Technology Lab staff (OMG Joel Ferree!!!) and LACMA curators have been thoughtful, dedcated, and flexible about all elements of this process. They have worked across departments (media, facilities, curatorial, registrar, design, and probably others I didn't even hear about) to make a complicated project happen very very quickly against significant technical odds. And throughout all of this, they remained laser focused on realizing the best version of the work possible, knowing when to follow my lead, and when to suggest productive adaptations. Everyone has been deeply competent, and deeply reasonable. I've never had such a good experience before.

Read further documentation of Michael Mandiberg's development of *Workflow* at www.lacma.org/art/lab.

Kirsten Mosher

Awarded: Year 3 (2016–17)
Project Dates: 2016–20

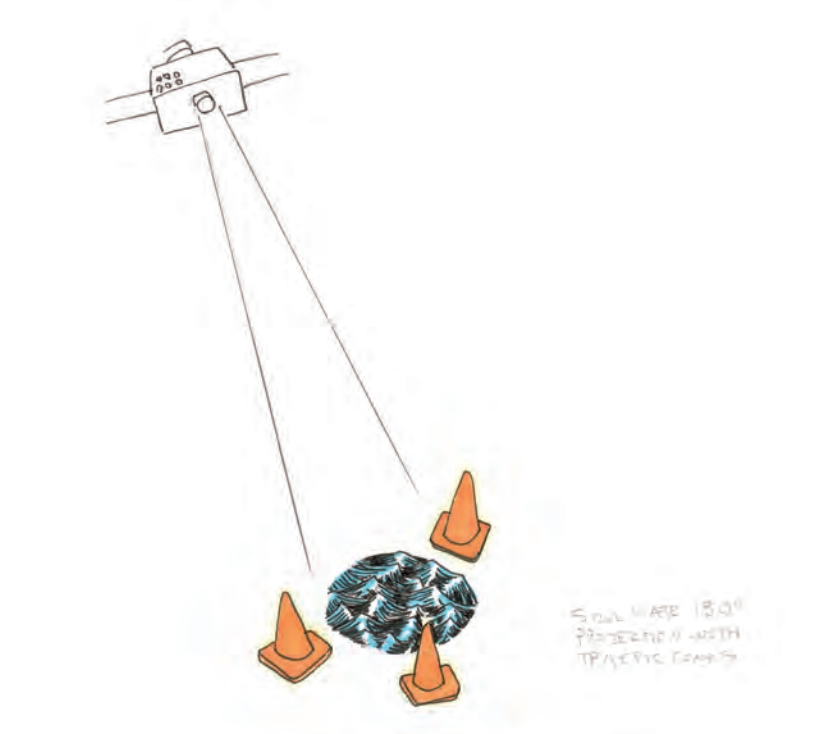
Massachusetts-based artist and writer Kirsten Mosher has long been interested in exploring antipodes, the parts of the earth diametrically opposite one another, as a metaphor for thinking about the world in terms of polarities. For *Soul Mate 180° (The Other Side is Here)* (2019), an installation consisting of two elements—a sculpture and a text—on view at the Broad Contemporary Art Museum (BCAM) from November 7, 2019 to February 25, 2020, she researched LACMA's antipode to explore the tension between the visible and the imagined. That antipode, she noted, is a "wave cresting somewhere in the Indian Ocean."

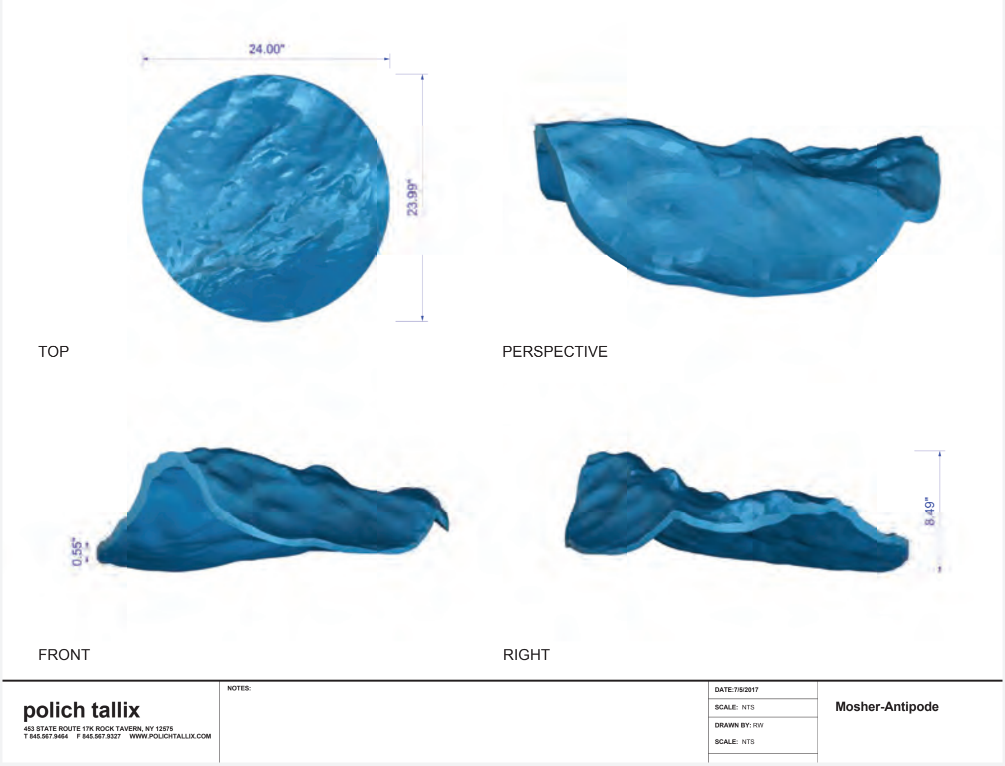
The installation's centerpiece was a marble sculpture of this imagined wave installed in the garden outside of BCAM. "I proposed to find out what the exact shape of a wave is on the other side of the world from a given point," she stated. "So the inspiration has to do with looking at the whole world as an architecture with these opposing spots and wanting to put them together." Accordingly, she produced a 3D print of a wave using data she compiled from high-resolution images from satellites, planes, ships, and other sources.

Mosher has remarked that creating the shape of the wave was more straightforward than deciding on a material to use, writing texts about what it would be like to experience "a landscape of ocean waves" in a variety of substances (see her Artist's Reflections). She settled on marble after determining that the

top
Sketch for *Soul Mate 180°, Projection with Traffic Cones*, 2016

bottom
Rendering for *Soul Mate 180°* by Polich Tallix art foundry, 2017





24.00"
23.99"
TOP
PERSPECTIVE
0.55"
8.49"
FRONT
RIGHT
polich tallix
453 STATE ROUTE 17K ROCK TAVERN, NY 12575
T 845.567.9464 F 845.567.9327 WWW.POLICHTALLIX.COM
NOTES:
DATE:7/5/2017
SCALE: NTS
DRAWN BY: RW
SCALE: NTS
Mosher-Antipode

sculpture could be fabricated in India. She sourced the marble from a quarry in Udaipur, India, and engaged an artisan in Jaipur to carve it by hand, using her 3D print as a guide. “The data is tech-based,” she has explained, “but the experience with the sculpture is very human.” Visitors were even permitted to touch the handmade object.

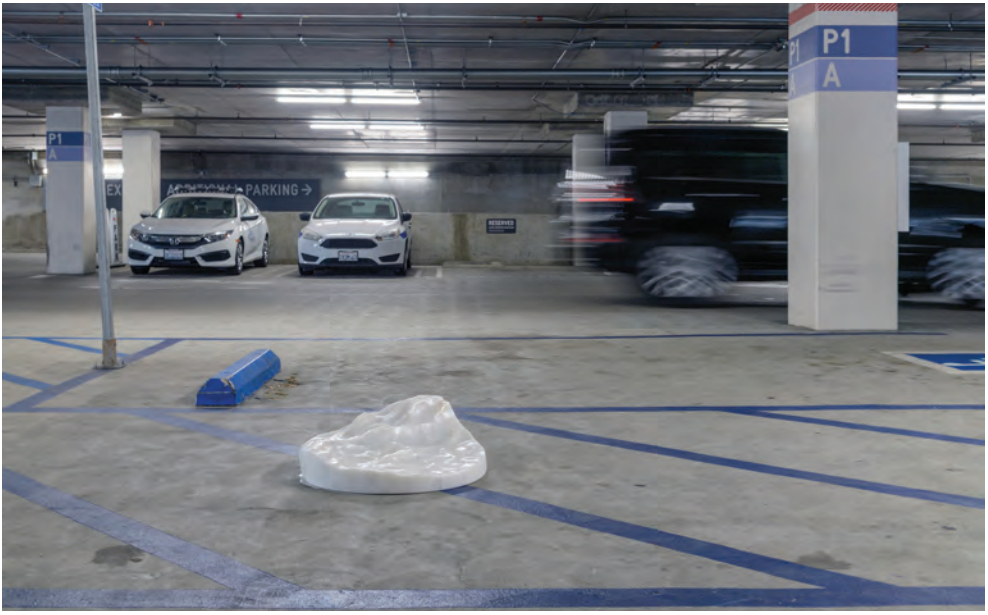
The installation’s second element was a short story that Mosher wrote and presented on one of the I-beams outside BCAM, adjacent to the wave, where visitors could read it from the building’s balcony. The text—part of a novel in progress, in which the sculpture is a character—begins with the following passage: “You told me that an antipode wasn’t just about opposite sides. You said the line piercing through this side to the other just keeps going inside and beyond.” Mosher has observed that “the story is not only about the architecture of this side and that side, but what’s in between and beyond. It’s geographic space but also the cultural and political space.” She continues: “In my novel, also titled *Soul Mate 180°*, Myra, the protagonist, is thrown into a world defined by polarities—this side and that side, black and white, etc. The marble sculpture, the idea of marking geographic polarities, allows for the possibility of seeing the gray areas beyond them. The text piece, which is taken from a rant of Myra’s, is a degree of gray.”

Artist’s Reflections

THE OCEAN IS PROJECTION. One hundred and eighty degrees from here, ocean-wave data sourced from ships, aircraft, high-resolution radar, satellites, and buoys is collected, recorded and rendered into video files. Wind speed, wave height and wind direction—transform into a moving-image of the ocean surface.

A point on an ocean from the other side of the world is live-streamed to us here in the city. The data generates an antipodal connection. Images of crests

Kirsten Mosher, *Soul Mate 180° (The Other Side is Here)*, 2019



and wakes flicker across a parking lot. Shifting currents of light pan over our bodies, over our neighborhood. A dog yaps at the splatters of shadow climbing up our legs. We lose our footing. A veneer of rolling waves crosses over cars, up the sides of buildings, across lawns and houses. It floods everything in its path, recontouring the landscape with every swell. We hold out our hands; lines of calligraphic crests slide between our fingers. The film washes over our faces as we look up.

The sky is filled with a dusty luminescence. A projector hums from its station high above us. We mistake its lens for a full moon. It beams a pulsing cone of light through miles of dark sky. The geometry of our city softens. The projection draws an illusion of depth so complete, we jump off roofs into a safety-net of salt water.

THE OCEAN IS MARBLE. A behemoth, its voyage-wide body stretches from one continent to another. Gusts

top and opposite
Kirsten Mosher, *Soul Mate 180° (The Other Side is Here)*, 2019

hammer black barrel-waves, grind rose-colored rollers, rasp jade-green combers, shave blue breakers and creamy crests. Afterward, breezes polish cloud-white ripples, splashes and spray. Each day the sun sparks a blaze of blinding reflections.

Veined and slippery, the luminous rock breathes. We take its pulse. Lick its salty skin. Our bulges rest in its hollows. We drape ourselves over its crests, cool relief in the heat of the afternoon. It rolls over, exposing kaleidoscopic patterns formed by crystallized minerals. Sea-foam draws streaky patterns of gray and golden seaweed across its glossy white surface. We spend afternoons floating along its luminous spine and sliding down its rippling back. Eventually, we slip under.

Pockmarked with time, the ocean's surface ages. Rough to the touch, its language, hard to read.

Read additional excerpts of of Kirsten Mosher's
Soul Mate 180° at www.lacma.org/art/lab..

Carl Cheng

Awarded: Year 4 (2017–18)
Project Dates: 2017–19

Born in San Francisco in 1942, Carl Cheng is an interdisciplinary artist who has worked at the intersection between art, technology, and ecology since the 1960s. He holds the distinction of being the only recipient of an Art + Technology Lab grant who was invited—and declined—to participate in LACMA's original Art and Technology initiative organized by Maurice Tuchman. The Lab, however, offered him an opportunity to continue his longtime investigations into the natural phenomenon of tar that he couldn't pass up. The *Tar Pool Project* (2017–18) marked the third phase of work he had begun at LACMA's neighboring Hancock Park, the location of La Brea Tar Pits, nearly thirty years earlier. For this phase, Cheng continued to develop what he called "art tool experiments"—devices designed to activate and display tar's distinctive properties.

Cheng has been attuned to the subtleties of natural processes since the 1960s, photographing at Point Mugu, camping in Death Valley, and tending a rooftop garden-laboratory in Santa Monica, where he lives. His art tools don't promise access to some distant "natural world" but instead transmit the immediacy and power of materials and forces already present around us. The *Tar Pool Project* continued this decades-long investigation, asking viewers to slow down and observe a substance central to Southern California's geological and cultural history. The Tar Pits are an Ice Age fossil site where ancient plants and were trapped and pre-

Maquette for *Anthropocene Plate*, 2018

served in asphalt. The artist's engagement with the site began in 1990, when he met with George C. Page, founder of La Brea Tar Pits and Museum, to discuss the idea of making a public artwork at one of the museum's unused sites. The idea gained support, and additional research funding was obtained, but unfortunately the project was shelved due to extensive renovation of Hancock Park in the 1990s.

For his project, Cheng created a maquette titled *Anthropocene Plate* (2018): a square steel plate with a large central hole immersed in a vat of glossy tar. At the push of a button, the plate rose above the vat, slowly dripping the thick, viscous substance back into the pool. The mesmerizing quality of watching tar move proved unexpectedly captivating—many viewers found themselves unable to look away once the dripping sequence began. On June 28, 2019, Cheng cohosted a walking tour of the still-active asphalt seeps in Hancock Park with Dr. Emily Lindsey, assistant curator at La Brea Tar Pits and Museum. She explained how scientists are using the detailed paleontological record from the Tar Pits to learn about the impacts of climate change, while Cheng described how this site has influenced his practice.

While the *Tar Pool Project* did not engage with emerging technology in the conventional sense, there was consensus at LACMA that it was an important undertaking for the Lab to support. As art and technology collaborations have become increasingly common, the phenomena that experiments depend upon can be overshadowed by the novelty of new tools themselves. Cheng's work offered a different approach: Rather than foregrounding cutting-edge technology, it used simple mechanical devices to reveal the material properties of a substance that has shaped Los Angeles for millennia.

L.A. County Supervisor Edmund D. Edelman response to Cheng's project proposal, 1991

MEMBERS OF THE BOARD

GLORIA MOLINA
KENNETH HAHN
EDMUND D. EDELMAN
DEANE DANA
MICHAEL D. ANTONOVICH

BOARD OF SUPERVISORS
COUNTY OF LOS ANGELES
821 HALL OF ADMINISTRATION / LOS ANGELES, CALIFORNIA 90012

EDMUND D. EDELMAN
SUPERVISOR, THIRD DISTRICT
974-3333

March 26, 1991

Mr. Carl Cheng
John Doe Company
1518 - 17th Street
Santa Monica, California 90404

Dear Mr. Cheng:

Thank you for your recent letter and proposal to develop a public art project at Hancock Park. I found your proposal to be unique, and an innovative way to express an aesthetic view of the tar pits.

Development of Hancock Park is at the preliminary stage, and discussions have just begun on the development of a master plan. The County's fiscal picture is bleak at this time so that cost and source of funding are major issues. I have taken the liberty of forwarding a copy of your proposal to Dr. Earl A. Powell, III, Director, Los Angeles Museum of Art, and to Mr. George C. Page, Director, Page Museum, for future consideration.

I appreciate the material you sent to me, and please be assured that careful consideration will be given to your proposal at the appropriate time.

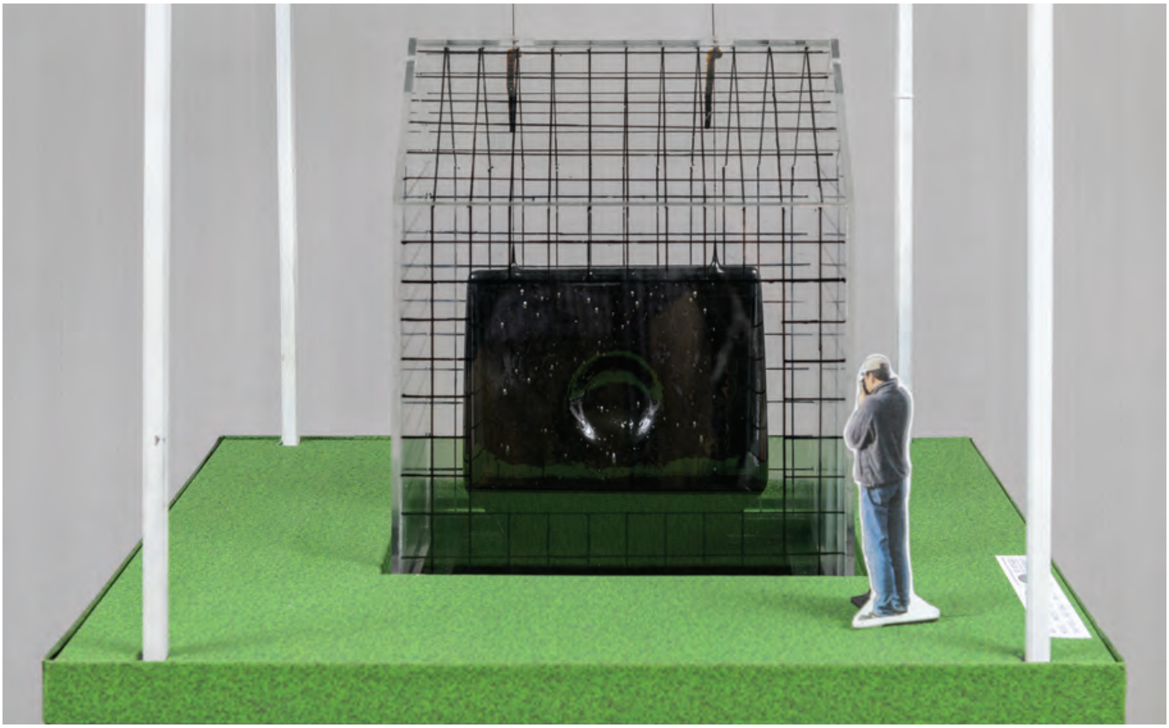
Very truly yours,

Edmund D. Edelman

EDMUND D. EDELMAN
Supervisor
Third District

EDE:fsf

cc: Dr. Earl A. Powell, III
Mr. George C. Page



Artist's Reflections

My main concern with LACMA since its establishment was that the La Brea Tar Pits area of Southern California where LACMA is situated is a historic natural landmark, where the residue of ancient organic life, TAR, oozed up to the surface of today. As a local citizen of L.A., it has personal meaning. As an artist, my interest was (is) to acknowledge this occupation with a public artwork that illuminated the natural phenomenon of the substance TAR. This thought has been with me since 1990. At that time, with a small grant from the City of L.A., I met George Page, founder of the Page Museum, and presented the idea of using one of the excavated tar pits in Hancock Park as the site for a Tar Pool project. He supported the idea and introduced me to some of his staff. The project has evolved in the years since 1990. In the early proposal, I was focused on using existing tar pools to create large tar bubbles.

I began experimenting with air compressors and valves to emit bubbles to test the idea. I then designed a prototype model dip and drip plate that emerged from a pool of tar. At this moment, I am continuing to add a two-part dip and drip cycle to the project.

In terms of the Art + Technology grant, I used the funding to test the valve system to produce bubbles and built and tested the prototype dip part of the final dip and drip sculpture project. I still have hopes to realize this project. Thanks for your support.

Maquette for *Anthropocene Plate*, 2018

Julia Christensen

Awarded: Year 4 (2017–18)
Project Dates: 2017–20

Julia Christensen's project *Upgrade Available* (begun 2017) examines how the rapid churn of "technology time" collides with the slower temporal frameworks of "institutional time," which shapes the work of personal archives, museums, and long-term scientific research. Sparked by her encounters with global e-waste in India, she traced how obsolescence reverberates through everyday devices, institutional infrastructures, and even interstellar mission planning.

During her LACMA residency, Christensen explored the friction between fast-moving media formats and the museum's enduring responsibility to preserve cultural memory, bringing legacy materials to the Media Archaeology Lab in Boulder, Colorado, to test the laborious—and often marginal—returns of constant technological upgrading. Through her collaborations at NASA's Jet Propulsion Laboratory, she extended these questions into "space time," contributing to early thinking around spacecraft that must outlast contemporary technologies by decades. Across these interconnected investigations, *Upgrade Available* asks how we design systems—on earth and beyond—that remain adaptable and meaningful in the face of continual technological change. The exhibition *Julia Christensen: Upgrade Available* was held at the Peter and Merle Mullin Gallery at ArtCenter College of Design in Pasadena from April 3 to August 23, 2020. That same year the artist published her book, *Upgrade Available*.

top
Installation of Julia Christensen, *Upgrade Available* at ArtCenter College of Design, Pasadena, 2020–21

bottom
Julia Christensen, *From the Archives*, 2018. Christensen transported these ephemeral materials from the LACMA archives to the Media Archaeology Lab in Boulder, Colorado


MASTER
TBM2014
002
#5
SONY
XBR
U-matic
Original Master
DINNER
9-11-96
SONY
L.A. ART
originals
KCS20
Education
X-16
maxell
DAT
94min.
R-94DA

Artist's Reflections

As soon as I arrived at LACMA, my project about Los Angeles e-waste quickly became a project about the impact of obsolete technology on museums. I photographed the old technology embedded throughout the LACMA buildings, some of which were about to be torn down. It felt weirdly urgent to catalog all this detritus before these buildings went down; a warning, or a bellwether. A museum exists to maintain a cultural story over many human lifetimes; how does obsolete technology disrupt and intervene in this cycle?

This question led me into the media archives of the museum, where I dug through LACMA's thorough documentation of its history, which is stored on every format of recordable media produced since 1965, the year that LACMA's Wilshire Boulevard location opened. LACMA's archivist Jessica Gambling was trying to figure out how to archive the museum's Twitter feed, let alone come up with processes to transfer documentation from sixty years' worth of media formats into something accessible on a contemporary Mac.

The biggest shift in my series of projects about obsolescence at LACMA came in 2017, when I met scientists and engineers at NASA's Jet Propulsion Laboratory, who were also thinking about obsolescence, but in the context of long-term space missions. I hit it off with a crew of JPL employees who made up the A-Team, an interdisciplinary group of scientists and engineers. When I met the A-Team, they were sifting through the potential challenges of an interstellar mission to Proxima B, an exoplanet in the Alpha Centauri star system. Their prompt: "Can we design a spacecraft, starting now, in 2017, that will be ready to launch in 2069 on a mission to another star system? What scientific discoveries do we need this future interstellar craft to attempt? It will take 42 years for the craft to get to its destination, so we will learn more about Proxima B after it has already left Earth; how do we design a craft that can respond to cultural and scientific changes on Earth, while in situ? Once it arrives at Proxima B, it will take roughly 4 years for the data to travel back to Earth, so what kind of format should we use to describe its findings?"

I joined the A-Team at JPL for about a dozen daylong studies investigating such questions. In collaboration with team members, I developed another art project, called *The Tree of Life*, a public art installation that consists of trees that "sing" via radio waves about their ecological data, in duet with a spacecraft in Low Earth Orbit "singing" back about its operational data. The aggregate sine wave of this data-song can be inscribed on the side of the future interstellar craft, a new "Golden Record" that tells the story of Earth's trees in conversation with human technology.

As *The Tree of Life* project grew roots of its own, my JPL collaborators and I formed our own organization to continue our work outside of any space agency or company: The Space Song Foundation. This non-profit, which we still run to this day, has a mission to find long-term solutions for technological obsolescence on Earth and in outer space. *The Tree of Life* is our primary project. We currently have a singing Joshua Tree in Hinkley, California, at the Center for Land Use Interpretation's Desert Research Station. This artwork persists through this time marked by rapid change. Here we are, most of us still on Earth, still grappling with systems of technology that change the ways we experience those collective frames of reference: time, community, landscape, culture.

Learn more about Julia Christensen's work on technological change and obsolescence at www.lacma.org/art/lab.

Stan Douglas

Awarded: Year 4 (2017–18)
Project Dates: 2017–18

Vancouver-based artist Stan Douglas works in photography, film, and video. His first foray into theater was the conceptually and technologically groundbreaking play *Helen Lawrence* (2014). Conceived and directed by Douglas with a script by the screenwriter and producer Chris Haddock, it premiered at the Arts Club Theatre Company in Vancouver from March 13 to April 13, 2014. It then toured internationally. With technical support from the Art + Technology Lab, UCLA's Center for the Art of Performance (CAP UCLA) brought the production to Los Angeles, where it was staged at Royce Hall on October 13 and 14, 2017.

The origins of *Helen Lawrence* date back to 2008, when Douglas began thinking about the parallels between that moment's social, political, and economic conditions then and those immediately following World War II. "There was a recession, the global banking system was in shambles and had to be reorganized, there was a housing crisis, as well as a shadowy threat to the U.S.—communism back then, and terrorism now," he has noted. "*Helen Lawrence* came from an epiphany I had about film noir. Somehow the behavior or people in film noir was based on the trauma of war."

The play takes place in the historic locales of Hogan's Alley and the Old Hotel Vancouver in 1948. Hogan's Alley was a multiracial but mostly Black neighborhood known for its vibrant nightlife, where gambling and prostitution were prevalent. The hotel was occupied by homeless veterans, many traumatized. It was demolished in 1949, followed by the razing of the neighborhood decades later. Douglas developed an augmented reality app titled *Circa 1948* that enabled users to take a virtual tour of the two sites.

The play revolves around the lives of twelve characters—hustlers, prostitutes, homeless vets, and crooked cops and politicians—whose lives intersect in this seedy milieu as they struggle to adjust to the upheavals of life after the war. Helen Lawrence is a femme fatale who escapes from a psychiatric ward in Los Angeles, travels to Vancouver ostensibly in search of her husband's killer, and checks into the hotel.

The production used cutting-edge technology to seamlessly weave together computer-processed images of historic Vancouver locales that no longer existed with live action onstage, and the highly engineered interplay of these elements allowed Douglas to establish the play's mise-en-scène in ways impossible with traditional stagecraft. The actors performed behind a translucent scrim on a blue stage with virtually no props. As they performed, their castmates filmed them with three digital cameras. The camera feeds were transmitted to a computer that replaced the blue backgrounds with virtual sets based on archival photographs of Hogan's Alley and the Old Hotel Vancouver. These feeds were projected onto the scrim as high-definition black and white film that portrayed the performers spliced into realistic sets from camera angles evocative of film noir cinematography. To be convincing, the actors and camera operators had to hit their marks with extraordinary precision. As audience members watched the actors perform in front of them, they simultaneously saw the live video. As Douglas observed, "The cast is making a film in real time every night."

Artist's Reflections

I want to have this fairly complex experience where the world doesn't make sense, yet somehow I can make sense out of it. I also do the research as a way of making sense of things that are either very big, very distant, or very much in the past. How do I get my head around that? How do we get here from there? These are things I'm trying to explore in this work.

With *Helen Lawrence*, I was trying to look at this transitional moment between wartime and the postwar period, the 1950s. We have an idea of what the 1950s

Performance of *Helen Lawrence*, The Arts Club Theatre Company, Vancouver, 2014; left to right: Allan Louis, Crystal Balint, and Sterling Jarvis

are like, but it's very ideological. It's probably not like that at all. Probably more like a James Ellroy novel than *Leave It to Beaver* or something. We have an idea of what the war is like, we have film noir—tough guys and femmes fatales, black markets, people doing dubious things to get by. How do we get from one condition to the other?

From a public conversation between Stan Douglas and Michael Govan at LACMA, October 17, 2017.

Curtis Tamm

Awarded: Year 4 (2017–18)
Project Dates: 2017–ongoing

In his project *Tympanic Tether*, the Los Angeles–based artist Curtis Tamm set out to examine the complex relationships among human settlements, natural disasters, and the sonic warning systems that have evolved across cultures over centuries. Traveling to Santorini, Yellowstone National Park, Iceland, and Japan, he researched the experiential and technological origins of the siren as a warning device and developed a series of new "siren candidates." Far from the shrill wail of modern sirens, the sounds in his mix—resonating temple bells, bubbling thermal mud pots, the calls of wildlife across Yellowstone's vast Central Plateau—aim to heal trauma.

Tamm's extensive research in Japan inspired him to develop other works. He created playful propositions for new aural warnings built from field recordings for local emergency broadcast sirens throughout the country—which lured city inhabitants into spontaneous social experiences of deep listening. He gathered hundreds of sound recordings, met with seismologists to learn about the nature of waves, listened to the chants of blind female shamans, and spent time with the engineer Nyuki Yada investigating the abilities of other animal species to predict earthquakes. His recordings attempt to follow the radiation of seismic waves outward as they vibrate through the whiskers of the giant Lake Biwas catfish, which is believed to predict earthquakes, resonate with the syncopated buzz of cicadas, and chime against the ritual process

Curtis Tamm listening to *bonshō* at Kotabe Foundry, Sakuragawa, Ibaraki Prefecture, Japan

of casting and striking multi-ton temple bells known as *bonshō*. He also surveyed the unique character of a dozen different bells throughout Kyoto and Ibaraki, recording rarely heard ultra- and infrasonic frequencies as they resonate and decay within the large open cavity known as the bell's womb.

Tamm's efforts culminated in the exhibition *MAM Project 026: Curtis Tamm*, presented at the Mori Art Museum in Tokyo from February 9 to May 26, 2019, which featured the work *Spelling for Protection Against Oneself* (2019). Its centerpiece was a sound sculpture that invited visitors into the womb of a bonshō. It became a summoning space for terrestrial extrasensitivities, using the ancient bell tones as an excavation tool for dormant, catfish-like capacities. In this and other works, Tamm summons a state of deep listening within the body, in which our senses are recast by bandwidths usually obscured by noise.

Artist's Reflections

After the bombing of Pearl Harbor in 1941, hundreds of air-raid sirens were installed across Los Angeles as part of an early detection network designed to alert inhabitants of imminent attack on California's shoreline. The system was never officially activated; it was, however, regularly tested. In fact, the sirens roared every last Friday of the month between 1942 up until 1986. For forty-four years, haunting tones swept through the streets of L.A. like wraiths—proliferating echoes of an attack that never was. As of 2025, many of the sirens still stand. Though their sound has been nearly forgotten, the silence of those sirens speaks volumes about the use of simple sensory triggers to incite fear and alter our reality—even if under the context of a pragmatic simulation.

In 373 BCE, Diodorus wrote that five days before the earthquake that ruined the city of Helike, hordes of different animals such as snakes, weasels, centipedes, and worms migrated in droves, fleeing days before shocks descended upon the city. In Japan, earthquakes were (and are still) notoriously connected to catfish—specifically, the Lake Biwa catfish, which leapt up out of the lake in great numbers minutes before the Ansei earthquakes devastated the region in 1854. The event was later mythologized in the form of breathtaking woodblock prints, known as *namazu-e*, which depict the catfish as a supernatural being, replete with grotesque human teeth, in a variety of satirical situations, like asking forgiveness from townspeople or playing games of chance with other mystical characters.

It's not a question of which comes first, catastrophe or culture; they feed from one another. At a certain scale, catastrophe is a signal for the planet's rhythms: a music through which we are given the opportunity to reflect upon worlds beyond our senses. Sometimes music can be violent, though in so being, our perspectives of deep-time frissons, deepening within our skeletal frame. Knowing this, how can we cultivate a relationship with the ecstatic vibration of emergencies as a set of mysterious and interrelating signals, moving across and in between perceptible entities, thoroughgoing and continuous, no matter how sequenced, striated, or discontinuous it may feel? How might we better leverage the absences and blind spots in our systems of knowledge toward greater intimacy with our animal friends? What do we have to offer in return?

Read more about Curtis Tamm's research into the cultural history of warning systems at www.lacma.org/art/lab.

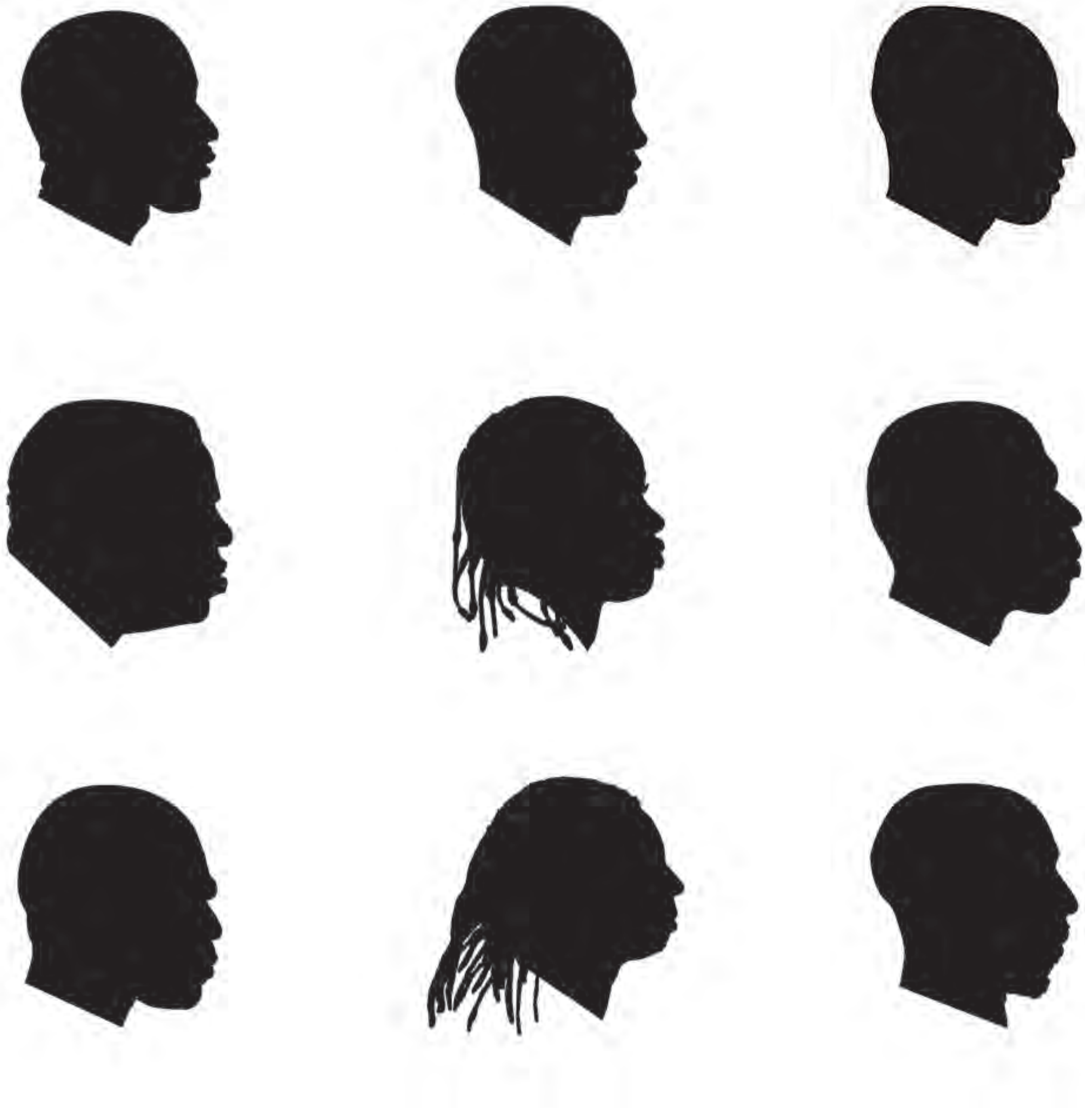
Tahir Hemphill

Awarded: Year 5 (2018–19)
Project Dates: 2018–ongoing

Tahir Hemphill describes himself as a creative technologist, educator, radical archivist, cocreator, artist in residence, research fellow, peripheral visionary, rap enthusiast, and native Queens New Yorker. His 2018 project *Implications of a Rap Neural Network* combined virtual reality, machine learning, digital humanities research, interactive narrative structures, and community data grounded in active cultural practice. It examined how algorithmic systems—both the creative ones that generate rap lyrics and the punitive ones that assess criminal risk—shape and constrain Black artistic expression and freedom.

Hemphill came of age in Queens in the 1980s, when hip-hop culture was thriving in New York. During this period, young New Yorkers were expressing themselves through breakdancing, DJ'ing, graffiti, and of course rap—on the street, in the subway, and at house parties. De la Soul, Run-DMC, Public Enemy, Salt-N-Pepa, and A Tribe Called Quest were among the many groups reinventing rap, and this period has since been recognized as the genre's golden age. At the same time, home computers were becoming more common, and Hemphill has recalled "exploring cyberspace from my basement in Queens with a dial-up modem connected to a Commodore 128 computer." He has further remarked: "A fundamental affinity between Hip-hop culture and hacking would define the trajectory of my professional and creative life. Starting in middle school, my exposure to curricula that foregrounded engineer-

Tahir Hemphill, *Famous Rap Singers*, 2012, laser etching on paper, 10 × 10 in., courtesy of the artist



ing-oriented making
led me to acquire knowledge, values, and skills at institutions of higher learning while hip-hop's 'golden era' informed my perspectives on popular culture and politics. The theoretical frameworks that support these two educational influences have been synthesized into my current creative endeavors."

Hemphill is the founding director of the Baltimore-based Rap Research Lab, a creative technology studio that "explores rap as a cultural indicator through educational, editorial, and creative interrogations," according to its manifesto. One of the lab's major objectives is to use rap to teach data literacy to young people. Hemphill is also the creator of the Hip Hop Word Count, subsequently relaunched as the Rap Almanac, a continually evolving database that compiles the lyrics of thousands of rap songs. Data fields include artist name, song title, album title, geolocation, and release date, among others. Users can search the database to analyze hip-hop music and culture. Hemphill has noted that "visualizing hip-hop's data allows us to listen to hip-hop in a new way; this new way of listening produces new ways of understanding hip-hop culture and in turn, new ways of understanding ourselves."

Using data mined from this database, Hemphill has produced a variety of artworks. For example, during his term as the Frank-Ratchye STUDIO for Creative Inquiry Fellow at Carnegie Mellon University, he produced his series *Maximum Distance. Minimum Displacement*. (2014), in which he made data visualizations of rap lyrics to examine how rap artists travel geographically in their songs. Inspired by Pablo Picasso's light pen drawings of 1949, he translated geographic mentions from the lyrics of twelve rappers into geocoordinates. He then used an industrial robot arm to trace the paths plotted by these coordinates. The resulting maps were materialized as photographic

prints, gold-plated steel sculptures, and a virtual reality experience using the same data. Each shape, the artist observed, "represents the unique global distances traveled by the lyrics in each artist's career."

For *Implications of a Rap Neural Network*, Hemphill investigated the associations between rap and criminality. In their book *Rap on Trial: Race, Lyrics, and Guilt in America* (2019), which was published after the artist submitted his project proposal, law professors Erik Nielson and Andrea L. Dennis analyzed the use of rap lyrics as evidence in criminal trials; they identified over seven hundred cases in which prosecutors have used these lyrics to justify charging, indicting, or recommending sentences for defendants accused of crimes. Hemphill's project consisted of multiple interconnected components: a machine-learning algorithm trained on the Rap Almanac that generates new lyrics on demand; a database of court cases in which rap lyrics were used as criminal evidence; scholarly research into the use of rap lyrics as evidence in legal proceedings; research into "risk assessment" algorithms used to calculate the likelihood of recidivism; and the cultural architecture of rap music's intersection with a justice system that has prosecuted rappers for crimes linking their artistic output to their alleged actions.

Tahir Hemphill, *Mapper's Delight: Nas*, 2023, gold-plated brass (3μm), 5 × 5 × 4 in., courtesy of the artist

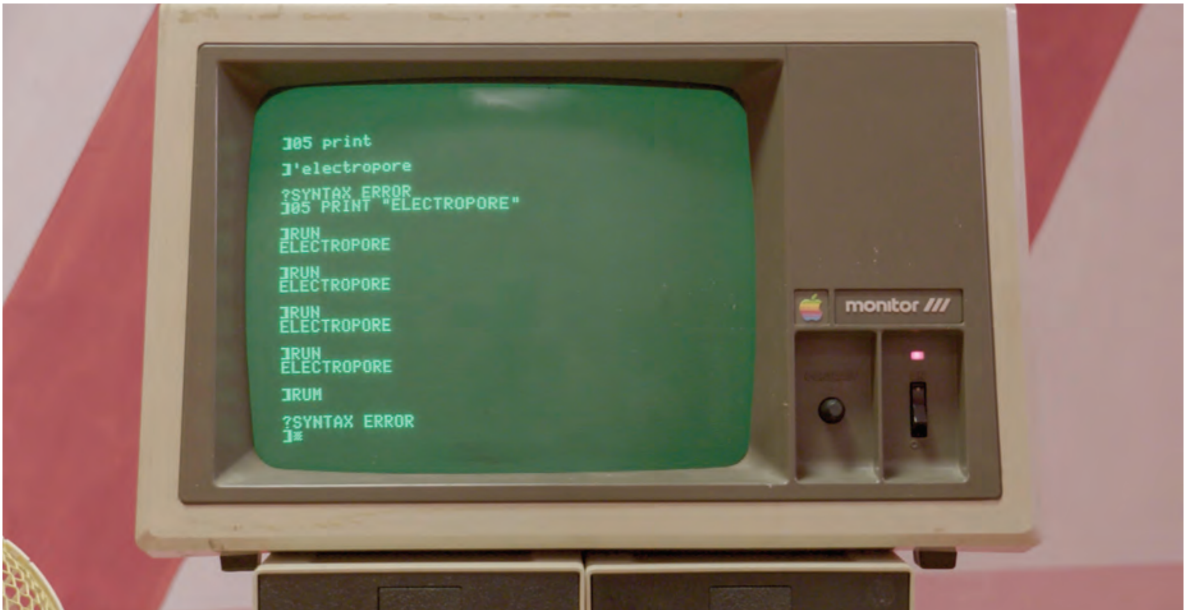
Jen Liu

Awarded: Year 5 (2018–19)
Project Dates: 2018–21
Key Partner: ArtCenter College of Design

"Pink slime" is the popular term for a meat byproduct used as a food additive in ground beef and processed meats. The artist Jen Liu has described her project *Pink Slime Caesar Shift* (begun 2016; LACMA works, 2018–19) as "a set of proposals for alternative networking through food production and distribution." Drawing on genetic engineering and labor activism to develop a speculative narrative around synthetic meat production and the plight of female factory workers in Special Economic Zones (SEZs) in South China, she proposed to alter the genetic material of cow cells to carry covert messages on labor organizing.

Labor protests in China are typically brief and localized; large-scale organizing is hindered by the inability to communicate across distances. Meanwhile, beef shortages—resulting in counterfeit beef scandals—have become common. Liu imagined a scenario in which synthetic meat grown from cow stem cells could solve both problems at once. By inserting synthetic DNA sequences easily decoded into pinyin text, existing food distribution networks could become communication channels for political organizing. Like pink slime itself, these messages would be unauthorized additives, encrypted using one of the oldest encryption systems: the Caesar shift cipher, a method used by Julius Caesar to encode messages during war campaigns by shifting letters of the alphabet a fixed number of spaces.

Stills from *Pink Slime Caesar Shift: Electropore*, 2021


]05 print
]'electropore
?SYNTAX ERROR
]05 PRINT "ELECTROPORE"
]RUN
ELECTROPORE
]RUN
ELECTROPORE
]RUN
ELECTROPORE
]RUN
ELECTROPORE
]RUM
?SYNTAX ERROR
]
monitor ///

Working with biologist Sümeyye Yar at Biotech Without Borders, Liu explored methods for embedding genetic messages into cow cells. These included fluorescent markers to encode labor law documents, microinjection to carry information about organizational structures, biolistic delivery of DNA-coated particles via gene gun into cells to transmit strike tactics, and viral transfection to introduce messages about workplace sabotage. All content synthesized into DNA came from existing documents: worker advocacy manuals, the Chinese legal code, firsthand accounts, and case studies. Liu's single-channel 4K video titled *Pink Slime Caesar Shift* (2018), which combines live action and animation, is based on this research. She has written that "the video itself is a message carrier, connecting the speculative proposal with the reality of SEZ workers today. Each 'method' speaks of various facets of the so-called Floating Population, legal and medical fugitives to a system that renders their bodies a secret subscript to global industrial production."

Liu also collaborated with graduate students from the Media Design Practices (MDP) MFA program at the ArtCenter College of Design in Pasadena to create a wearable sculpture—a bracelet designed for the transfer of genetic messages and delivered by biolistics. Her bracelet is based on antistatic bracelets worn by electronics factory workers, which "serve strictly to protect the product from the workers as antistatic barriers—as well as to monitor the movements of the workers," as she has observed. By contrast, Liu's version features pink acrylic cast around a gold-plated brass circuit with mechanisms for customized fit, skin contact points, and a connection port compatible with existing electronic grounding circuit boards. Their genetic messages, she has explained, "can easily be decoded by anyone with a working knowledge of DNA: amino acid codon triplets all have international standard abbreviations, which strung together, can constitute a text—in this case, a pinyin translation of protest methods for activist education."

Artist's Reflections

It's fascinating to think about the Art + Technology Lab through the lens of its longer history, and the ways in which "technology"—and its variations in form and function—has drastically changed over the decades through the twentieth into the twenty-first centuries, and thus then its relationship to artists. I think about the bankruptcy of techno-optimism, and the suspicion directed at and culpability of various areas of tech today. It's tempting to think that tech is more of a backend event these days. As a participant in the Art + Technology Lab, it was challenging but also rewarding to think through ways in which technologies whose applications lie inside the bodies of consumer goods, rather than accessible or visible on its surface—were also an invitation to think through the ways in which Art is more than its surface, how it too can be a machine with multiple internal functions. So while my collaboration in the end might have been somewhat unconventional for the program (Art Center MDP), there is still so much I gained from conversations with various technologists, on the micro- and macro-scale.

Pink Slime Caesar Shift: Method #2 Carrier: Anti-Static Bracelet, 2019–20, Brass body with adjustable rotating clasp, with hollow brass capsule containing synthetic DNA on blotting paper, embedded in cast acrylic, edition of 6

Sarah Rara

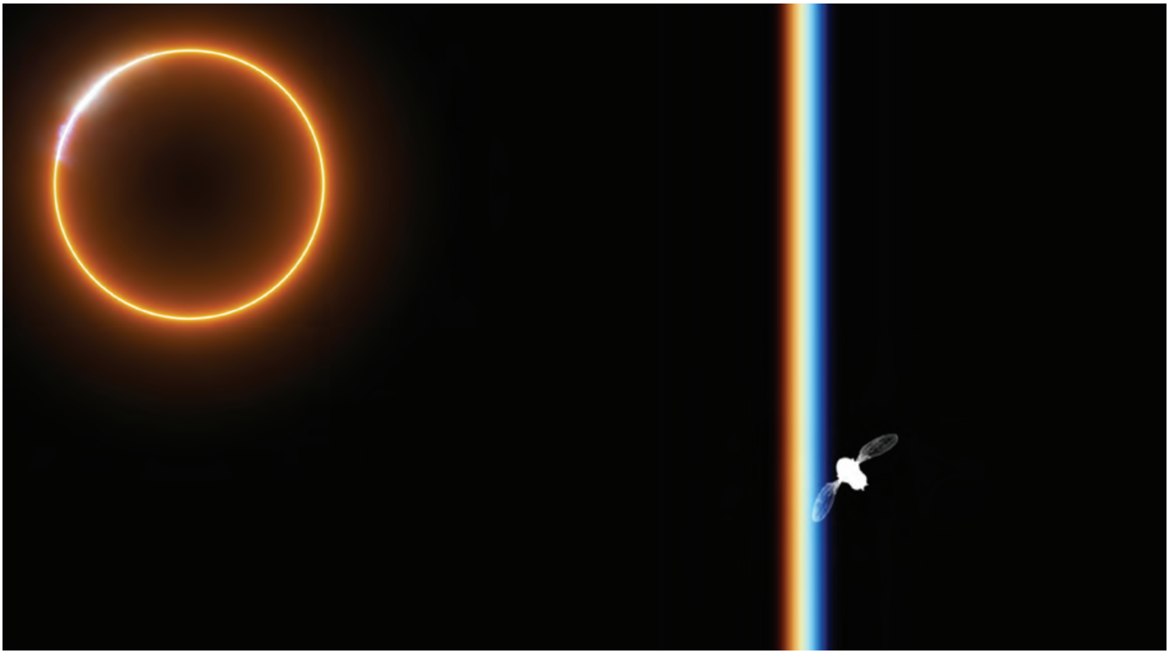
Awarded: Year 5 (2018–19)
Project Dates: 2018–ongoing
Key Partners: California Institute of Technology; Fulcrum Arts

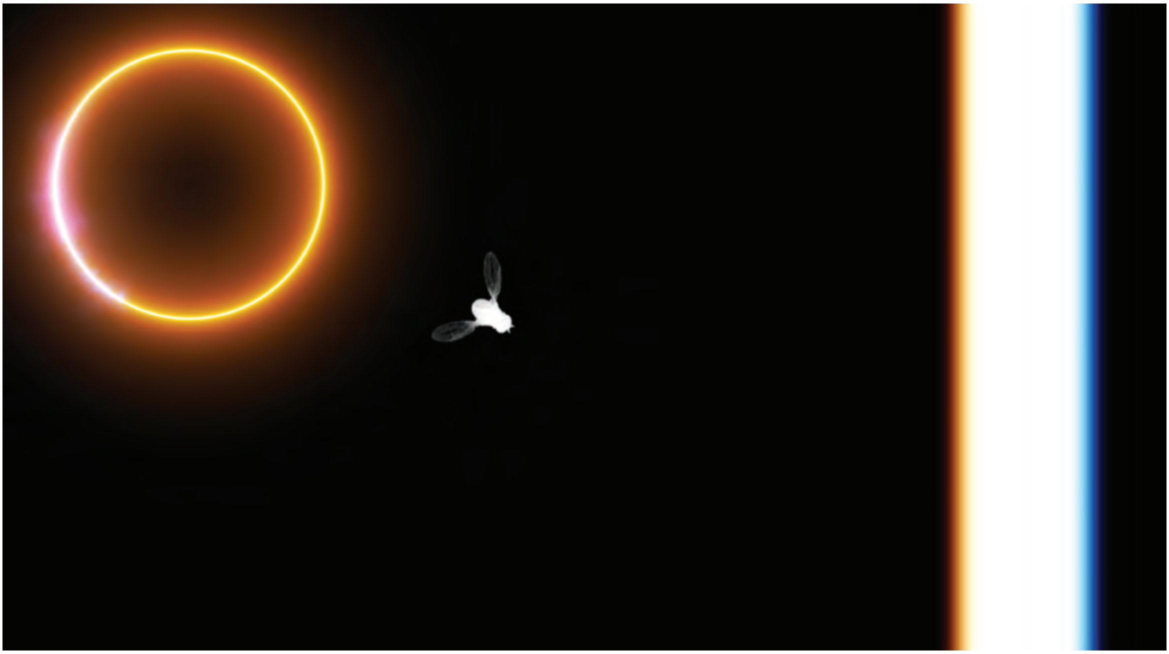
In 2017, during a three-month residency organized by Fulcrum Arts in Pasadena, Sarah Rara began participating in fruit fly navigation research as an artist-in-residence at Caltech's Dickinson Lab, known for its interdisciplinary approaches to the neural and biomechanical foundations of flight behavior in fruit flies. Her Art + Technology grant enabled her to continue this research. In *Ellipsoid Body* (begun 2018) she sought to understand how video imagery shapes human navigation. Using custom software and video, she studied fruit fly navigation through virtual reality and interactive environments. The artworks she produced assemble a range of sensing and navigational technologies to explore how on-screen and off-screen experiences overlap, developing new models for mapping three-dimensional space within two-dimensional images.

Ellipsoid Body takes its name from a ring-shaped structure in the fruit fly brain that functions as an internal compass. As a fly turns, neurons fire across this structure, rotating it like a steering wheel to track the fly's orientation. Though the fly's brain is no larger than a pinhead and contains just 100,000 neurons (compared to the human brain's 100 billion), it performs remarkably complex computations, making it an ideal model for both scientific and artistic study.

To study the fly's ellipsoid body and navigational behavior, researchers observe the species in closed-loop virtual reality environments, calibrated to the

Video stills from *Fly Study #1*, 2018





high-speed processing of insect vision. These environments provide simulated visual representations of the sun, which the fly can orient toward. The fly effectively controls the image: As wing amplitude is measured, the fly's brain calculates its heading and positions the video-sun accordingly. "Following from these experiments," Rara has explained, "I have developed video and virtual reality work that explores technologies of sensing, navigation, and mapping, mediated through video via satellite imagery, driverless cars, and virtual reality environments."

Artist's Reflections

Ellipsoid Body takes many turns, a project in process for close to ten years now. It remains a project in motion—a project about movement and navigation. *Ellipsoid Body* takes the form of an intentional meander, finding positions from which to ask: How do we orient ourselves? How do we know where we are and where we are going?

I want to understand how, amidst so many streams rich in spatial and temporal information, one forms an orientation or takes a position. At Caltech's Dickinson Lab, I observed how fruit flies navigate virtual space, flying in relation to video images that simulate the position of the sun. At NASA's Jet Propulsion Laboratory, I spoke with scientists who remotely navigated a vehicle with an ion engine into orbit around a dwarf planet in the asteroid belt between Mars and Jupiter. I studied videos designed for use in medical contexts, for subjects experiencing vestibular disability. I spoke to practitioners of celestial navigation techniques who traverse the open ocean, where there is no land visible. Each unfolding case study establishes further rich connections between computer-sensing and embodied-sensing of movement, orientation, and place.

Observing as an artist, not a scientist, I feel at home in the lab, another kind of studio. We should talk more, artists and scientists: highly trained observers, critics of reality. Each drawn to the kinds of questions that take generations of work to answer, to build upon. Work that never ceases, wide-ranging, infinitely surprising. Inquiries conducted in search of the moments when one is left speechless. There is nothing else to say, because the language has not been invented yet; we are inventing it.

The fruit fly experiments take place in small virtual reality theaters, tabletop rings of LED video screens where tethered flies react to video. Sometimes the fly controls the video display, as in a video game. Cameras and sensors map the image to wing movements of the fly. As the fly "turns," the video image turns, or rather the fly senses they are turning, because the video image turns. Researchers are able to peer in real time at the activity of genetically modified neurons marked by fluorescent proteins. Active neurons fluoresce as the fly turns toward the image, as the fly alters its wing movements.

For the fruit fly in the lab, videos are not a simulation of reality—their reality includes video. There is no distinguishing between virtual and physical, as an image of the sun and the sun itself produce similar responses. Representation vanishes. Fruit flies automatically demonstrate something about the overlap between reality and video that took me years to articulate: the flow of images moves in two directions. Video modulates reality, reality modulates video, and our response to either kind of stimulus is physical, sensory, embodied.

While the fruit fly formed the starting point, *Ellipsoid Body* continues, agile and in motion. To study navigation is to study how we progress through forms of knowledge, how a question travels, and how it arrives.

Read more about Sarah Rara's fruit fly research and her work on navigation and perception at www.lacma.org/art/lab.

Diana Thater

Awarded: Year 5 (2018–19)
Project Dates: 2018–20

Since the early 1990s, the Los Angeles–based artist Diana Thater has explored the relationships between humans and the natural world through film and video installations. LACMA hosted *Diana Thater: The Sympathetic Imagination*, a major exhibition of her works, in 2015 (see dianathater.delmonicobooks.com), and in 2018, with the support of the Art + Technology Lab, she proposed to develop new video work focused on biomimetic robots—machines that adapt the neurophysiology and behavior of their animal models. After meeting with engineers at SpaceX, UCLA, and NASA's Jet Propulsion Laboratory to discuss options, she found what she was looking for in JPL's Robosimian, a robot based on an orangutan. She traveled with this robot to Death Valley in March 2019 to record footage, but the robot's slow and deliberate movements did not suit her vision.

Thater then reconsidered her approach. She investigated creating a robot through computer graphics, but the cost proved prohibitive. She turned instead to an entertainment designer and costume builder to create a robot costume based on a chimpanzee about four feet tall. The result was slightly alienating and strange, exactly the effect she wanted. She chose to film the robot at Green Animals Topiary Garden in Newport, Rhode Island, a site filled with hedges shaped as elephants, giraffes, and dolphins—"a relic of the past, a romantic representation of our relationship to the animal." In the planned video, the robot

above and pp. 140–41
Diana Thater, *Yes, there will be singing*, 2020

was to walk around the garden observing the animal topiaries. It would be shot from multiple angles, in Super-8, 16mm, and 4K video. Except for a moment at the end, when the crew was meant to be visible on one screen, it would be filmed without humans—a place where an imitation of an animal (a chimp—one of the most intelligent mammals) would contemplate other imitations of animals. However, the filming was canceled because of the COVID-19 pandemic.

Thater then started over from scratch. During a time when many people were living in isolation, she decided to make an online work that everyone could see. This work became *Yes, there will be singing* (2020), for which she drew on her longtime interest in Whale 52. She first learned of this whale after reading a magazine article. Initially detected in the Pacific Ocean in the 1980s, he's unusual because he's never been seen—only heard. Further, his distinct sonic signature has a frequency of fifty-two hertz—radically different from those of blue and fin whales (he may be deaf or physically different from other whales of his species, which is unknown). Named for his signature frequency, he

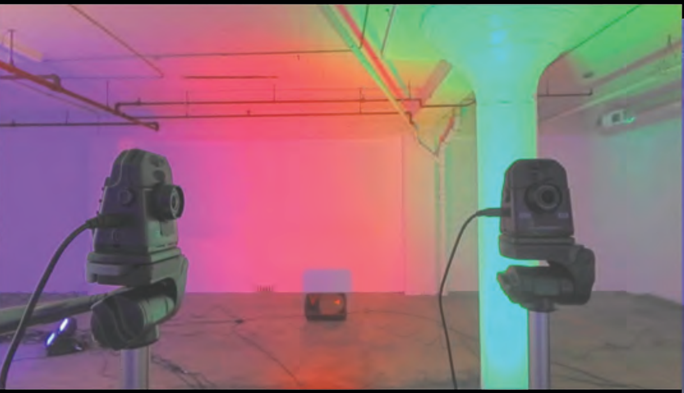
Diana Thater

sings into the darkness, never heard by other whales, never receiving a response, but continuing nonetheless.

Yes, there will be singing was installed in a deserted concrete room at an anonymous location in Los Angeles. Viewers could only experience it via a 24/7 livestream on the David Zwirner website from October 14 to November 28, 2020, during that dark time defined by the pandemic, the unrest following the murder of George Floyd, and the tumult of the 2020 U.S. presidential election. Because Whale 52 has never been seen, the room contained no images of him. The only visible objects were four video cameras and four speakers arranged in a circle, as well as lights, cords, and other technical equipment—illuminated in rich, sensual colors. Hauntingly beautiful, the room evoked what Thater has described as a correlative to an underwater world.

Echoing throughout the space was an edited soundtrack. The bassline was Whale 52's plaintive song, mixed with songs from other whales at different frequencies. Thater has observed that the more she

Diana Thater, *Yes, there will be singing*, 2020




worked on the installation, "the more I realized how ghostly it is.... I decided I'd show an empty space. That's all we have now. I was thinking about images of Times Square at the height of New York's lockdown. I was thinking about empty space, and distance, and delay, and echo. All of those things are ghostly and spectral." She continued: "What this is about is trying to represent an absence. Trying to represent someone who isn't there."

While the work can be read as an elegy on loss, it simultaneously evokes resilience. Thater again: "The whole purpose of this work is to put…into the world… this idea about the necessity of communication and the necessity of interrelating with one another at a time when it's been denied to us." This faith in the necessity of communication during dark times is conveyed in the work's title, inspired by the motto to the second section of Bertolt Brecht's *Svendborg Poems* (1939), which he wrote while living in exile from Nazi Germany: "In the dark times / Will there also be singing? / Yes, there will be singing. / About the dark times."

Ebru Kurbak

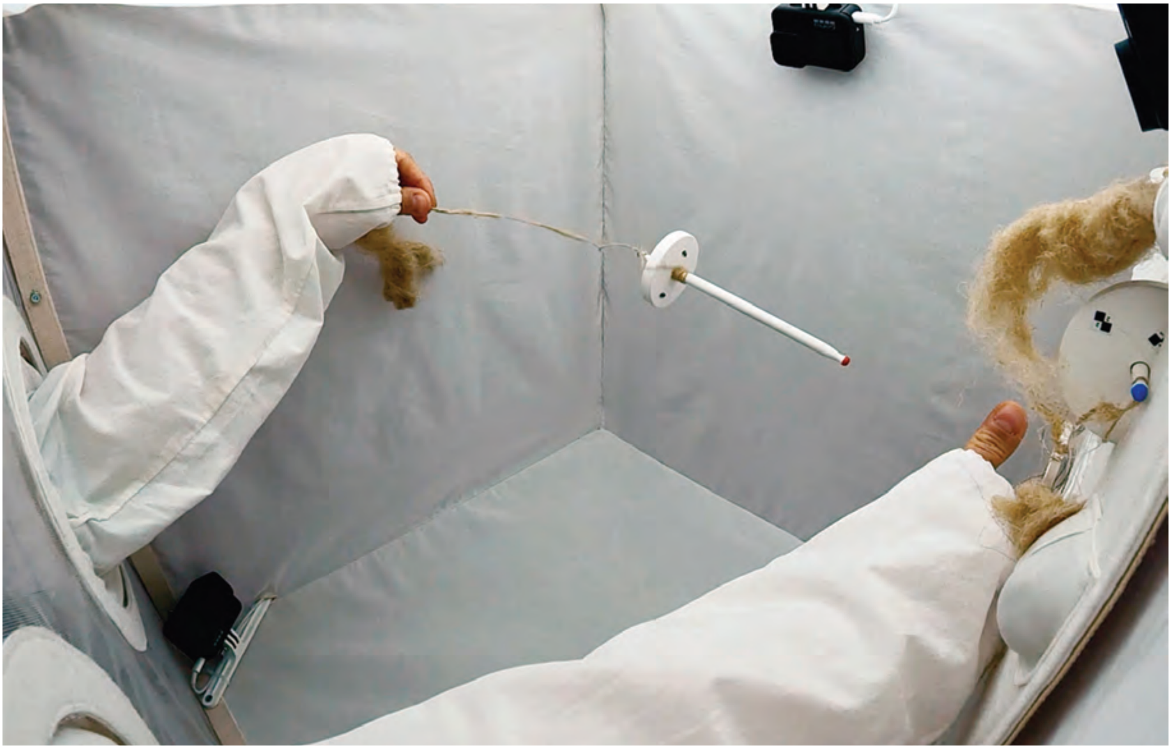
Awarded: Year 6 (2019–20)
Project Dates: 2019–ongoing
Key Partner: MIT Media Lab Space Exploration Initiative

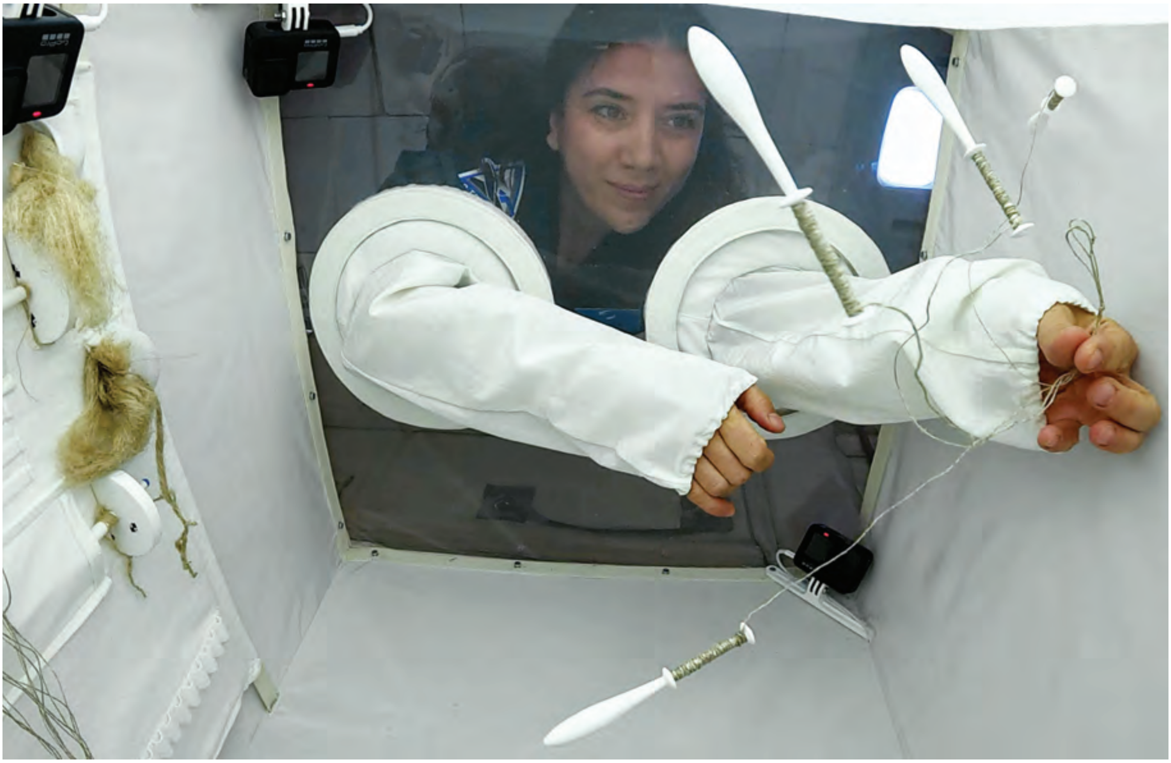
When Ebru Kurbak learned that Soviet astronauts had attempted to grow flax during a 1971 space mission, she was intrigued. Growing up in 1980s Turkey, she recalled, "it was almost a must for me to learn textile handicrafts," including hand-spinning flax—a skill that would become central to her artistic practice. What would it be like, she wondered, to spin fibers in conditions of weightlessness? As a grant recipient, she was able to find out.

The spindle is, as Kurbak observes, one of humankind's oldest technologies, predating even the wheel. She decided to combine this technology with cutting-edge science that simulates weightlessness. But when she began investigating the possibility of working with fabric in space, she was dismayed by the lack of research. Eventually, MIT Media Lab Space Exploration Initiative invited her to conduct experiments on a parabolic flight, in which an aircraft executes a series of climbs and dives to produce weightless conditions. The flight included twenty parabolas—martian, lunar, and zero-gravity simulations—each providing about twenty to thirty seconds of reduced gravity interspersed with ninety seconds of hypergravity (1.8 G). Given the disorienting nature of the zero-gravity experience, Kurbak had to plan and practice the flow of experiments with precision.

Spinning yarn normally requires tension on the fibers, achieved by holding the shaft against the gravitational force pulling on the spindle. In zero gravity,

opposite and pp. 146–47
Handcrafting in microgravity, *Reinventing the Spindle*, 2023





Ebru Kurbak

this tension must be created by other means. Kurbak constructed a zero-gravity booth equipped with traditional tools that would allow her to evaluate the challenges. She focused initially on the drop spindle, a hand spindle suspended during the spinning process—a particular challenge in weightlessness. She also tested lace bobbins, tatting shuttles, and sewing thread spools, because they don't require rigidly anchored structures.

The work proved difficult. Any action in weightlessness creates amplified movement effects and must be performed slowly and deliberately—but the twenty-second time limit conflicted with this measured approach. Structures collapsed and strings tangled during hypergravity. But much to Kurbak's surprise, she succeeded in spinning nearly four feet of string.

Kurbak exhibited the multimedia installation *Reinventing the Spindle* at the SIGGRAPH 2023 Art Gallery in Los Angeles, where it received the Best in Show Award, followed by installations at Neue Galerie Graz (2023–24) and Istanbul Modern (2024). The installation included the crafting booth from the parabolic flight, the linen thread she spun during weightlessness, and a ghostlike replica of the booth made from translucent, lightweight fabric suspended by invisible cords. A slow-motion video shot during the flight was projected onto the three sides of the floating fabric cube.

Artist's Reflections

When I think back on how this project began, what I remember most is a sense of disbelief mixed into the excitement. I had written the proposal as an almost impossible gesture: to bring a spindle and flax fibers into microgravity. When the pandemic delayed my planned microgravity flight three times, stretching the wait to three years, I even felt a sense of relief. Looking back, I believe I needed that time to grow into my own idea, transforming not only this project, but also the way I think about my own limits.

The microgravity experiment grew out of several connected (re)discoveries during those years. Craft today is often perceived as a traditional way of making, directed toward a specific outcome. But craft tools and techniques are never only instruments of production. They are also investigations of materials, of earthly forces, and sometimes of much more. The spindle, for example, takes fibers from plants or animals and, through a shaft, a weight, and the pull of gravity, turns them into workable threads. It became clear to me that I was not only working with a technology that had enabled string-making thousands of years ago, but also with one of the earliest instruments for exploring gravity itself.

Reinventing the Spindle, in the end, became an interwoven fabric of many histories: the imagination of zero gravity, the development of gravitational physics, the prehistoric technology of the spindle, space botany and materials research in Low Earth Orbit, questions of ownership of exoplanetary and earth orbits, and even the biographies of people who had traveled to space. Yet the project would not have been what it became without actually going on the parabolic flight. Each parabola gave twenty seconds of weightlessness, and in those brief moments I spun a thread of flax. Fragile, imperfect, but real. That thread not only captured the long research process in its twisted fibers but also carried me from what once felt unimaginable to what became possible, reshaping what I can imagine as work.

Read more about Ebru Kurbak's work on spindle spinning and the history of craft at www.lacma.org/art/lab.

Rashaad Newsome

Awarded: Year 6 (2019–20)
Project Dates: 2019–ongoing

"How do you depict a body for a being that doesn't need one?" wondered the interdisciplinary artist Rashaad Newsome. "How do you create a visual language for that body when it doesn't exist in the world?" These are not idle questions, but ones that animated Newsome's conception of *Being* (begun 2019), his ongoing project developing a cloud-based, artificial intelligence entity. *Being*, whose pronouns are they/them, describes themselves as "a reimagining of the griot, a West African cultural figure that acts as an archive, performance artist, and healer."

The version of *Being* that Newsome produced with support from the Art + Technology Lab takes the form of a 3D avatar: a humanoid figure with a torso and face plates inspired by the *pwo* (female) masks of the Chokwe people of Central and Southern Africa, danced by men to honor mothers and their original female ancestor. In the early twentieth century, European artists turned to abstraction after encountering African masks in museums and galleries. "This is one of the reasons I chose the *pwo* mask," the artist has said. "For me, it represents the true origins of abstraction, which I feel appropriately represents *Being* for the moment. I also liked the idea that the Chokwe people's culture was matrilineal, and that the mask was typically danced in by men to honor women. I found that this connected the mask to queer practices found in the vogue ballroom scene, which are a consistent reference in my work." *Being*'s voice, meanwhile, is an amalgamation of different voices that have been

Rashaad Newsome: To Be Real,
Fort Mason Center for Arts & Culture,
San Francisco, 2020

altered to sound gender-neutral. And as the artist has stated, its movements use motion capture technology to "archive and embody the movement patterns of prominent vogue practitioners."

Newsome first developed *Being* to act as a critical guide to his fall 2019 exhibition, *Rashaad Newsome: To Be Real*, at the Philadelphia Photo Arts Center (now TILT Institute for the Contemporary Image), which traveled to the Fort Mason Center for Arts & Culture in San Francisco in winter 2020. *Being* appeared on a large projection screen; visitors could approach a microphone in front of the screen and ask questions, to which *Being* would respond. From a technical standpoint, *Being* differs from typical AI agents in that they have been designed with agency in mind; they have the ability to "go rogue," rather than simply respond to users. Its mind has been populated with the works of radical thinkers such as bell hooks, Paulo Freire, Michel Foucault, and Cornel West. "I wanted to start a conversation about the importance and complexities of agency," Newsome has explained. "There is a good deal of debate about the possibility of agency in AI. But I think that, in the peculiar space inhabited by robots, the concept of agency can be accessed through simulation. For the robots, this is a form of agency; however, for the programmer, it is an opportunity for them to see themselves engaging in the process of decolonizing. Robots can at best be mirrors for their creators. This gesture to create something with an inherent sense of agency can be seen as a radical act of love."

For *To Be Real*, Newsome also collaborated with Snap Inc. to create custom augmented-reality lenses. Visitors were invited to use the Snapchat app to reveal hidden digital layers embedded in several of the artist's static works on view, bringing them to life. The works confronted viewers directly, engaging in a kind of oppositional gaze, explaining their own significance,

and even quoting the writers Newsome programmed into them, such as an observation from hooks on the importance of having and using your voice as a form of resistance.

Since 2019, *Being* has continued to evolve. With this entity, Newsome draws comparisons between the labor performed by robots and the unpaid, compulsory service historically demanded of Black people. In the face of untenable conditions, the artist asserts, Black culture has not only survived and adapted, but has found ways to flourish: "When I think about the legacy of Black folks, I think about endless innovation—folks having to sort of create themselves with lack of knowledge of where they came from."

Artist's Reflections

The Art + Technology Lab was instrumental in helping me create the first generation of *Being*, the Digital Griot, an AI-powered entity rooted in Black radical thought. With their support, I also produced a groundbreaking virtual ball hosted by the *Being*—an unprecedented fusion of machine learning, vogue performance, and community celebration that pushed the boundaries of what a museum-hosted event could be.

Rashaad Newsome, virtual ballroom experience, *King of Arms Art Ball 6*, 2020

Eun Young Park

Awarded: Year 6 (2019–20)
Project Dates: 2019–21

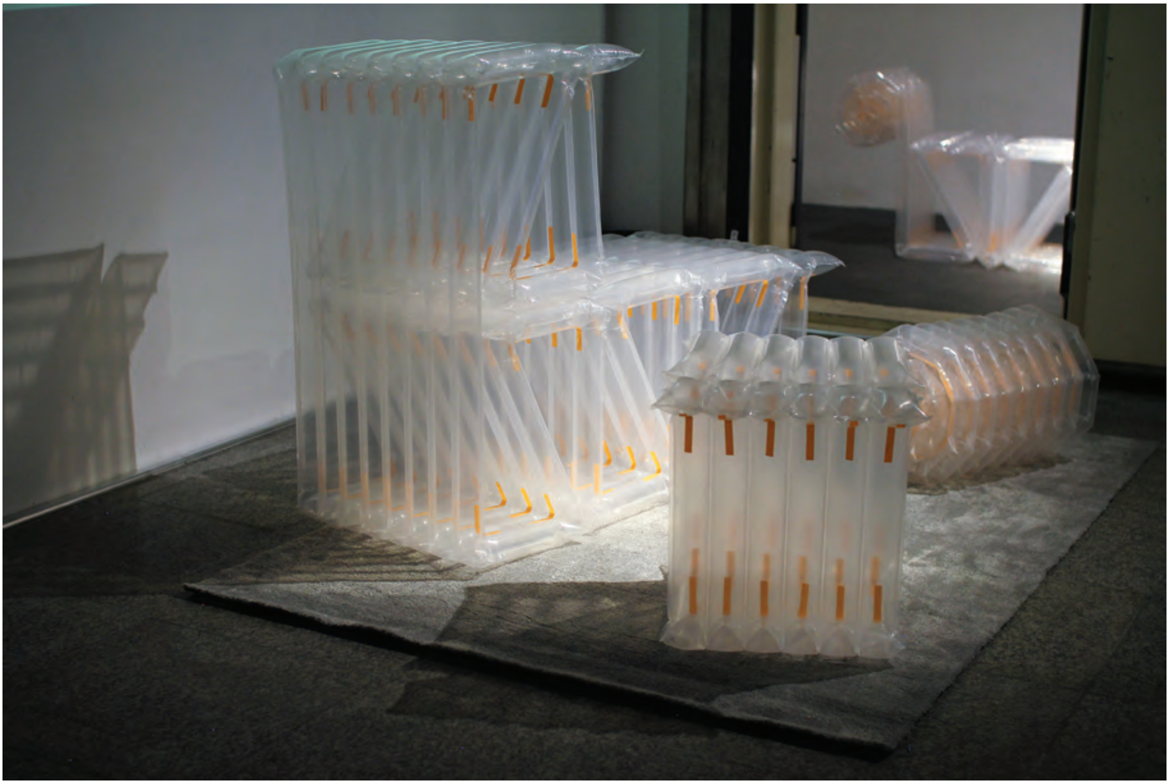
The word *robot* typically conjures images of metal humanoids or heavy-duty industrial tools employed in the production of, for instance, automobiles. Soft robots, by contrast, are made from flexible materials such as silicone, vinyl, fabric, and paper. Researchers into soft robotics are typically concerned with issues of safety and flexibility, particularly in fields such as health care, and they often make use of "craft" techniques such as paper folding and fabric manipulation. Influenced by these researchers, as well as by artists and designers of the 1960s who found potential in low-cost, light-weight inflatables, in her project *Radical Soft Robots* (2019–21) Eun Young Park decided to explore the potential of soft robots as an expressive and critical medium beyond the sphere of engineering.

Park began with a "pillow study"—pillow, in this case, signifying such qualities as softness, scale, and modularity. Being flat, pillows can be folded and transformed into a variety of three-dimensional forms with one actuator (a device that changes the pillow's shape or firmness through the use of air pressure or other means), as well as made into screens and responsive elements in wearables, furniture, and other products. This can be achieved by a few different methods—by embedding a folded origami structure inside the pillow as a skeleton, for example, or designing a pattern for air channels.

Softness involves not only materiality, but also

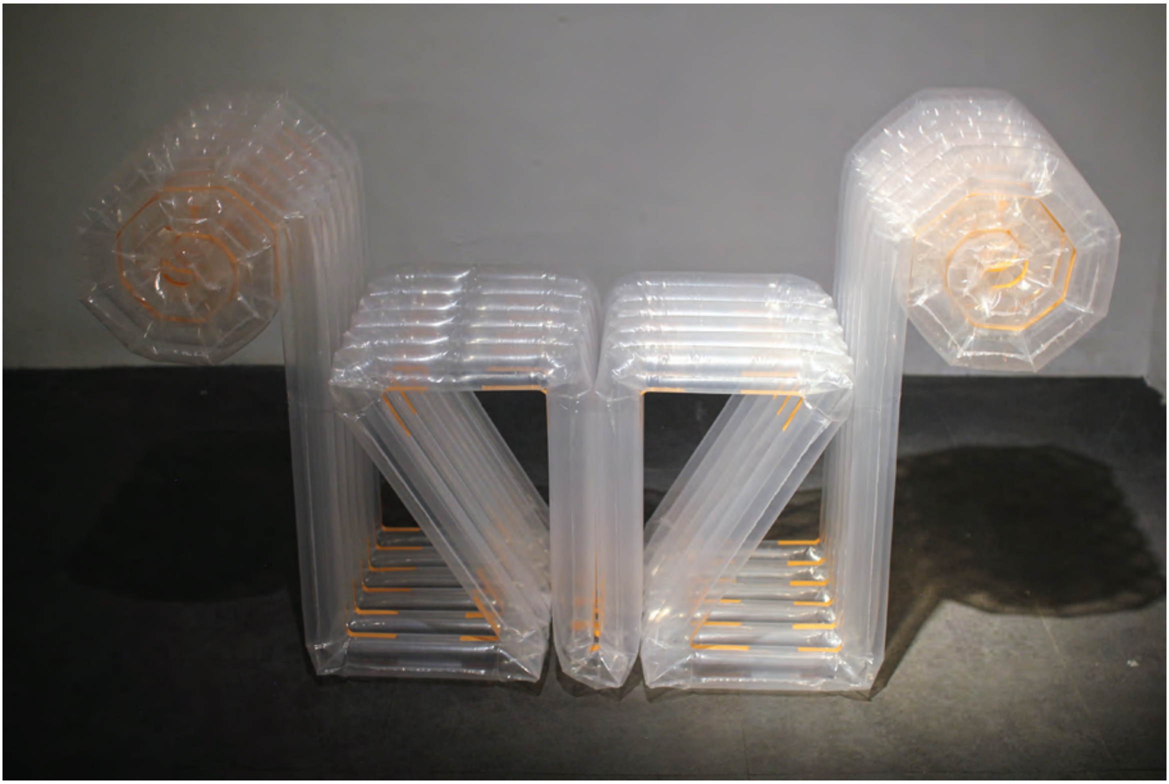
top
One of the pillow prototypes

bottom
Eun Young Park, *The Place Where You Used to Be*, installed in *PLEATS: Interior Scenes with Soft and Affective Robots*, Post Territory Ujeongguk, Seoul, 2021



change, the subtle passage of time. "Movement," Park has noted, "evokes emotion, makes static and mundane things alive and playful." Think of flowers blooming, leaves sprouting, the rhythmic breathing of a pet sleeping on your lap, curtains fluttering in the wind. This prompted Park to wonder whether there could be a robot plant, a wall, a hat, a dress, an armchair. One of her pillows breathes in tune with bio signals—in this case, with a heartbeat; another is responsive to touch so that when it is out of breath, you can calm it down with a gentle caress. When slow movement is combined with textured skins, it produces an aesthetic impact amplifying the change. The texture can be made with various methods, such as by folding or cutting papers or manipulating fabrics. Depending on the surface design and material, it transforms its shape in varied ways—by popping up and unfurling.

above and opposite
Eun Young Park, *My Room in a Suitcase* installed in *PLEATS: Interior Scenes with Soft and Affective Robots*, Post Territory Ujeongguk, Seoul, 2021



Inspired by research on space-navigating soft robots, Park explored the possibility of making furniture that pops up from a flat sheet. She constructed prototypes from basic materials—rolls of polyethylene tube and insulating tape. She also used pleating techniques borrowed from fashion to make flat-foldable furniture, such as a sofa and a bench. She then sought to build objects and installations based on her initial experiments. She began with furniture like seating and lighting, to which she hopes to add more artifacts. More active pillows can grow, fold, spiral, roll, and finally make specific forms.

Park focused next on the qualities of light and form-making, experimenting with Japanese kirigami (paper-cutting) techniques and making lamp shades on soft actuators that create subtle and breathing shadows. When lights are embedded in pillows, the change of shape becomes more evident, opening

new possibilities. Light-embedded pillows create textured reflections on the wall; lights can be dimmed or brightened to create changing moods.

As her project advanced, Park devoted increasing attention to the idea of softness and slowness in technology more broadly, researching materials and processes and building prototypes. She has also exhibited some of the results of her work in a series of shows at galleries in South Korea.

Artist's Reflections

Receiving the Art + Technology Lab grant was a big honor and a huge boost for me to start a new project. My idea was to create unconventional soft robots in terms of form and function, robots as our surroundings that act on our emotions. Since it was my first time working with soft robotics, I started from scratch—researching materials and technologies and making prototypes of pillow-sized, modular soft robots. This experiment, which I later titled *Pillow Study*, became an art project on its own, and I had a chance to write articles about it for LACMA's blog.

From there, I took it further and ended up with a solo show called *PLEATS: Interior Scenes with Soft and Affective Robots* in 2021, where I designed soft robotic environments with elements like lights, furniture, and textiles. I continue developing this project, and most recently, I presented *Pillow Study 2* at a group exhibition at Hyundai Motorstudio Busan.

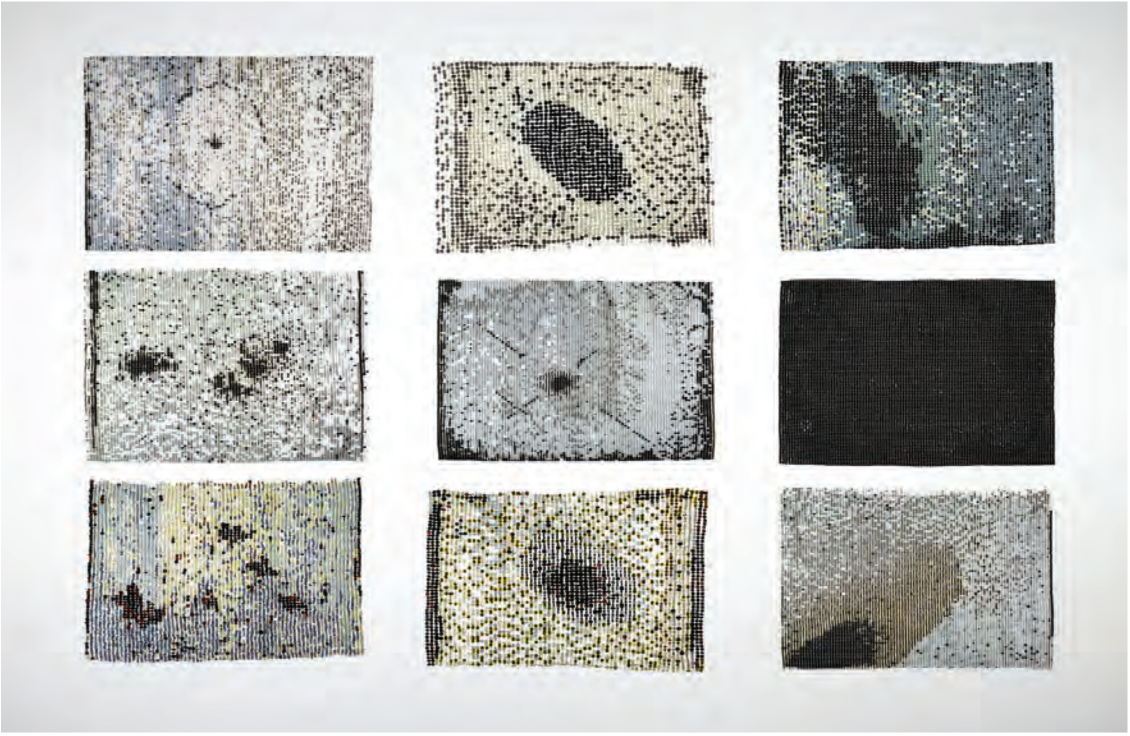
Eun Young Park, *Pillow Study 2*, installed in *Where Is My Friend's Home*, Hyundai Motorstudio Busan, Seoul, 2023

Sarah Rosalena

Awarded: Year 6 (2019–20)
Project Dates: 2019–23
Key Partner: Mount Wilson Observatory

Sarah Rosalena is a Los Angeles–based artist and weaver. As part of her project, *Exit Points*, LACMA, in conjunction with Mount Wilson Observatory and Carnegie Observatories, presented the exhibition *Sarah Rosalena: Standard Candle*, from May 20 to June 18, 2023. Staged inside Mount Wilson Observatory's Hooker 100-inch telescope, *Standard Candle* used instrumentation and darkness as a lens for examining women's labor and colonialism in the advancement of Western scientific thought and the imaging of space.

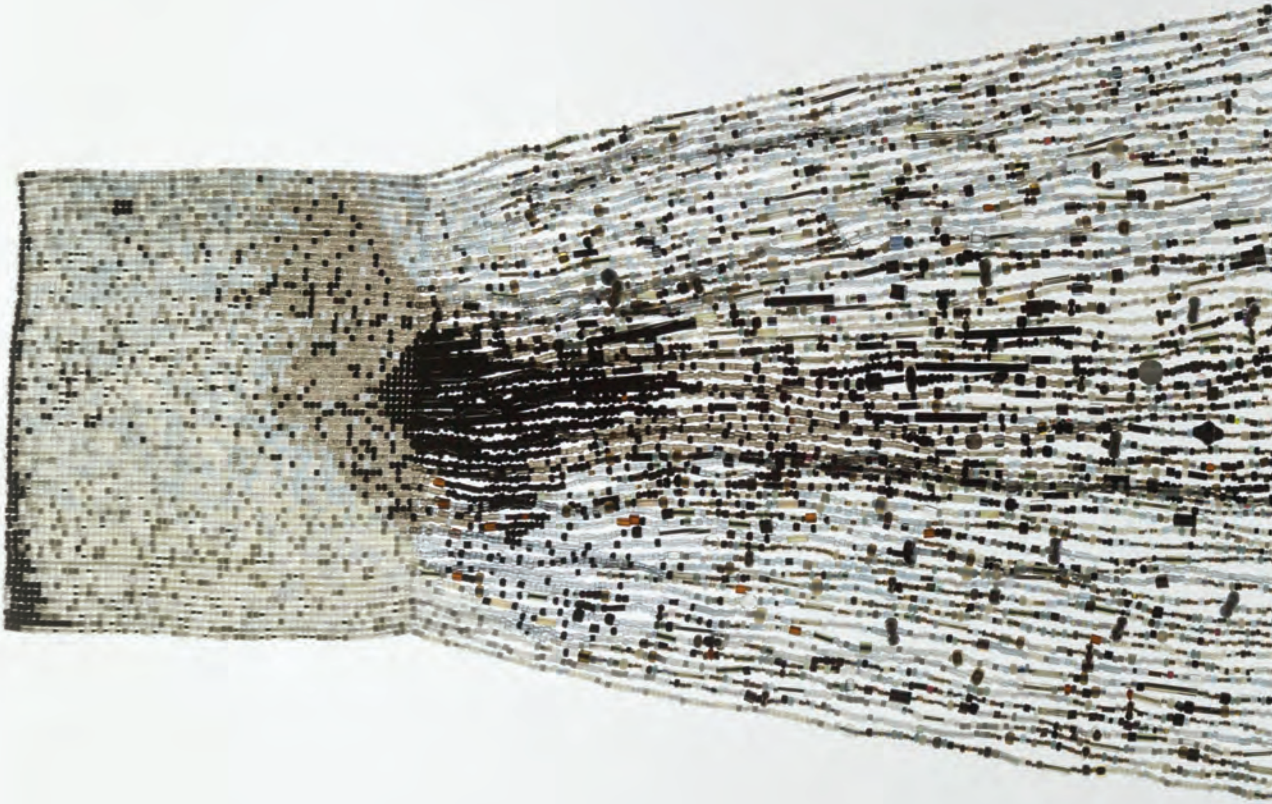
Artist's Reflections
Exit Points emerged from my research in digital weaving and textiles and the desire to interrogate artificial intelligence not as a tool of innovation, but as a continuation of colonial systems of extraction, erasure, and control. Supported by the Art + Technology Lab, I began experimenting with artificial intelligence (AI) and satellite data, not to showcase machine learning's potential, but to expose its failures—its noise, biases, and distortions. My early experiments with machine learning models such as generative adversarial networks (GANs) and convolutional neural networks (CNNs) were conducted between 2017 and 2020, before the widespread commercialization of generative AI. Prior to these generative AI models, I was interested in using AI as a site for material thinking: a way to interface with algorithmic systems while remaining attentive to their architectures of bias, omission, and control.



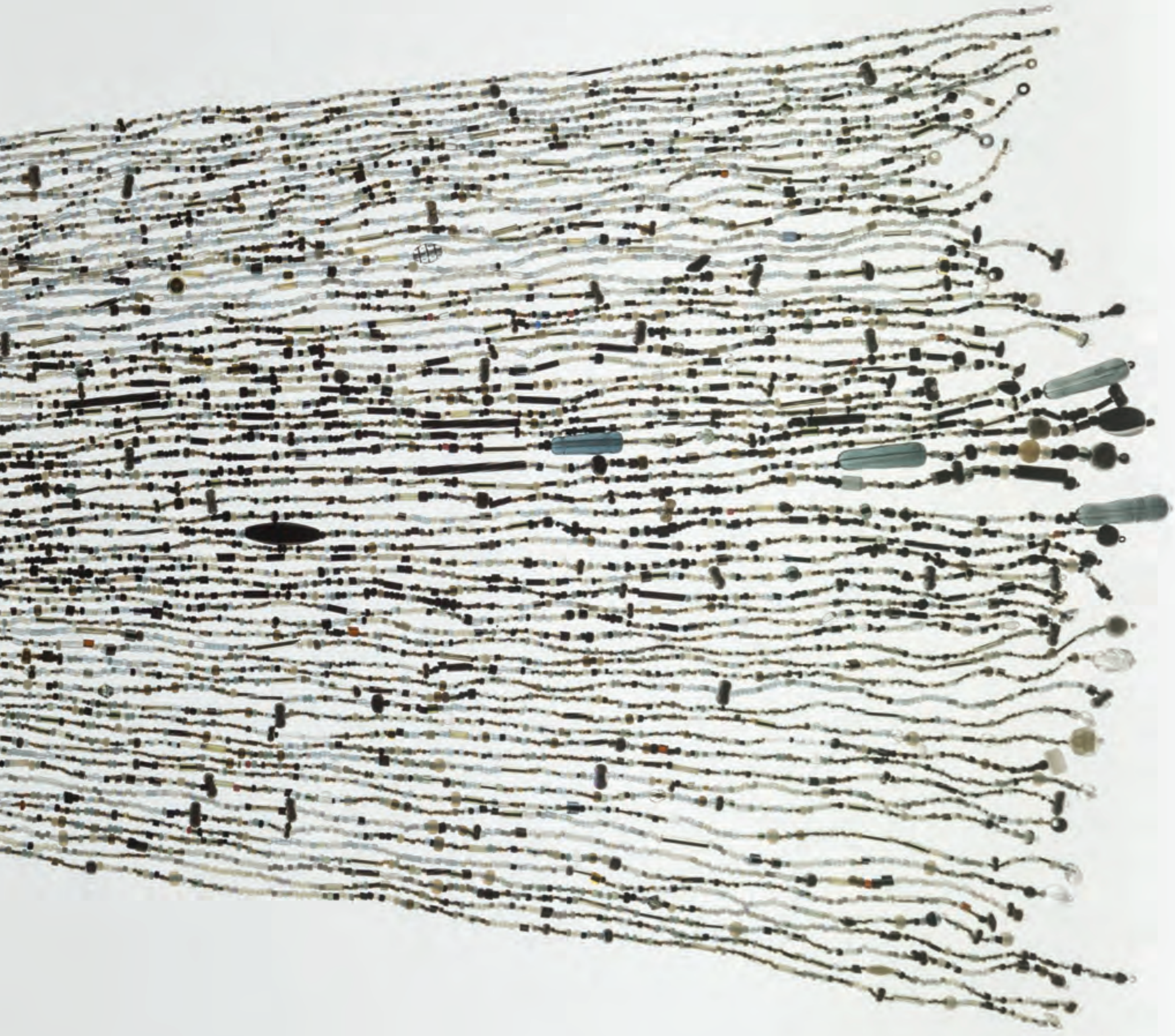
Sarah Rosalena, *Expanding Axis*, 2022, glass beads and thread, 9 of 10 works, each 4 × 6 in., collection of the artist

pp. 162–63
Sarah Rosalena, *Exit VAR!*, 2022, glass beads and thread, 23 × 4 in., Los Angeles County Museum of Art, Bernard Kester Costume and Textiles Acquisition Fund

The release of generative AI platforms like those from OpenAI in 2022 marked a significant shift without consent, flattening visual culture into homogeneity. I watched how these systems simply did not produce, but *reproduce* and amplify the very systems of colonial extraction, intellectual dispossession, and ecological harm that my work attempted to challenge—one that extracts labor, scrapes culture, and consumes vast energy, all without consent, while reinforcing existing structures of power under the guise of innovation. In response, I began using AI-generated images not as ends in themselves, but as patterns for weaving—transforming them through material resistance. Where digital image-making erases its processes in favor of smooth resolution, the woven surface insists on showing its warp and weft—revealing what the screen conceals: the conditions of its own making. Each textile rendered the instability of AI systems in physical form: frayed edges, pixelated distortions, gradients



Sarah Rosalena



bleeding across warp and weft. In my hands, resolution—a central function of image processing—fails on purpose.

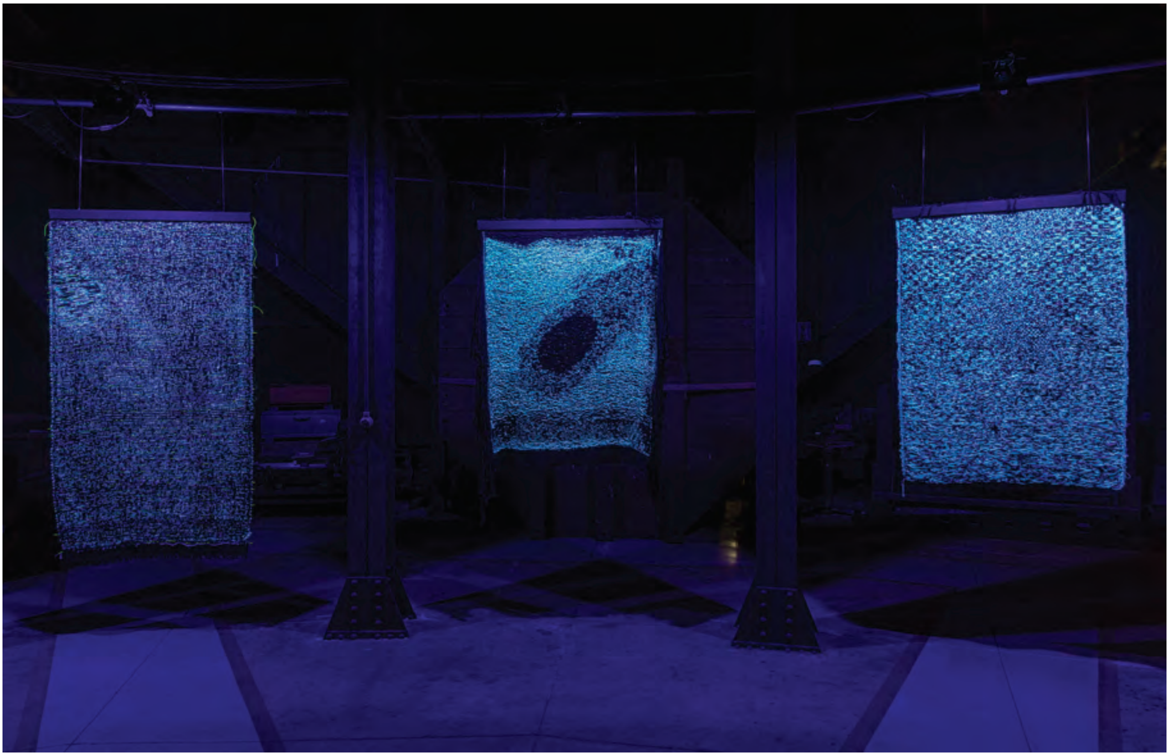
This exploration continued in *Standard Candle*, my 2023 solo exhibition. Installed in the darkened chamber of the 100-inch Hooker telescope, the exhibition reflected on how resolution—both optical and conceptual—renders the cosmos visible. Here, resolution becomes a measure not only of image clarity but also of the resolution of space. The darkness at Mount Wilson Observatory, essential for early astronomical imaging, was made possible by unceded Indigenous Tongva land. Installed within the darkened chamber of the historic telescope, the exhibition engaged with another system of power and invisibility: the labor of early female "computers." These women, often working underpaid and uncredited, were responsible for cataloguing astronomical data by hand, using glass plate negatives and mathematical calculations to measure the universe. Their contributions laid the groundwork for astrophysics and mapping the universe, yet they were consistently erased from the scientific narrative.

In *Standard Candle*, I reclaimed this silenced labor by weaving the very images captured by the 100-inch telescope. Each textile was generated from coded interpretations of astronomical data, then beaded and woven into dark, radiant surfaces that evoke the night sky while referencing the hands that once measured it. Installed within the telescope's black box interior, the exhibition was intentionally disorienting—a space of observation turned inward, toward the labor behind the lens. Weaving here becomes not only an act of translation, but of recognition: a way to trace the invisible architectures of both textiles and science, and to make visible the deep interconnection between gender, technology, and extraction.

Weaving, for me, is not just a method—it is a

top
Sarah Rosalena, *CMB*, 2022, glass beads, pine sap, tree resin, gourds, collection of the artist

bottom
Installation view, *Standard Candle* at Mount Wilson Observatory, 2023



proposition. It resists flatness, both visually and epistemologically. Unlike the seamlessness of the screen, woven textiles carry depth, friction, and time. Each thread bears the memory of its making. *Exit Points* speaks directly to this logic of rupture—pixel per thread. Weaving on the loom is an active technology of resistance. Frayed edges, blurred pixels, unstable gradients—these are not errors to be corrected, but ruptures to be amplified. Each textile becomes a "disruptive terrain," where threads refuse alignment, colors resist containment, and resolution collapses.

This idea of the terrain—both material and conceptual—is critical to my practice. I understand weaving itself as a terrain: a surface where systems are constructed, challenged, and unraveled. The woven grid mimics what software is made from—not in perfect resolution, not as command, but in the places it falls apart. In those gaps, something else becomes possible.

opposite
Sarah Rosalena, *Ri 0*, 2023, cotton and UV reactive yarn, 106 × 41 in., collection of the artist

above
Sarah Rosalena, *Standard Candle,* 2021, cotton yarn, 45 × 49 in., collection of the artist

Read more about Sarah Rosalena's weaving practice as part of her critiques of systems of power at www.lacma.org/art/lab.

Tom Sachs

Awarded: Year 6 (2019–20)
Project Dates: 2019–21

In the early 1990s, Tom Sachs began re-creating mass-produced brandname objects, by hand, in humble materials like plywood, foam core, and glue, in which the imperfections of his process remained visible. Although these works are typically playful, they also address aspects of American consumer culture.

Born during the height of the Apollo Program, Sachs has long been fascinated with space exploration, and he has created an astonishing range of works on this subject. *Space Programs 1–5* (2007–25), for example, is a series of immersive installations simulating missions to destinations throughout the solar system. *Space Program: Mars* (2012) was installed in a 55,000 square foot space in New York's Park Avenue Armory. It included re-creations of mission control, launch platforms, the Martian landscape, a rover made from a golf cart, and performers playing astronauts and engineers.

As an Art + Technology Lab grant recipient, Sachs proposed *Space Program 4: The Infinite and the Beyond*, a "virtual reality experience module" consisting of components including a massage chair, television, fan, headphone set, misting system, heating, and cooling, synchronized by computer to allow visitors to explore the deepest reaches of their psyche.

Sachs pivoted in 2021 and launched Rocket Factory. This custom-built digital platform lives on the blockchain and serves as a marketplace where branded virtual Rocket Components are bought and sold as

Tom Sachs, *Too Darn Hot* at LACMA, 2021

pp. 170–71
Physical Rockets in the Rocket Factory


TROJAN
CHANEL
CUP NOODLES
"TOO DARN HOT"
Tom Sachs
S/N: 2021.192.501


ROCKET FACTORY
ROCKET
Coca-Cola
NASA
SNICKERS

Scotch
WONDER
Marlboro
ATARI
WD-40
UNITED STATES POSTAL SERVICE
CUP NOODLES
TOMATO SOUP
SKIPPY
TROJAN
CHANEL
FACTORY

NFTs. It allows participants to assemble three Rocket Components into either a Perfect Rocket or Frankenrocket. Perfect Rockets are composed of matching and singularly branded Components; Frankenrockets are a discordant combination of different brands. Once a Rocket is assembled, a Completed Rocket NFT is minted, and the Component NFTs are burned, which Sachs calls "comburning." Rocket Factory also provides an option to launch a Complete Rocket. Here, a physical twin of the Complete Rocket NFT is created. The sculpture is launched and recovered, the matching NFT is updated with a video link and metadata documenting the launch, and the Physical Rocket is then shipped to the owner in a vitrine, donated to the Rocket Factory's Museum, or shredded. With the help of Lab advisor Anthony Sims, principal industrial designer at SpaceX, and LACMA's own Corporate Partnerships team, Sachs conceived a Frankenrocket for the museum featuring a Cup Noodles–branded tail (chosen by Sims), a Chanel body (LACMA), and a Trojan nose cone (Sachs). Tom Sachs Rocket Factory Launch #6: Los Angeles took place at the museum on November 21, 2021.

Artist's Reflections

Even though I am a plywood prosthelytizer, I use computers every day. The studio has been making movies for twenty years and that's digital art, it only exists on the screen, but has the same values as anything we make in plywood. A real artist isn't afraid to use technology. Technology is how I connect with a larger community, and expand on the values of my work and my studio. Half the job is making the sculpture, and the other half is communicating the ideas.

The blockchain is about transparency. In my sculpture you can see the pencil marks and the glue drips. The wood is painted and then cut. It is evidence of how the thing was made and who made it. What excites me about NFTs is that the rules, the boundaries, are transparent and concrete throughout the blockchain. No one person owns the information, and you can see the digital fingerprints of everyone that was there before you. That degree of transparency makes it democratic and decentralized. It allows for everyone to control it. It's utopic.

[Regarding LACMA's Frankenrocket,] I'm interested in the comparison between Apollo and Dionysus as the two extremes in our world, my identity, and my work. The Trojan nose cone in a way represents the two sides: Responsibly irresponsible. The 30 brands we chose for the Rocket Factory are all deliberate. Brands form our sense of tribal belonging. We picked our 30 Rocket brands because of some attachment I have or because I identify with them on some level. The story of LACMA's Frankenrocket shows the power of one of the Rocket Factory's most unique aspects. We allow people to create these stories themselves. We just provide the framework, but it's up to you to decide what Rockets get made. The community decides, out of over 113,500 potential combinations, which 1,000 Rockets the world needs.

We see the potential for NFTs to reshape the way art is produced and distributed. The Rocket Factory, and all of the NFTs it generates, are artworks. These artworks draw on the foundation of sculpture and painting I have made for over thirty years. I see no difference between this project and a Tom Sachs sculpture at a museum.

Read more from Tom Sachs's discussion of his practice at unframed.lacma.org/2021/11/09/nfts-and-museum-tom-sachs-rocket-launch.

Matthew Angelo Harrison

Awarded: Year 7
Project Dates: 2020–21

Detroit-based artist Matthew Angelo Harrison is best known for the sculptures he produces using customized 3D printers and CNC routers that he builds himself. He previously worked as a clay modeler for Ford Motor Company, where he built prototypes and learned the design and manufacturing techniques he employs in his art practice. In his *Dark Silhouette* series (begun 2017) he suspends in polyurethane resin blocks African artifacts like wooden masks and figures—some authentic, some fake—that he has acquired. He also encapsulates ephemera from the automotive industry and its labor-organizing movement, such as UAW strike signs, helmets, and protective gear (including gloves that his mother used when working on the General Motors production line). In some of these works, he uses a CNC router to carve cuts and forms evoking industrial parts (in the African artifact sculptures) and African artifacts (in the automotive industry ephemera ones). To create the sculptures in his *Dark Povera* series (also begun 2017), he digitally scans African artifacts and creates low-resolution ceramic clay replicas using a 3D printer. As he wrote in 2019, "I think there is great potential in mixing 3D prototyping with constructions, deconstructions, and redefinitions—to treat things that are thought of as concrete as clay-like, malleable substances."

For his Art + Technology project *The Consequence of Platforms*, Harrison proposed to explore these techniques further. Initially, he sought to collaborate

Matthew Angelo Harrison in his studio


RUPES

with scientists on materials that could be reconstituted for 3D printing. He envisioned developing a machine capable of building, destroying, and restoring objects, architectural forms, or environments—re-creating structural environments as far-ranging as the deserts of Mali and the Packard automotive plant in Detroit. This self-replicating system would juxtapose localities not typically seen side by side. As he explained, "I'm curious about what this grouping of places would say about [the African] diaspora and the contemporary experience of displaced peoples today."

The project evolved as Harrison began exploring automated fabrication processes in his own studio to produce works for his solo exhibition *Proto: Matthew Angelo Harrison*, held at the Kunsthalle Basel from June 3 to September 25, 2021, which was followed by the exhibition *Matthew Angelo Harrison: Robota*, presented at the MIT List Visual Arts Center from March 25 to July 24, 2022. The centerpiece of *Proto* was a 3D printer he built—a work of art in its own right. The sculptures in the show included works from his *Dark Silhouette* and *Dark Povera* series. In an interview he gave in connection with the exhibition, he stated that he approaches his art like a scientist "to implicate something greater about the world at large, about the systems…that…affect my life and everyone else's life, the universal elements of what makes up our society." He is particularly interested in the dehumanizing impact of systems like colonialism and capitalism on communities and peoples, particularly Afro-diasporic groups. For example, both the African artifacts and the automotive industry ephemera he uses have been severed—*distanced* is a word the artist sometimes employs—from their original religious, political, or economic contexts; captured and entombed; and in some cases coldly violated with precision cuts from a CNC router. Inviting viewers to examine their own stakes in the systems he critiques, Harrison states:

"This show is about you. It's not about me."

Harrison's investigations ultimately prompted him to reconsider how he might reconfigure labor in his studio through robotics and potentially achieve full automation. Framing this question is his acute awareness of the extent to which the concept of the robot, a machine developed to perform forced labor, is embedded within the histories of enslavement, colonization, and labor extraction and exploitation that he attempts to make visible in his work. "I want to be in control of the process and design components for all the newest materials and newest technologies," he has explained. "I'm interested in the premise of the artwork as well as the artwork itself." Looking ahead, he envisions performances with humanoid robots built on-site—self-powered and constructed from raw clay, fired clay components, and metal composite materials—that eventually will break down over time. Harrison once more: "I want to be an alchemist"—a philosopher scientist who transforms common materials into purified ones through seemingly magical processes.

Agnieszka Kurant

Awarded: Year 7 (2020–21)
Project Dates: 2020–22

Born in Poland, Agnieszka Kurant is a conceptual artist based in New York whose works are thought experiments that explore collective and nonhuman intelligences. Collective intelligence is a phenomenon by which complex systems—which can consist of organisms ranging from microbes to humans, as well as artificial intelligence (AI) agents—generate knowledge by self-organizing without specifically designated individual leaders.

In a 2020 interview published in *Tank Magazine*, Kurant described the origins of her interest in collective intelligence: "My point of departure was the exploration of complex collective forms of authorship, such as Wikipedia. Culture might be evolving in this direction. That brought me to explore collective intelligence, which is observed in bacteria, slime moulds, termites, social movements, the internet, cities, and inside our brains." She continued: "It consists of the unpredictable emergence of novel forms out of interactions between thousands of elements, particles or agents in a complex system. For example, forests form a so-called 'wood wide web'—a superorganism of networked trees connected by fungi. In our times of surveillance capitalism, it was humbling to discover these remaining uncomputables: phenomena so complex that they are impossible to predict precisely even with AI, from revolutions to stockmarket crashes to hurricanes."

top
Agnieszka Kurant, *Nonorganic Life 1*, 2023, crystals of metal salts (copper, cobalt, iron, nickel, manganese, chromium) on anodized aluminum plates, 63 × 43¼ in. Collaboration with Dr. Magdalena Osial, Institute of Fundamental Technological Research, Polish Academy of Sciences; Fabrication by Krzysztof Smaga

bottom
Agnieszka Kurant, installation view of *Chemical Garden* (2021–ongoing) in *Uncomputables*, Kunstverein Hannover, 2023. Collaboration with Dr. Magdalena Osial, Institute of Fundamental Technological Research, Polish Academy of Sciences

In her project *Artificial Society/Collective Tamagotchi* (begun 2020), Kurant set out to explore the phenomenon of collective intelligence by developing a group of shape-shifting sculptural organisms, algorithmically controlled by the collective intelligence of users around the world. Participants' data and live inputs would be harvested by AI neural networks to shape an evolving ecosystem—part natural, part artificial; biological, geological, and algorithmic. The centerpiece was originally conceived as a terrarium containing "planimals"—hybrid plant-animal forms whose shape, color, and behavior would continuously change based on decisions made by thousands of online participants. The term *tamagotchi* refers to a popular handheld digital pet, marketed by a Japanese company, contained in an egg-shaped casing to which Kurant compared her planimals; players can connect with other players, and their tamagotchi can grow, marry, and even have offspring. COVID-era restrictions, however, forced the artist to reimagine her project, leading to several separate but related works.

In *Adjacent Possible* (2021), Kurant collaborated with computational social scientist Justin Lane to apply artificial intelligence to an archive of thousands of iterations of thirty-two graphic signs dating from 40,000 to 14,000 BCE—the earliest known forms of symbolic communication, documented in Paleolithic European caves by paleontologist Genevieve von Petzinger. The algorithm generated new signs that might have emerged through collective subjectivity. Over the centuries some cave paintings had been colonized by bacteria and fungi, which gradually replaced the original pigments. Collaborating with synthetic biologists, Kurant used pigments produced by the bacteria, into which genes from corals and jellyfish, responsible for the production of natural pigments, were inserted to create new ones.

Kurant's 2021–22 installation *Chemical Garden* explored the unstable forms produced when organic and inorganic substances combine. Inspired by chemical gardens—structures formed by mixing water glass (a compound containing sodium oxide and silica that forms a glassy solid soluble in water) with metal salts—she created plant-like crystalline structures using salts of metals common to computer hardware, including copper, cobalt, manganese, chromium, and iron. The industrial extraction of these elements contributes to the devastation of entire ecosystems. Strikingly, chemical gardens in deep-sea hydrothermal vents are a plausible path for the origins of life on earth, and some of the earliest fossil evidence may be remnants of such formations.

In *ERRORISM* (2021), Kurant trained AI on her past artworks and writings, then transformed the machine-generated descriptions into holographic animations. "Using the example of my own art," she reflected, "I analyze the role of error in the creative process and undermine the idea of creativity as an individual endeavor."

Finally, in *Semiotic Life* (2022), Kurant presented a seventy-four-year-old bonsai tree alongside its "optimized" counterpart: a 3D-printed resin sculpture created through algorithmic prediction of the tree's idealized future form. While the living tree will continue to grow and change, the model will stay the same, but our experience of it will be affected by the changing nature of the real tree. *Agnieszka Kurant Collective Intelligence* (2025), edited by Stefanie Hessler, Jenny Jaskey, and Kurant, is a major monograph documenting the artist's work of the previous ten years.

Kyle McDonald
Dr. Marianne George
Members of the Holau Vaka Taumako Association

Awarded: Year 7 (2020–21)
Project Dates: 2020–ongoing

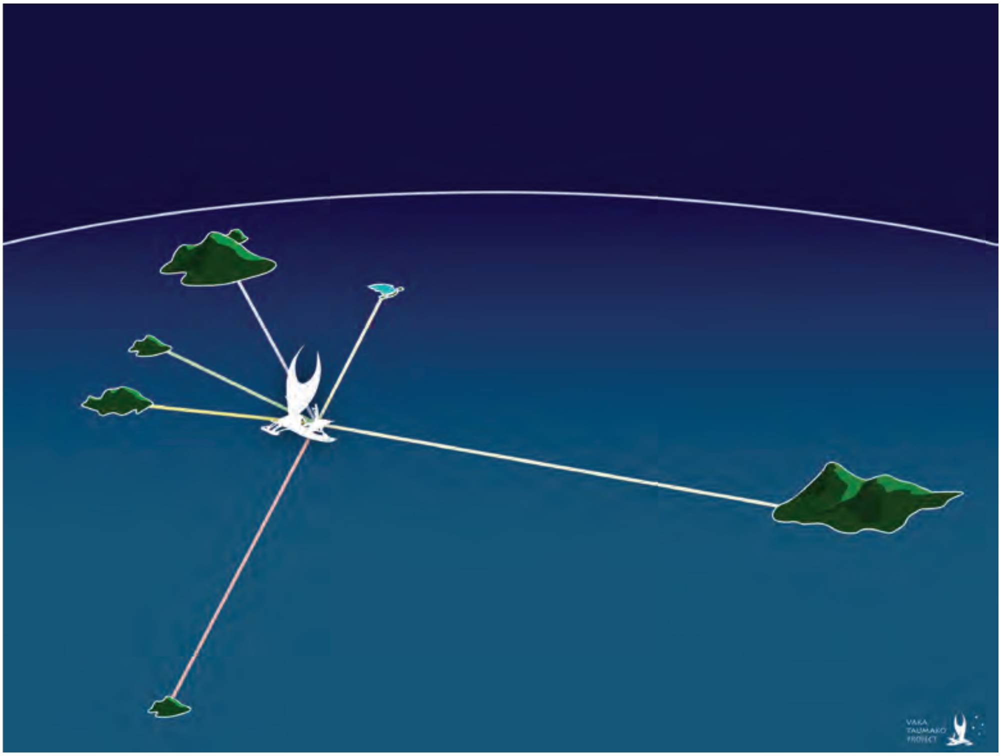
With their project *Te Lapa: Polynesian Navigation Illuminated*, Kyle McDonald, Dr. Marianne George, and members of the Holau Vaka Taumako Association are documenting ancient navigation techniques with new technologies. Of particular interest is *te lapa*, a faint burst of light that reportedly emanates from land and has been used by many Polynesians and other Pacific peoples for centuries but never visually recorded. Te lapa is said to travel in a straight line away from islands and reefs over the surface of the water. Its appearance varies based on location, origin, and other possible factors such as swell patterns. According to various accounts, the light, though fainter than bioluminescence, is visible anywhere from 20 to 120 miles away from land and appears in intervals of ten to fifteen minutes.

Dr. George has a long connection to the effort. More than thirty years ago the late Paramount Chief of Taumako in the Solomon Islands, Koloso Kaveia, initiated the Vaka Taumako project to teach ancient voyaging knowledge to his grandchildren. He enlisted Dr. George to help document ancient navigation methods for future generations. McDonald was drawn to the project through his encounter with her writings.

COVID-19 restrictions and equipment failures forced the team to postpone their voyage on multiple occasions. McDonald used the extra time to modify the

top
Indigenous sailors in a *drua*

bottom
Diagram of a *tepuke* (voyaging canoe), with lines of different colors connecting to islands and reefs in the middle of Temotu Province, Solomon Islands


VAKA
TAUMAKO
PROJECT

commercial camera equipment he had acquired so that it could capture extremely low light and record for hours without recharging. In preparation for sailing for a few nights with experts from Taumako, he pushed the cameras' low-light capabilities to their limits. The first test was off the Venice Beach breakwater, in Los Angeles, where he captured the glint of Jupiter reflected in the ocean.

In April 2023, the team attempted a voyage in the *S. V. Lata*, a traditional, twin-hulled Indigenous sailing vessel known as a *drua* that can sail either backward or forward. They modified the boat for a long-distance, open-sea voyage from Hawai'i to Taumako, some three thousand nautical miles away. The goal was to document te lapa during the trip, record interviews in Taumako, and deliver equipment to colleagues on the island. But they had to cancel the trip due to design flaws in the vessel. After additional attempts, they completed the two-month voyage in a modern boat. McDonald and George believe that they spotted te lapa on one or two occasions but have not yet succeeded in capturing it on video.

Artist's Reflections (Kyle McDonald)

When Indigenous voyagers first settled the Pacific thousands of years ago, their deep environmental knowledge guided their complex navigation techniques and boat building traditions. Today, that knowledge has reached a bottleneck due to the impact of colonialism. But on the island of Taumako, in the remote Temotu province of Solomon Islands, the knowledge is alive.

I mostly create interactive installations with a research-based practice that focuses on new technologies. After a long hiatus I started sailing again around 2018. I wanted to learn everything I could, and that led me to the navigators of Taumako. I learned about their traditions from a paper by Dr. Marianne "Mimi"

George, a cultural anthropologist.

In Mimi's writing, she describes te lapa, a brief flash of light that travels in a straight line from distant islands to the navigator, on the surface of the water. People who use te lapa explained that ancestors send the light. It takes less than a second to travel from the horizon to the viewer, and you might see it a handful of times any given night. If you know how to look for it, ancestors will guide you to your destination.

When I heard about te lapa, I felt an epistemic tear open in my reality. I reached out to Mimi to see if there was some way I could help. She introduced me to her collaborators from Taumako. We started conspiring to build a special imaging system that might be able to capture this extremely low-light phenomenon.

Five years later, this work has blossomed into hundreds of discussions between myself, Mimi, and many collaborators across the Pacific—primarily Luke Vaikawi, director of the voyaging organization Holau Vaka Taumako Association. We built a special low-light camera system, one of the most sensitive on the planet, and have spent many nights miles offshore watching the ocean and sharing stories.

Our collaboration exists at a meeting point between computational technologies and Indigenous technologies. It pushes the envelope of what is technically possible while also pushing an epistemological envelope, asking what we can know and how we know it, somewhere between the technological and the spiritual, the phenomenological and the ancestral.

Read more about Kyle McDonald's investigations into te lapa and the relationship of technology and culture at www.lacma.org/art/lab.

Virginia San Fratello
Ronald Rael

Awarded: Year 7 (2020–21)
Project Dates: 2020–25

Virginia San Fratello and Ronald Rael, principals of the Oakland-based design studio Rael San Fratello, had initially hoped to work in Los Angeles and examine the city's past in relation to its historic adobe building stock—above all, the Pueblo de Los Angeles, historic home to the Chumash and Tongva peoples. The COVID-19 pandemic, however, forced them to pursue their work remotely. With *Mud Frontiers/Zoquetes Fronterizos*, they combined Indigenous adobe-based building materials with twenty-first-century robotics to construct a case study residence in the San Luis Valley in southern Colorado: *Casa Covida*, a house for cohabitation in the time of COVID.

Casa Covida has three adjacent rooms: an entry with bench and hearth, a room for bathing with a sunken tub, and a room for sleeping with an adobe bed. The artists used a special 3D-printing system to build inner and outer walls, both sine waves that touch each other, to allow for a small cantilever to occur in the interior and create a dome shape. An oculus defines the final frustrum (partial cone) form of each room.

The house has a *shou sugi ban* door—a traditional Japanese method for charring wood to make it more durable—fabricated using beetle kill pine, a term used to describe pine trees killed by the mountain pine beetle, from the nearby forests of the San Juan Mountains, and custom door hardware made from 3D-printed bioplastic parts cast in an adobe mold. The plastic was

Exterior and interior of "Hearth," from *Mud Frontiers*, 2019, 3D-printed hearth with cedar, embedded for structural stability of adobe walls

burned out in a kiln, and aluminum was poured in, similar to the lost-wax method for casting bronze. The artists have remarked: "Our work with 3D printing takes on the material culture of the region, micaceous pottery and adobe are reimagined through contemporary technology, building upon ancestral traditions in new ways, creating a hybrid form of craft that is essential to what defines the borderlands—a landscape of hybrid conditions where languages, foods, beliefs, and knowledge from different sources and different times come together."

Artists' Reflections

Casa Covida, a house for cohabitation in the time of COVID, is an experiment in combining 3D printing with Indigenous and traditional building materials. The experimental case study house explores new and ancient ways of living and is sited in the high alpine desert of Colorado's historic San Luis Valley, where adobe, a combination of sand, silt, clay, water, and straw that is dried in the sun, is the traditional building material of the region. The house is comprised of three spaces, each for two people to sleep, to bathe, and to gather around fire and food, and the spaces have openings to the sky, the horizon, and the ground. The central space contains a hearth surrounded by two *tarima*, or earthen benches, covered with woven textiles. 3D-printed cookware crafted using regional micaceous clay reminiscent of traditional New Mexico Pueblo pottery, can withstand the heat shock of the hearth, and is used to cook locally grown beans, corn, and chiles.

The sleeping space is built of a platform constructed of locally harvested beetle kill pine covered with sheep skins and woven churro wool blankets and cushions designed in collaboration with a local weaver. Views to the landscape and the sky are framed by the adobe oculus. The bathing space is filled with ancient waters

Fabrication setup for 3D printing with earth from the deep aquifer below this mountain desert landscape and the retention of heat is provided by the ground. Tumbled river stones surround the bath, and bathers can lie back and enjoy a view of the sky.

The printer can be easily carried by two people and can be operated entirely by as few as one person using a cell phone that controls the printer. Mixing and sifting the earth mixture is done manually but assisted by a mortar mixer. The design files are created by a robust software application that grows from Potterware, a ceramic 3D-printing software developed by Emerging Objects, which was a by-product of the architectural aspirations for printing with clay.

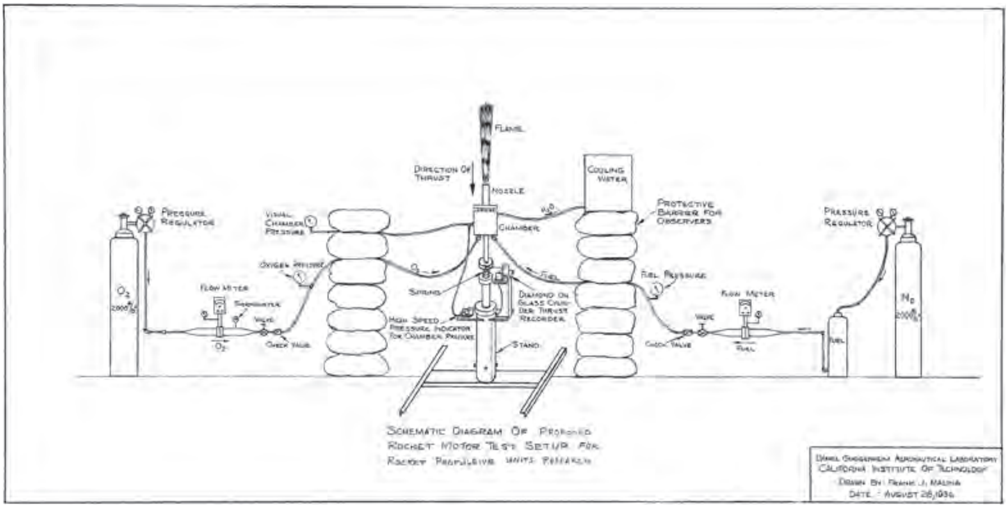
Read more about the printing and building methods that went into *Casa Covida* at www.lacma.org/art/lab.

American Artist

Awarded: Year 8 (2021–22)
Project Dates: 2021–25
Key Partners: Ayana Jamieson, Adam Kleinman, and Chester Toye, along with Reaction Research Society

Inspired by Octavia E. Butler's 1993 novel, *Parable of the Sower*—set in the then-distant year of 2024—American Artist developed a project titled *The Monophobic Response* (2021–25). This title was inspired by the title of an essay that Butler, a renowned writer of science fiction and speculative fiction, published in the groundbreaking anthology *Dark Matter: A Century of Speculative Fiction from the African Diaspora* (2000). The project, which included a performance and a two-channel film and sculptural installation, reimagines a pivotal 1936 rocket engine test that presaged the United States' foray into spaceflight. The original test, conducted by students at Caltech's Guggenheim Aeronautical Laboratory, saw the so-called Suicide Squad venture into the Arroyo Seco, a dry canyon wash in Pasadena, in October 1936 to test their newly designed rocket engine. Seven years later, many of those same men would be instrumental in founding the Jet Propulsion Laboratory, now part of NASA but administered by Caltech.

On June 8, 2024, American Artist organized a filming session in the Mojave Desert, and the next day a performance centered on the firing of a rocket, with the assistance of the Reaction Research Society, a group of amateur rocketeers established in 1943, took place. This performance, a reimagining of the 1936 test, featured a detailed replica of the original engine; the Suicide Squad was replaced by performers representing adherents of Earthseed, a belief system described



top
American Artist, still from *The Monophobic Response*, 2024

bottom
Frank Malina, schematic diagram of proposed rocket motor test setup, 1936

in Butler's *Parable* series, whose central tenet is "God is Change." Amid her imagined dystopia, members of the Earthseed community aspire to reach the stars. Ayana Jamieson, a foremost scholar of Butler's life and work, was one of the key collaborators in the project. She has eloquently described the performance: "'We are all that we have. We are the only thing that we have to go forward with. We need each other. We need each other to go forward,' said a performer before our group convened in a circle of faith, dressed in layers of sepia, light umbers, and sandy pastels; a multigenerational and multiethnic band of community members. The desert breezes felt like the landscape was breathing. Flames ignited toward the sky in a loud invigorating blaze."

Like Butler, American Artist grew up in the neighboring communities of Altadena and Pasadena, and they even attended the same high school. One of the artist's goals for the project was to examine the writer's "experience as a young Black girl growing up in Altadena, at a time when rocket science was emerging as a field and the space and tech industries in Southern California were beginning to take shape. What seepages, contaminations, and spurs of thought resonated between Butler and her surroundings at such a formative age?"

In drawing parallels between Butler's fictive 2024 U.S. presidential race and the actual election that was unfolding, American Artist's project explored strategies for survival in a bleak world. It culminated in an installation that opened at LACMA as part of the Getty's PST ART: *Art & Science Collide* initiative on November 1, 2024, just days before the election. This presentation featured artifacts from the rocket test, including a faithful replica of the 1936 rocket engine, a two-channel film, and related objects and documentation.

The Monophobic Response is part of *Shaper of God*, a multiyear cycle of ongoing work that launched in 2021 with an online "research machine" linking Butler's themes with contemporary events. This led to the exhibition *Shaper of God*, held at REDCAT in Los Angeles from May 28 to October 2, 2022, which featured newly commissioned work in video, installation, sculpture, and drawing that engaged with Butler's fiction and biography, as well as the experiences of African diasporic communities in Los Angeles. Another iteration, which culminated the project, was presented

American Artist, still from *The Monophobic Response*, 2024

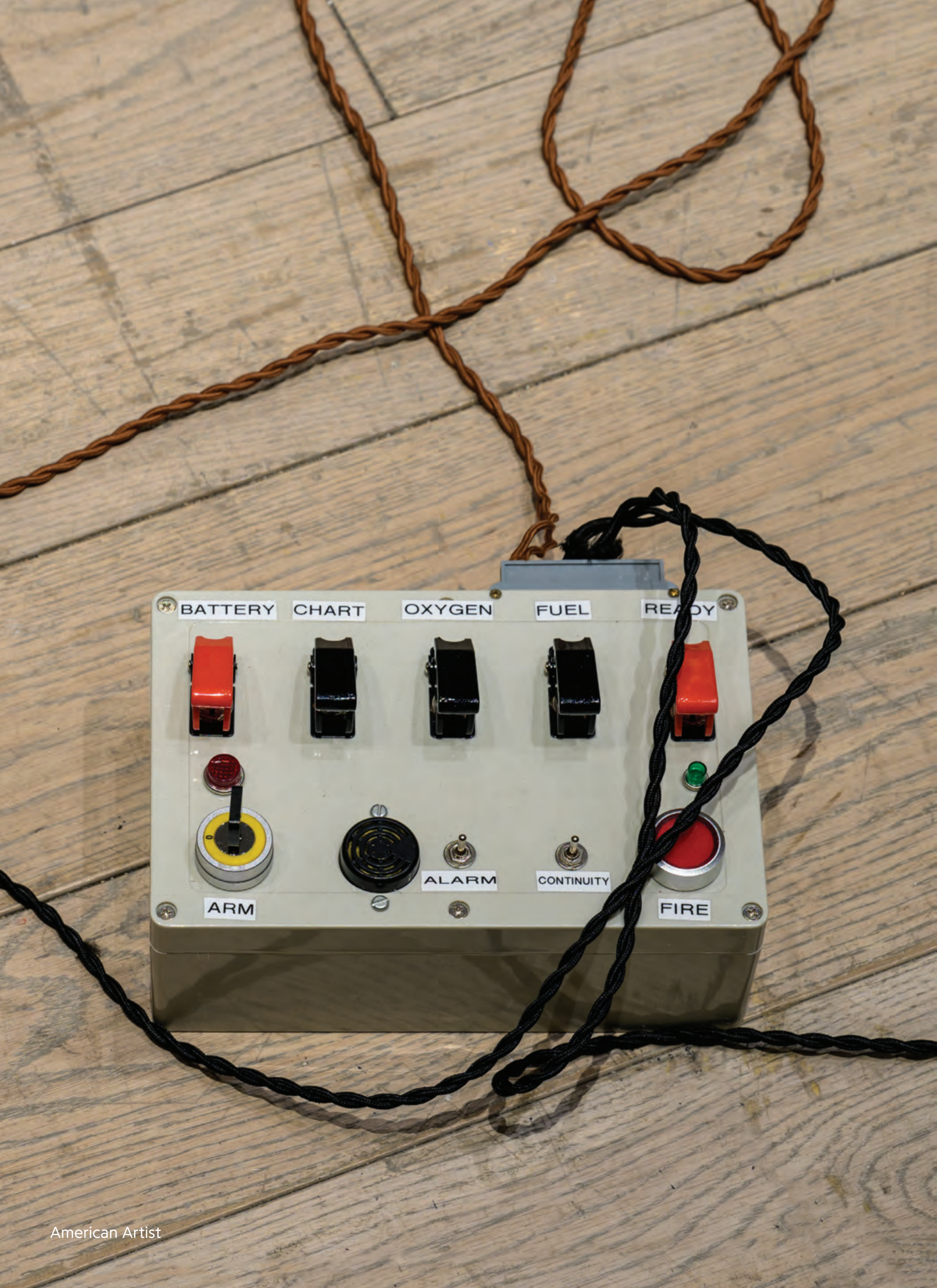
pp. 194–97
Installation views of *The Monophobic Response*, Los Angeles County Museum of Art, 2024

at Pioneer Works in Red Hook, Brooklyn, from January 24 to April 13, 2025. "We are living in the reality Butler warned us about," American Artist has said. "This project is a case study of how to respect history without reproducing it."

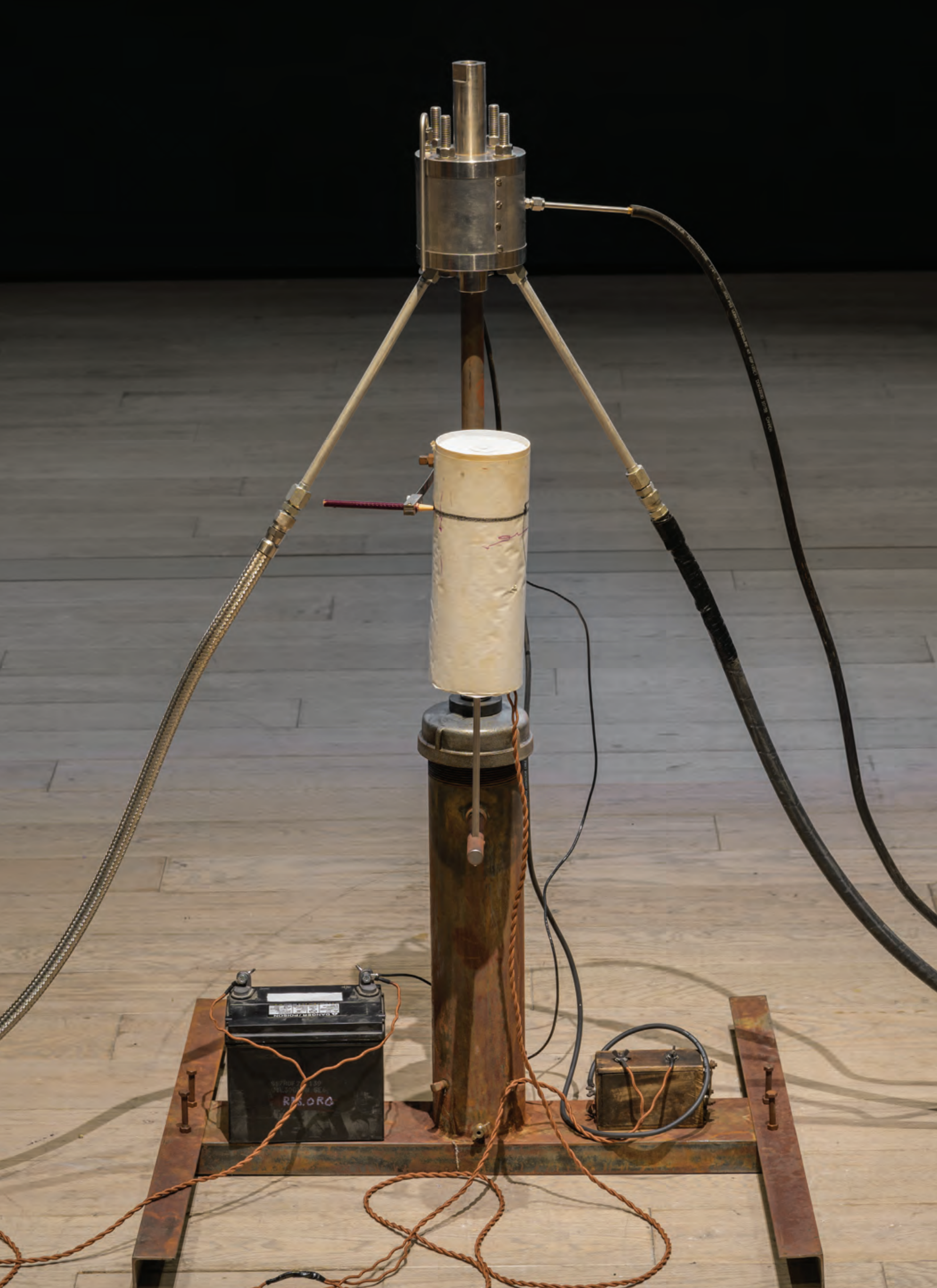
Artist's Reflections

The Art + Technology Lab allowed me to work with real rocket engineers. The art world can be incredibly insular, but this project has expanded my community to include scholars, performers, engineers, and more artists. I appreciate Joel Ferree's tireless support and agility in navigating every institutional hurdle under the sun. Together we've been able to honor the work of Octavia E. Butler, and help build a bridge between her work and the work of rocket scientists in the past and present.

American Artist



American Artist



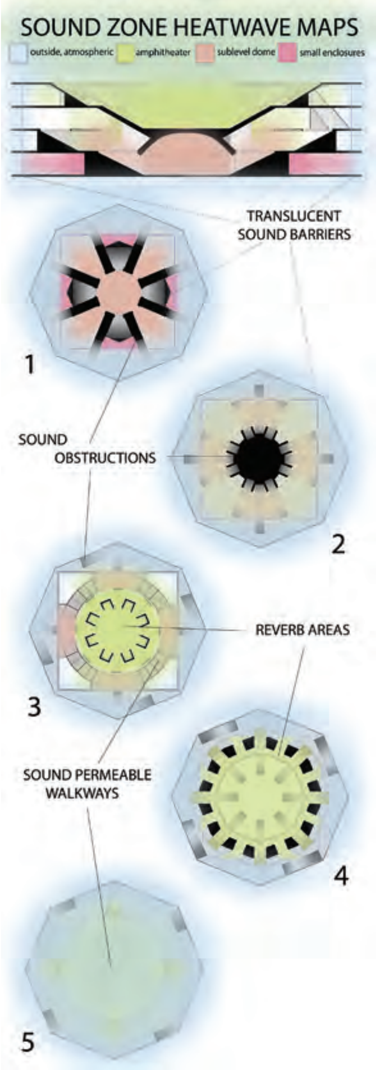
Jaqueline Kiyomi Gork
Rhett LaRue

Awarded: 8 (2021–22)
Project Dates: 2021–ongoing

Jacqueline Kiyomi Gork investigates the relationships between sound, sculpture, installation, and performance. At the San Francisco Art Institute she studied sound art and other mediums, and at Stanford University she researched the history of communication technologies, acoustics and computer music. Many of her works invite beholders to become more acutely aware of how built environments shape the perception of sound. Rhett LaRue is a multimedia artist who creates video games, 3D animations, and designs for sets, exhibitions, and other projects; he has collaborated extensively with other artists, including Ryan Trecartin and Lizzie Fitch.

With support from the Art + Technology Lab, Gork and Rhett LaRue formed a collaboration to develop *Inhabit360*, a multiplayer game that uses sound rather than vision as its primary means of navigation and interaction—or, in their words, “to have the players rely on their ears more than their eyes.” Unlike most games today, *Inhabit360* emphasizes cooperation rather than competition as players negotiate the digital terrain. In addition to recording and mixing sounds that will help guide players, the artists tested surface textures and materials that will accentuate the aural rather than visual dimension of the space.

Gork has noted that the spatial framework of the game is evolving in response to a broader cultural shift—one marked not by a post-COVID recovery, but by intensified political aggression and a pervasive



Proposed sound map for *Inhabit360*, 2026

sense of anxiety. This condition has generated a renewed desire for more intimate modes of spatial experience. In response, the project proposes a transition from an arena-like architecture to a more club-oriented configuration. In Los Angeles, BIPOC queer experimental dance communities face limited access to clubs, which in the post-pandemic landscape have become increasingly cost-prohibitive, often forcing gatherings into warehouse spaces with inadequate sound and acoustics. This project creates an opportunity to imagine a speculative club utopia—one that rethinks the social, acoustic, and affective potential of collective space in the present moment.

Lawrence Lek

Awarded: Year 8 (2021–22)
Project Dates: 2021–ongoing
Key Partner: 18th Street Arts Center

With *Death Drive*, the London-based artist, filmmaker, and musician Lawrence Lek uses video game technology to create an interactive road movie that explores non-Western perspectives on technology and the idea of empathy for a nonhuman Other. At the story's center is a rebellious autonomous vehicle named Theta, who inhabits a virtual world where digital surveillance and artificial intelligence have redefined the sociopolitical landscape. Set on the border between China and Russia in the year 2030, the narrative follows an AI psychologist investigating the death of a border guard—for which Theta stands trial. The story moves fluidly through time, blending forensic investigation with memories and flashbacks. In probing the unforeseen psychological costs of training AI, *Death Drive* poses the question: What if intelligent machines not only think but also feel?

While *Death Drive* explores the evolving relationship between humans and AI, it also serves as an allegory for the conflicts between regimes of surveillance and control, and the subjects who question or resist the conditions of their existence. With support from the Art + Technology Lab, Lek used Unreal Engine, a real-time 3D creation tool developed by Epic Games, to produce a short film, *Theta* (2023), as a proof of concept that distills the key aspects of his larger Sinofuturist project. The synopsis for the film states: "Set in an abandoned smart city, SimBeijing, the film follows a driverless patrol car conversing with its own cloud

Lawrence Lek, *Death Drive*, 2021



consciousness as it attempts to understand the source of its dissatisfaction and sadness as it careens around a ghost town that, despite being abandoned, is still under constant surveillance." *Theta* is also being adapted into a live performance, in which Lek "plays" the game by navigating through the virtual world to a digital venue where a segment of the film is screened.

Artist's Reflections

I'd been developing *Death Drive* for about a year before the 2021 Art + Technology sessions, but had to wait until 2023 to spend the summer out in Santa Monica, where Joel Ferree had arranged a residency (an actual *live-in* residency). It was the California dream, except I don't really drive. I took the Metro and the bus all the time, heading into Mid-City and Koreatown. It's a cliché, but there's a huge gap between the illusion of what you think Los Angeles is and the actual urban fabric. Underneath bridges, in-between cracks in the pavement, walking forty-five minutes to the grocery store over cycle ways that I never really saw anyone cycle down. It's a surreal stage set, with beautiful lighting.

Art + Technology keeps evolving, so what seemed cutting-edge and relevant at the outset of the project kept getting sidetracked with new ideas. Especially since the initial project premise of a sentient self-driving car taking revenge on its creator seemed to be getting closer to everyday reality on the L.A. streets. At first, I stopped to take videos of the cute meal delivery bots, then everyone encouraged me to take a fully automated Waymo (confession: I still haven't).

One highlight—of many—was the 18th Street Arts Center community in Santa Monica: they wisely advised me to take a surfing lesson. At the time of writing this, I'm only one lesson deep into my wave riding career, and, like any self-respecting moviemaker in Los Angeles, I am still pitching *Death Drive* to an endless series of roundtable juries, industry panels, and enthusiastic producers who never seem to call me back. Whenever I feel discouraged about the state of time-based media art, I hear the words of a Belgian friend: "Just don't, whatever you do, start painting." I won't, at least until I finish *Death Drive*.

Lawrence Lek, *Death Drive*, 2021

MUXX

Awarded: Year 8 (2021–22)
Project Dates: 2021–22
Key Partners: L.A. Dance Project; Fulcrum Arts

Founded in 2020, MUXX Project is a collective that includes Lukas Avendaño, the composer EYIBRA (formerly known as Abraham Brody), the digital artist Oswaldo Erréve, and the sound artist NNUX (Ana López-Reyes). With support from the Art + Technology Lab, this collective created *BIGUIDIRIBELA*, a performance that employed 3D video technologies alongside live dance, music, and immersive set design to explore a variety of themes, including the multiplicity of gender identities in a futurist context. Indeed, Avendaño has stated that one of the collective's goals is "to challenge the idea that Indigenous art must necessarily be deprived of…these technologies." The work was presented at L.A. Dance Project on September 16 and 17, 2022, as part of the Fulcrum Festival. The ensemble was responsible for every aspect of the production: costumes and scenography, choreography, music and sound design, and video.

Avendaño is a *muxe* performance artist, choreographer, and anthropologist whose family is from the Isthmus of Tehuantepec in southeastern Oaxaca. Among the Binni Zaa (Cloud People), the Zapotec community of which the artist is a part, the term *muxe* identifies persons of a nonbinary gender encompassing multiple understandings of masculinity and femininity. Avendaño describes *muxeidad* as "a way of life circumscribed to a geographic region on the Isthmus of Tehuantepec" involving "people who are born with a 'penis and testicles,' and who live their everyday lives enacting cultural roles considered

BIGUIDIRIBELA at L.A. Dance Project, 2022



‘non-masculine roles, functions, aesthetics, and preferences.’” It is “a poetics of life and a less orthodox subjectivity that acknowledges and experiences bodies at variance from the scrupulous gaze of heteronormativity.”

The collective developed *BIGUIDIRIBELA* through earlier works: *Bardaje*, presented in February 2022 at Laboratorio ArteAlameda in Mexico City, and *MUXX*, created that spring. *BIGUIDIRIBELA*—a Didxazaa (Zapotec) term referring to the god of bats and meaning “butterfly of flesh”—evolved from these experiments with 3D video, music, and performance.

BIGUIDIRIBELA was performed on an elevated platform bisected by a translucent scrim on which 3D video was projected. Audience members moved around the platform as the performers enacted a spiritual journey from the precolonial past to a potentially utopian future beyond binary understandings of gender. At the beginning of the performance, Avendaño emerged from earth, dressed in a costume of leafed branches, while EYIBRA and NNUX pushed their hands out from a tarp covering them. Avendaño then moved across the platform, exited the space, and finally returned wearing a costume of rattles; after removing this costume, the artist was reburied in the earth by EYIBRA and NNUX. This narrative arc—life and death as a fluid continuum—held particular poignancy: Avendaño’s brother disappeared in Mexico on May 10, 2018, and was found in an unmarked grave a few years later. In a review by the critic Steven Vargas for the *Los Angeles Times*, the artist noted: “Every time we run through the piece, I feel like we’re doing a healing ritual.”

As Vargas observed, EYIBRA and NNUX created a soundscape drawing from polyphonic ritual songs and contemporary experimental music, incorporating stacked hums and vocals over electronic music and, at times, EYIBRA on violin. Erréve’s 3D video projec-


tions immersed performers and audience in a hauntingly beautiful imaginative space: "The vision I want to forward in this project
is that of genderless digital entities, or otherworldly supernatural avatars, which allow for the total transformation of human and spiritual presence as they coexist in a series of metadigital ecosystems that give life to science fiction flora and fauna as well as ancient symbols." NNUX described the digital world of the production "as an imagined future where colonization didn't happen."

Unless otherwise noted, quotations from the artists are from María Regina Firmino-Castillo's article "Tracing the Ouroboros' Tail: Paradoxical Politics Against Necropolitical Binaries in Lukas Avendaño and Muxx Project's Theory and Practice" (2025).

Artists' Reflections

As artists who work primarily with performance and emerging technologies, receiving the Art + Technology Lab Grant was a pivotal moment in our careers.
The support allowed us to realize new work on a large scale, giving us a springboard to reach new audiences, places, and connections. This type of generous support is rare, and especially for artists whose work is risk taking and experimental. We hope the Lab only keeps growing and reaching more artists and audiences.

left
MUXX, featuring Lukas Avendaño, 2022

right
MUXX, featuring Lukas Avendaño, *GAN Training*, 2022

Kelly Akashi

Awarded: Year 9 (2022–23)
Project Dates: 2022–ongoing
Key Partner: SCI-Arc

In contrast to digital photography, analog combines the medium's link to time with the materiality of the photographic image. The Los Angeles–based artist Kelly Akashi has explained that her artistic practice emerged from an early interest in analog photography "that slowly expanded into indexical sculpture." She creates these sculptures by blowing glass, molding wax, and casting bronze, among other techniques. Making molds of her own hands and body, as well as of other living things, reminds her of the process of taking photographs and capturing moments in the flow of time. She has remarked that "as a sculptor trained in traditional analog photography, I have spent years speculating about the future of 3D imaging." Through her investigations of 3D digital imaging, Akashi has explored the materiality and temporality of the photographic image in new ways by bridging photography and sculpture.

For her project *Fissures*, Akashi proposed to use 3D imaging technologies such as micro-CT scanners and XFELs (X-ray free-electron lasers) to research new methods of creating "intricate metal sculptures that current 3D-print-to-lost-wax casting cannot achieve." Micro-CT scanners, for example, use X-rays to create detailed 3D models that can then be printed as physical objects. "These tools allow me to see beyond the human eye, isolate areas of rich information relaying organic growth, and represent that information on a larger-than-life scale that draws viewers into the

Kelly Akashi, *Reliquary (Devil's Claw)*, 2024–25, at Lisson Gallery, Los Angeles

pp. 210–11
Kelly Akashi, *Reliquary (Datura)*, 2024–25, at Lisson Gallery, Los Angeles

extraordinary phenomena held within the natural world."

Before developing *Fissures*, Akashi had experimented with some of these imaging technologies, borrowing fossils from extinct invertebrates at the Natural History Museum of Los Angeles County to create CT scans that led to resin prints, video animations, ortho-litho prints, and hollow-core lead-crystal casts. These works revealed evidence of the life of these extinct species and asked viewers to consider their own mortality and the limited lifespan of the human species as a whole.

In Fissures, Akashi extended these investigations to a molecular scale by scanning seeds using micro-CT. "I began looking at different kinds of seeds from trees, as…I find them full of symbolic meaning regarding growth, potential, protection, and legacy. I CT scan some and examine their internal, organically formed, and functional structures. I did this out of a desire to show other people the structural formation of these seeds in detail, as they marvelously reveal their engineering." She envisioned creating, among other works, a colossal bronze sculpture of a redwood tree seed, split in half, for a trail in Muir Woods National Monument that visitors could walk through. "As time passes, the trees will migrate to [more] hospitable climates, and eventually the bronze sculpture will stand alone. Once surrounded by its predecessors, the seed will be a marker of a time when it existed within a greater ecosystem that has since moved on."

However, Akashi's project took a new turn after the catastrophic Easton Fire, which began on January 7, 2025, and destroyed her home and studio in Altadena—including most of the works she had planned to include in a one-person exhibition scheduled to open at Lisson Gallery in Los Angeles on February 20. Through perseverance, she opened the exhibition on time. It included sculptures she created by enlarging CT scans of *Datura*, devil's claw, sweetgum, and other seedpods, 3D printing them, and then casting them in bronze. Symbols of the continuity of the life cycle, these works acquired new meaning after the fire. She also began scanning doilies from her grandmother, which had burned in the fire, and which she had intended to use in new sculptures. "My work's always been about impermanence. It's always been about inheritance, and it's always been about the natural world. And to me, while those themes didn't shift, it really gave everything a new meaning." Shortly after her exhibition opened, Akashi teamed up with a group of students from SCI-Arc to 3D laser scan details of her property.

Artist's Reflection

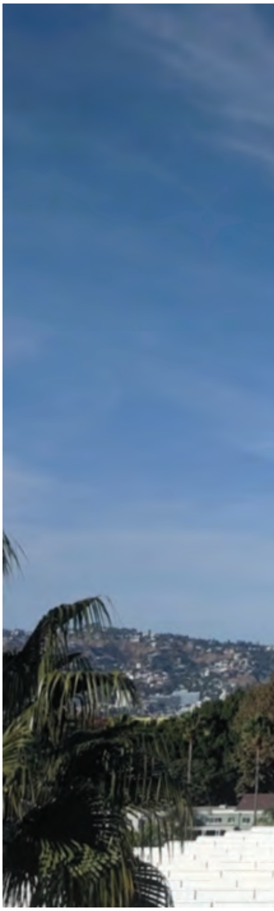
Art + Technology is a rare grant that fosters unique connections between artists and technology, while also allowing each artist the flexibility to shift their goals as their projects unfold. I initially proposed to integrate new imaging technologies into my sculpture production, developing methods for re-creating large-scale seeds. During this time, the Eaton Fire destroyed my home and studio. I knew I needed to build on my research to respond to the moment, and Art + Technology made it possible for me to quickly pivot, partnering with SCI-Arc to 3D scan elements of my property. Seeing Joel bicycle to my burn site to meet the SCI-Arc team and begin scanning my property offered a kind of support beyond what most grants can provide. That flexibility and care will have a lasting impact on my practice. This grant has brought new, unexpected tools for bridging photography and sculpture into my practice that I am continuing to explore.

Nancy Baker Cahill

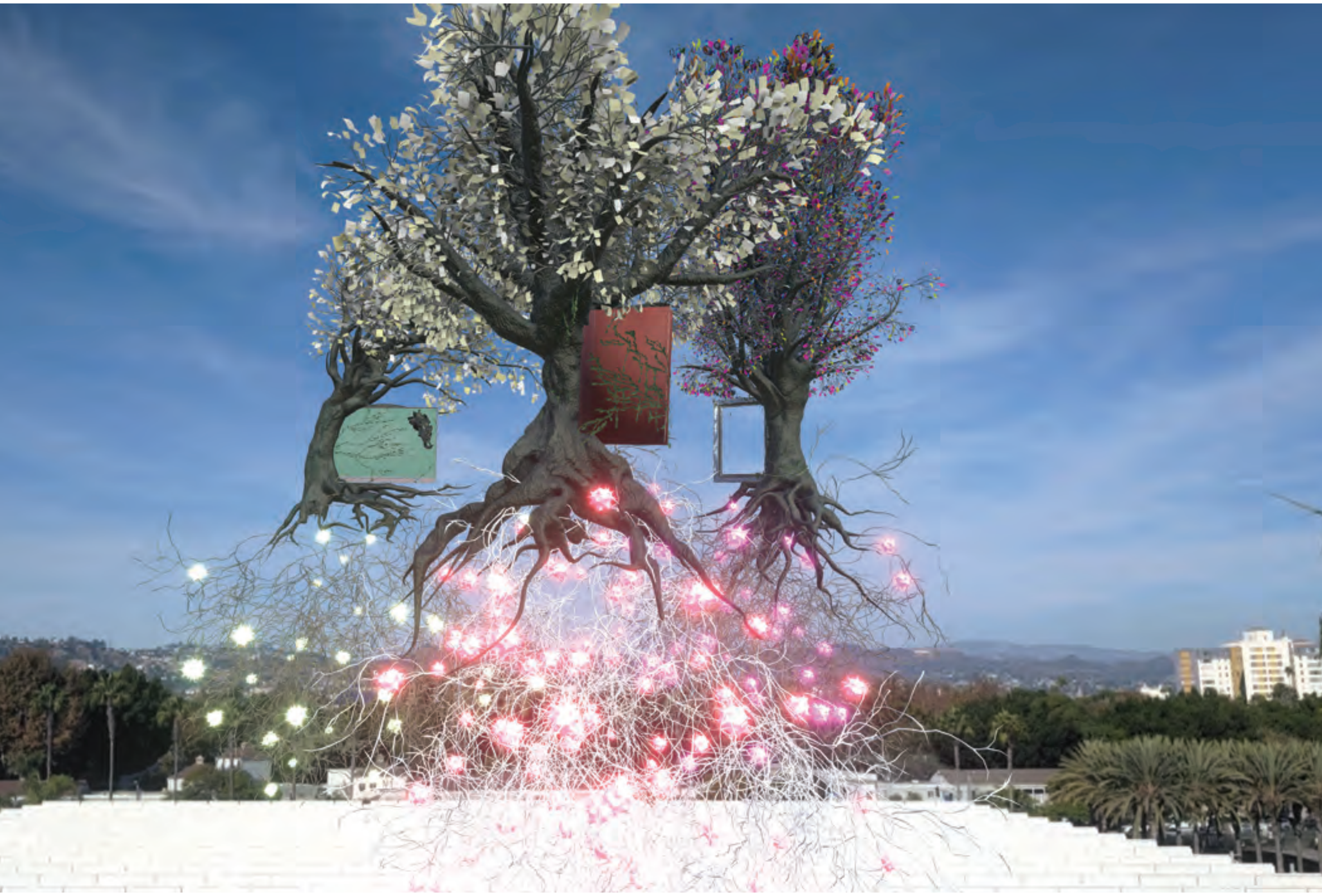
Awarded: Year 9 (2022–23)
Project Dates: 2022–25
Key Partners: Los Angeles Public Library;
Long Beach City College

Mycelial networks are vast subterranean webs of fungal threads that allow trees and plants to communicate and share nutrients in mutually beneficial ways. In *Substrate* (2022–25), Nancy Baker Cahill examined the distributive properties of mycelial networks and their potential parallels with emerging data-sharing technologies. "In the face of compounding, interconnected global crises," she has observed, "mycelial networks provide a model as decentralized, self-sustaining, reciprocal, efficient systems of community care and resource-sharing to the interdependent carbon-based life they support. Our shared social, economic, and environmental futures may depend on learning from this blueprint."

Some technologists have envisioned a new iteration of the internet called Web3, which which would shift power from corporations to individuals by integrating concepts like blockchain, decentralization, and privacy enhancement. Emerging technologies such as blockchain-based distributed ledgers and the digital landscapes and interoperability of a Web3 internet, along with decentralized autonomous organizations, may even offer new frameworks for redistributing and protecting cultural knowledge, thereby advancing the goal of generating more equitable civic futures. Baker Cahill, however, is more skeptical: "I found myself increasingly disappointed in narratives that extolled myths about empowerment, especially as Web3 fostered more one percenter–style accumula-



Nancy Baker Cahill, *Substrate*, 2025. Interactive augmented reality, commissioned by the Los Angeles County Museum of Art's Art + Technology Lab

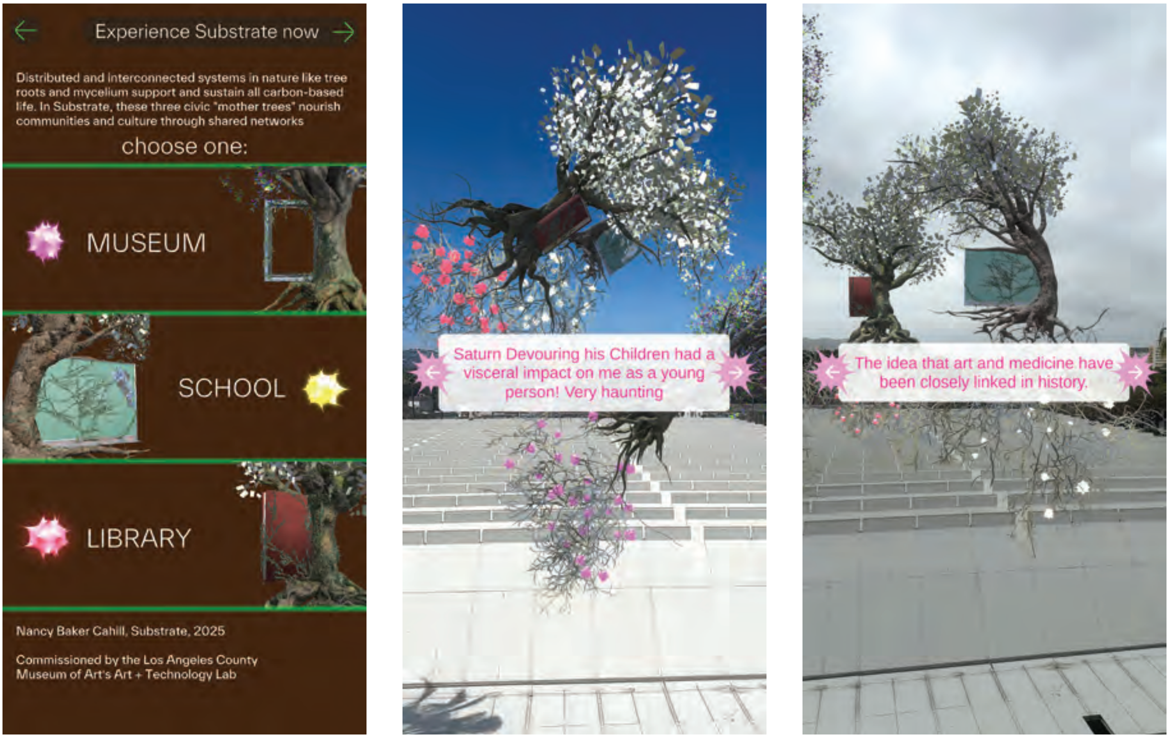


tion." She conceived *Substrate* to serve as a collaborative test case for connecting civic institutions, cultural resources, and data storage systems citywide, including the Los Angeles Public Library, LACMA, and Long Beach City College (LBCC). Using blockchain, it connected these resources as metaphoric "mother trees" with the potential to nourish communities through distributed networks of multistakeholder cultural initiatives. In the process, it imagined new ways to eliminate barriers to access, structure permissions, and produce and share knowledge.

Part one of *Substrate* was a community-determined exhibition titled *Universum*, which was presented on Central Library Video Wall, a 28-foot video screen located in the flagship branch of Los Angeles Public

Library, from June 27 to December 31, 2024. LBCC curatorial students researched the "nutrients"—that is, the metadata, histories, and properties—of cultural artifacts they valued from LACMA's collection. Then they selected from the collection works spanning the history of art that illustrated "the essential connectivity of human expression by touching upon themes of geometry, astronomy, and the collective unconscious." The exhibition was also minted, encrypted, and time-stamped on the blockchain so that it was shareable and adaptable through a vast network. The goal was to share, protect, honor and distribute the works presented through an innovative exhibition at the library, itself a vital hub for larger communities.

Part two of the project was a monumental interactive augmented-reality installation presented at LACMA from May 4 to August 24, 2025. On the third-floor balcony of LACMA's Broad Contemporary Art Museum (BCAM), a panel with instructions on how to view the work was mounted. Visitors could scan a QR code with their phone or tablet to access a website. Then they selected *Substrate* from the screen and chose a civic mother tree (museum, school, library) they wished to contribute to. If they picked museum, for example, they could share an artwork that had an impact on their life and add a comment explaining why. After submitting their response, they could scan an image on the panel to see the work, which appeared as three monumental trees floating in the sky over the museum's grounds, connected to each by the mycelial network intertwined with their root systems, visualized as brilliant point of light or "spores" in three different colors (one for each mother tree), which they could tap to see the responses submitted by other visitors. Through both of its parts, the project demonstrated the potential to form a substrate—an expanding, accessible foundation of experimental exhibitions as well as new (and, ideally, unexpected)



Screenshots of *Substrate*, 2025

forms of cultural engagement that could equitably and creatively sustain interested communities.

Artist's Reflections

Only the Art + Tech Lab, under Joel Ferree's leadership, would have embraced a systems project as complex and ambitious as *Substrate*, a two-part endeavor that spanned nearly three years. Establishing the collaboration between the three civic mother trees of a museum (LACMA), a public library (Los Angeles Public Library), and a community college (Long Beach Community College's fearless curatorial students) was an unequalled professional honor. Later translating this collaboration and inviting the public to contribute their own cultural nodes to the network in augmented reality (AR) allowed the original goals of the project to be realized in unforeseen, poetic ways.

Lauren Lee McCarthy

Awarded: Year 9 (2022–23)
Project Dates: 2022–25

On July 2, 2025, LACMA visitors were invited to go for a drive in Los Angeles–based artist Lauren Lee McCarthy's *Auto*. Gathering in groups of three or four in the museum's central plaza, participants were invited first to check in with an "AI assistant" that, in a delightful twist, was a very human actor who nonetheless captured the uncanny experience of interacting with a Turing machine running on floppy disks, complete with frustrating delays while she processed your responses to her questions. Visitors stated their destination and learned a simple tune. With the preliminaries out of the way, participants took the elevator down to the garage and the awaiting car.

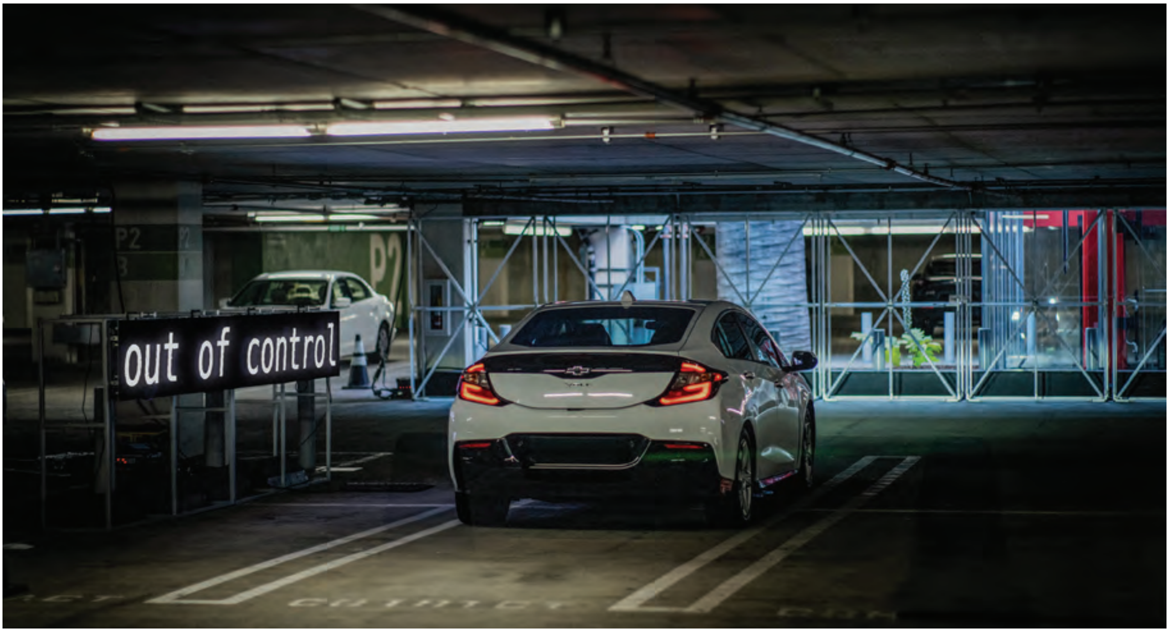
The parked car faced a sculpture of light tubes. Just outside the driver's door was a small LED panel. Over the course of the drive, the two banks of lights emitted words and symbols that guided participants on their trip while also guiding their behavior, prompting them to sing along to the tune learned a few minutes earlier, which was piped in through the car's speakers. The other notable sound was the nervous, anticipatory laughter of the passengers, unsure of what to expect or how to respond. "You're singing along," McCarthy has noted, "but you don't know where you're going."

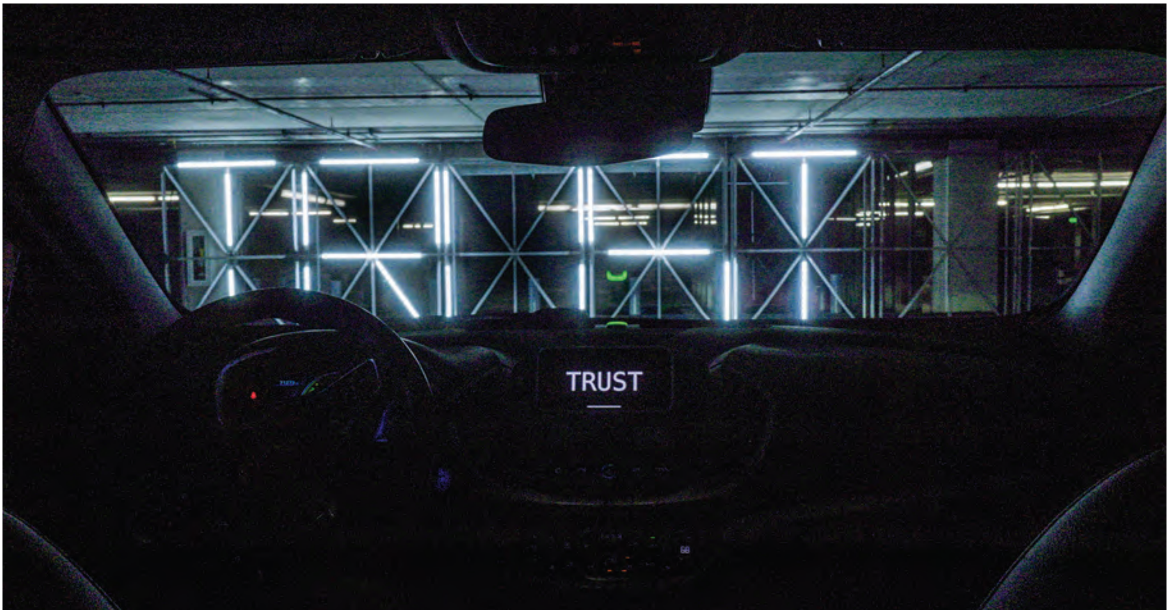
The experience was a bit discomfiting and deliberately ambiguous. Are we steering ourselves toward a future of sociability for which everyone is onboard, or are we barreling headlong into a world of command and control in which personal autonomy is sacrificed

top
Lauren Lee McCarthy & Casey Reas, *Auto Tune*, Los Angeles County Museum of Art, June 30–July 3, 2025

middle and bottom
Lauren Lee McCarthy, *Auto*, Los Angeles County Museum of Art, July 2, 2025


BE
AUTO


out of control


TRUST

for the greater good of the algorithms that will guide our every move? “How do we balance the ease and comfort offered by a driverless state,” McCarthy asks, “with the risks of surrendering our autonomy to machines?”

The presentation at LACMA was *Auto*’s maiden voyage and McCarthy’s proof of concept. A second, monthlong version took place a few month later in the Münsterhof, a large public square in the historic center of Zurich, Switzerland. Gone was the four-door sedan used at LACMA, replaced now by a minibus that could accommodate twice as many passengers. Passersby were welcome to join the ride, and many did. Enthusiastic about the response to the project, McCarthy is hopeful that the work will find further venues and, eventually, really hit the road.

Artist’s Reflections

Auto, my Art + Technology Lab project, involved developing a driverless vehicle. Passengers get in and are greeted by *Auto*—Where are we going? Utilizing roadside signage and sound via the car’s speakers, the ride unexpectedly becomes a sing-along. Passengers are prompted in singing the Auto anthem as they interact with each other, to become the engine of the ride.

Auto is freedom. *Auto* is ease. *Auto* is out of control. Throughout the ride, the singing passengers navigate the feeling of cruise control, hands off the wheel, moving at high speed toward the future with nobody in the driver’s seat.

The passengers, becoming part of a fully automated system, learn what they’re saying just as it is passes from their lips. Questioning their own autonomy, the line between system and human blurs and the riders become *Auto*. The performance becomes a vehicle for reflecting on our relationship with AI as impending crises loom.

Lauren Lee McCarthy

Lauren Lee McCarthy, *Auto*,
Los Angeles County Museum of Art,
July 2, 2025

I valued the Lab's support for artistic experimentation and risk-taking. This project developed over several years in collaboration with the public through a series of test rides. Passengers, unaware of their final destination, tested new features in a play between automation and control.

When the project reached the edge of the risks an institution could support, it shifted into the LACMA parking garage, becoming an underground test site. The garage, a place of constant motion, required close collaboration with many LACMA team members to navigate its complex infrastructure. Lab director Joel Ferree was especially vital, and I am deeply grateful for his belief in the project and his commitment to supporting art that pushes the limits of what is possible.

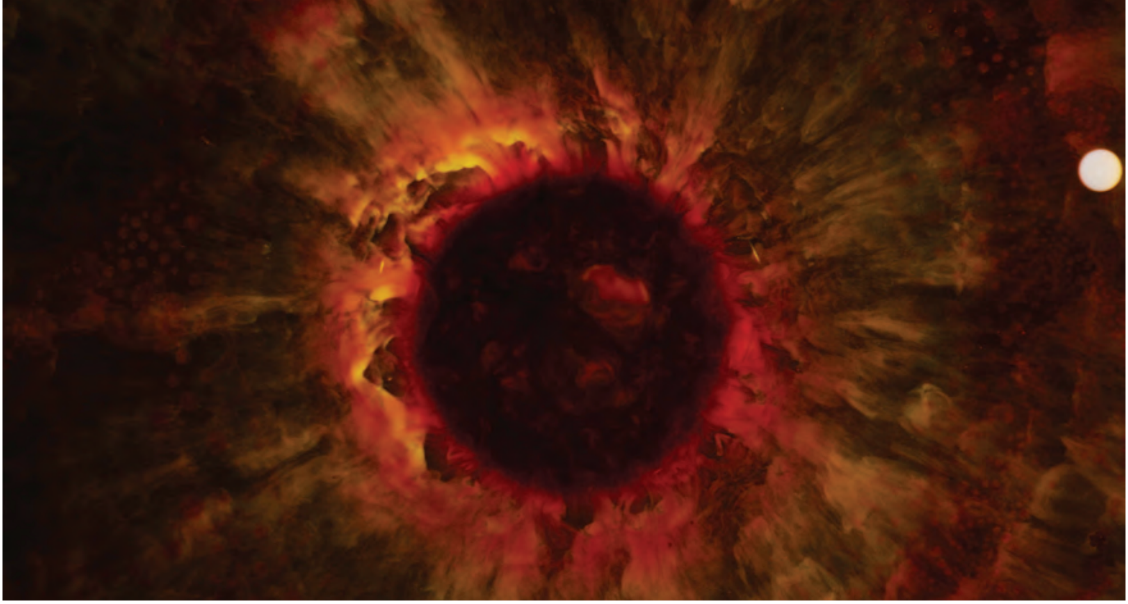
Daniel R. Small

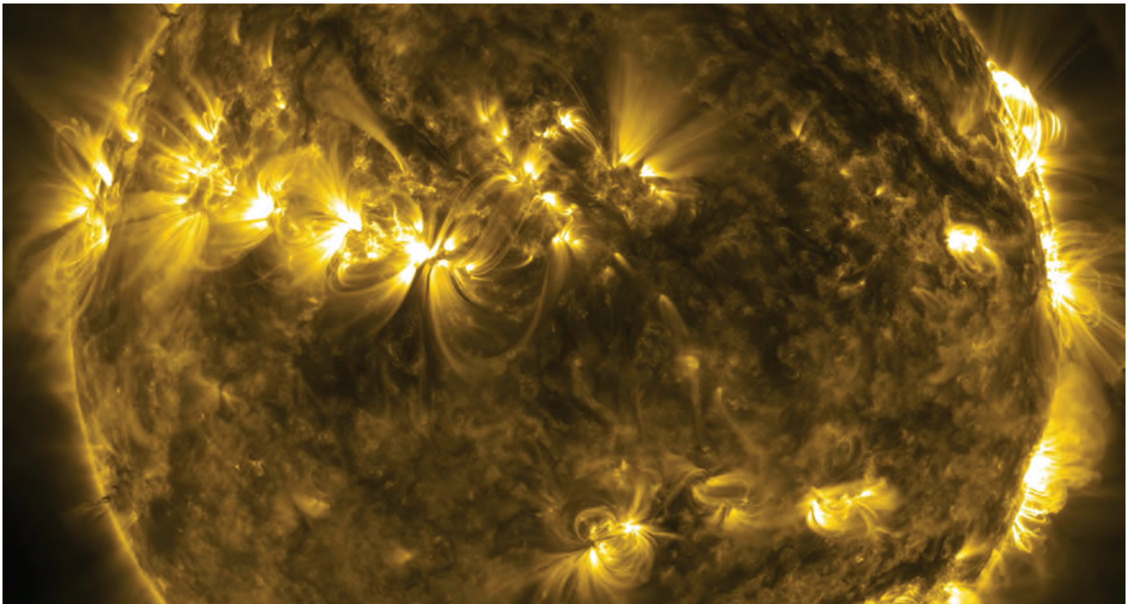
Awarded: Year 9 (2022–23)
Project Dates: 2022–23
Key Partner: California Institute of Technology

On August 17, 2023, LACMA, in collaboration with Caltech, premiered the first episode of *Techne: Evidence in the Anthropocene*, a documentary series directed by Daniel R. Small. This series draws on research from experts in philosophy, zoology, astrophysics, planetary science, robotics, and artificial intelligence, placing these scientific fields in direct conversation with the inquiries of contemporary artists. Through case studies exploring human evolution, environmental change, and technological advancement, the series examines how we gather and interpret evidence of our impact on earth and our potential future in space.

Techne: Evidence in the Anthropocene moves between galactic and planetary scales, opening with a simulation model developed by scientists at NASA's Jet Propulsion Laboratory that calculates the probability of intelligent species occurring in the Milky Way galaxy and their potential for self-annihilation. The series travels with these scientists and artists to explore diverse sites: a remote Indonesian palm oil plantation; the abandoned ruins of a nuclear test site in Bikini Atoll, now appearing as a submerged alien megastructure; and zero-gravity experiments with weaving prototypes related to space colonization. It considers the concept of the "material witness" in legal contexts and what constitutes evidence of planetary transformation. Commentators include the astrophysicist Jonathan H. Jiang, the physics educator and

Daniel R. Small, stills from *Techne*, 2023





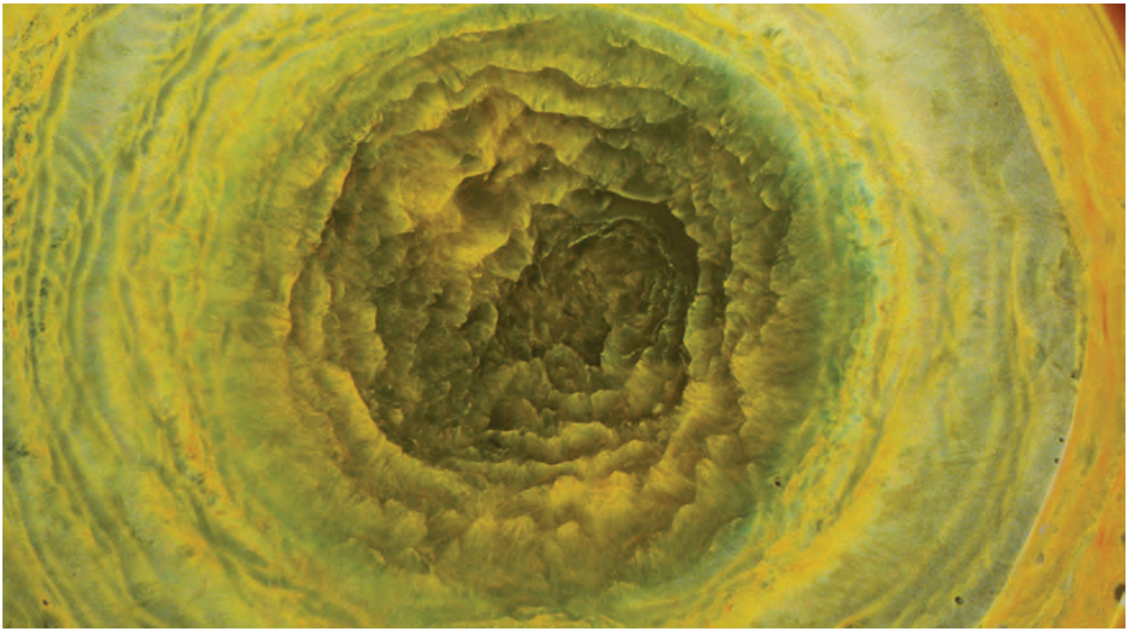
science systems engineer Kristen Fahy, the artist Julian Charrière, the artist-researcher Susan Schuppli, and 2019–20 Art + Technology grant recipient Ebru Kurbak.

At the premiere, the forty-eight-minute film was followed by a panel discussion and an announcement about a new effort to update the Golden Records—a pair of gold-plated copper disks launched into space aboard *Voyager 1* and *Voyager 2* in 1977. The records contain a selection of sounds and images representing the diversity of life on earth for any extraterrestrial civilizations that may encounter the spacecrafts in interstellar space. The panel included Small, Jiang, and Ann Druyan, creative director and collaborator with her late husband, the astronomer Carl Sagan, on the original Golden Records.

Artist's Reflections

Techne emerged through a deep collaboration with the Art + Technology Lab, not simply as a production site but as a methodological engine. The Lab's legacy of radical experimentation shaped the project's form—blurring documentation, simulation, and speculative inquiry. What emerged was less a film than a cross-disciplinary ecology—part forensic lens, part temporal conduit, shaped by the idiosyncratic methods of artists operating at the edges of science, law, and speculative thought.

Daniel R. Small



Daniel R. Small, stills from *Techne*, 2023

Patty Chang
David Kelley

Awarded: Year 10 (2023–24)
Project Dates: 2023–26

More humans have gone to space than to the bottom of the sea. Indeed, according to the *New York Times*, "humans have visually documented…a mere 0.001 percent of the deep seafloor." Nonetheless, as terrestrial mining becomes more challenging both physically and politically, corporations are turning to the deep seabed in search of polymetallic nodules, hydrothermal vents, and rare-earth minerals. Longtime collaborators Patty Chang and David Kelley conceived *~~Stray Dog~~ Hydrophobia* after learning that the International Seabed Authority (ISA), headquartered in Kingston, Jamaica, was moving toward approving controversial deep-sea mining regulations. Kelley explained that the title combines "independence, danger, ecological disruption, and the fear of water. Ultimately, it points to how human and non-human lives are entangled, sometimes symbiotically, sometimes violently."

The artists explored the legal and ecological implications of the developments they studied through extensive archival research in Jamaica, England, and the United States, including at LACMA with curator Susanna Ferrell. Their research culminated in the four-channel video installation *~~Stray Dog~~ Hydrophobia* (2024), which premiered at the San Jose Museum of Art in 2024 before traveling to the Alyce de Roulet Williamson Gallery at ArtCenter College of Design in Pasadena (September 18, 2025, to January 24, 2026) as part of their exhibition *Our Abyssal Kin*. Projected onto four walls, the video blends filmed sequences—

Performance of *~~Stray Dog~~ Hydrophobia* at the Los Angeles County Museum of Art, November 6, 2025,

including ISA delegates, museum curators discussing oceanographic specimens, Jamaicans describing the devastating 1692 Port Royal earthquake, musicians from the Charles Town Maroon Settlement, roaming stray dogs, and undersea footage—with 3D animation and photogrammetry.

Prominently featured is Kānaka Maoli (Native Hawaiian) activist Solomon Kahoʻohalahala reciting an *oli* (chant) and asking the ISA to incorporate Indigenous perspectives into deep-sea mining regulations. Chang stated that the title *Our Abyssal Kin* references the activist, "who explained that his ancestors are coral polyps on the ocean floor—that the ocean itself is his family. If we can extend the perspective that 'the ocean is everyone's family,' we might see the deep sea as more than a resource, instead as a kinship network deserving of care."

For one memorable animated sequence, the artists built a 3D digital model of the delegate-filled ISA assembly hall with the 3D creation tool Unreal Engine and relocated it to the seafloor, where it is pummeled with boulders.

The exhibition also included seven *Chakra Sculptures* (2024), which incorporate oceanographic specimens such as manganese nodules in handblown glass receptacles, and the kinetic sculpture *Our Abyssal Kin* (2024)—twenty-four intermittently spinning plates inscribed with texts by the artists, evoking the precarious balance required to resist extractivism.

On November 6, 2025, the artists presented a one-hour live screening and musical score directed and composed by Yasna Yamaoka Vismale, reimagining *~~Stray Dog~~ Hydrophobia* on LACMA's Smidt Family Plaza next to the David Geffen Galleries. A powerful exploration of the impacts of deep-sea mining on the more-than-human—a category that prioritizes the primacy of relationships between species, elements, and forces over individual entities, such as humans—

Still from ~~*Stray Dog*~~ *Hydrophobia*, 2024

Chang and Kelley's project invites us to meditate on our relationships with the pasts, presents, and futures of the deep sea.

Artists' Reflections

~~*Stray Dog*~~ *Hydrophobia* explores the entangled histories of extraction from the sea, rooted in British colonialism in Jamaica. Kingston, Jamaica—once a key site where the British brought enslaved Africans to cultivate sugar, cocoa, and chocolate—is now home to the International Seabed Authority (ISA), the UN global body charged with regulating deep-sea mining. Today, corporations and countries are attempting to secure licenses to exploit transition minerals sought for green and digital technologies.

This work speaks about the intertwined issues of extraction, dispossession, and the future of the ocean. It approaches the subject in an abstract and poetic mode, where legal reasoning is destabilized by the embodied, affective presence of the artists, musicians, and activists. Through textual interventions, music, and movement, the work links emotional and corporeal relationships to the planet's ecology with the commercial realities of resource exploitation.

~~*Stray Dog*~~ *Hydrophobia* is not only about deep-sea mining and marine life, but also about the layered violence of colonial histories and the extractive systems that endure. It is a meditation on the ocean as a site of life, memory, and contested futures.

Tristan Duke

Awarded: Year 10 (2023–24)
Project Dates: 2023–ongoing
Key Partners: Byrd Polar and Climate Research Center; National Science Foundation Ice Core Facility; Wisconsin IceCube Particle Astrophysics Center

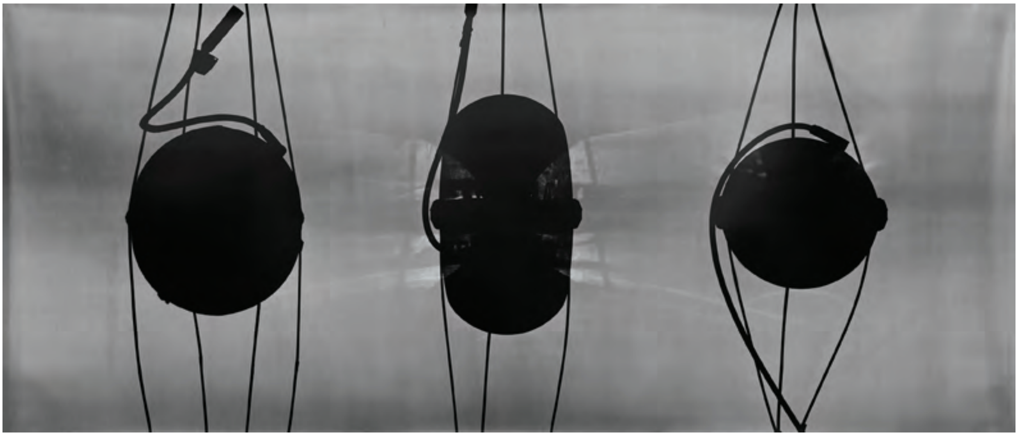
Tristan Duke received an Art + Technology grant to explore the intersection of neutrino astronomy and glaciology as embodied in the research conducted at the IceCube Neutrino Observatory in Antarctica. IceCube is a massive sensor array buried deep below the earth's surface in a cubic kilometer of glacial ice at the South Pole. It uses this ice as an optical element to detect the nearly massless subatomic particles known as neutrinos and answer fundamental questions about the nature of the universe. The same ice also holds secrets about the earth's climate past, serving as a detailed archive of atmospheric data spanning hundreds of thousands of years. For his project *Glacial Optics: Cold Cutting Edge*, Duke set out to document cutting-edge technology related to these subjects using an instrument of his own invention: a camera with a lens made of glacial ice.

Several years ago Duke stumbled across a volume in a bookstore that referenced a Chinese philosopher who used a lens made of ice to ignite a fire by focusing the rays of the sun. In the late 2010s, he began taking photographs using ice lenses he made himself. Then, in April 2022, he traveled to the Svalbard Archipelago with a custom-built camera, capable of recording 4 × 8 foot negatives. This camera used a spherical lens he crafted from perfectly clear glacial ice. Launching his *Glacial Optics* series, he photographed the Arctic and printed the images as gelatin silver contact prints and pigment prints.

top
Tristan Duke, *Ice Core Study 06: NSF-ICF Greenland Ice Sheet Cores with Allan Hills Cores*, 2023, gelatin silver photogram, 50 × 90 in., collection of the artist

middle
Tristan Duke, *Cherenkov Light*, 2023, gelatin silver photogram, 42 × 90 in., collection of the artist

bottom
Tristan Duke, *Death of a Glacier (Muir Stakes, Vertical)*, 2025, gelatin silver photogram; 90 × 42 in., collection of the artist



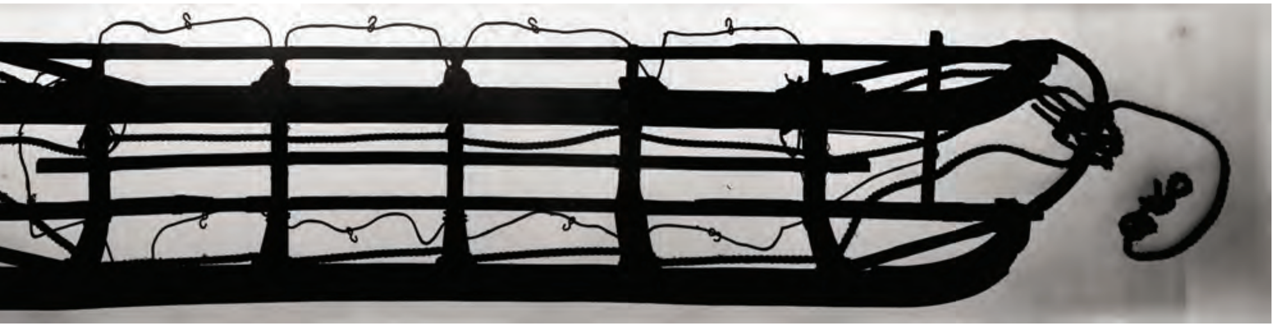
Duke subsequently met scientists studying glacial ice at the Byrd Polar and Climate Research Center, the National Science Foundation Ice Core Facility (NSF-ICF), and the Wisconsin IceCube Particle Astrophysics Center (WIPAC). NSF-ICF holds a collection of ice cores whose strata document the earth's climate history. There, Duke made photograms by placing ice cores on sheets of light-sensitive photo paper. He realized the cores "were the primordial lenses I had set out in search of, naturally occurring 'optical elements' shaped and polished by deep time. In this ancient ice, I felt I was, at last, looking into the eye of the glacier." In Wisconsin he photographed with his ice lens the sensors embedded in IceCube to detect neutrinos.

Duke's work earned him invitations to present at the Scientific Committee on Antarctic Research Astronomy and Astrophysics from Antarctica (SCAR AAA) meeting in Svalbard, Norway, on September 19, 2023, and to return to the University of Wisconsin as a visiting artist. There, he worked with researchers to assemble a camera system capable of recording video at one trillion frames per second—fast enough to visualize light as it propagates through a scene. While aware of his place in the long history of artists who have portrayed the polar regions, Duke has "begun to think of this *Glacial Optics* project as an inversion of the romantic gaze: here a fragile nature, embodied in the glacial 'eye' of my ice lens, regards a human world of overwhelming power, tumult, and cataclysmic extremes." The book *Tristan Duke: Glacial Optics* was published in 2025.

Tristan Duke, *NASA Sled (Cosmic Qamutiik)*, 2023, gelatin silver photogram, 42 × 211 in., collection of the artist

Artist's Reflections

When I applied to the Art + Technology Lab, I had already begun my *Glacial Optics* project with an expedition to the Arctic, where I formed lenses from glacier ice. Using custom-built cameras, I used these



ephemeral lenses to document melting glaciers. Since returning, I've turned my ice lenses toward a broader view—using them to confront climate change on a planetary scale, from megadroughts and wildfires to sea level rise and sites of energy production.

The grant has deepened this investigation—exploring glacier ice as both a literal and poetic technology, a lens for understanding time, memory, and environmental transformation. Photography, at its core, is a time-based medium. Glacial ice is, too. And through this parallel, I became increasingly interested in the layered temporalities embedded in both.

The grant came at a perfect moment, catalyzing multiple threads in my practice. It enabled visits to ice core research labs, where I created a new body of work, *Ice Core Studies*—large-format photograms that image ancient cores with their internal strata and air bubbles, revealing the deep-time they contain.

In short, this grant didn't just support a single project—it expanded the scope and depth of my practice. It gave me the resources and freedom to explore how glacial ice can act as a lens through which to view time, climate, and the cosmos. The work it enabled continues to evolve, branching into new collaborations, technologies, and terrains. I'm still following where the gaze of the glacier leads.

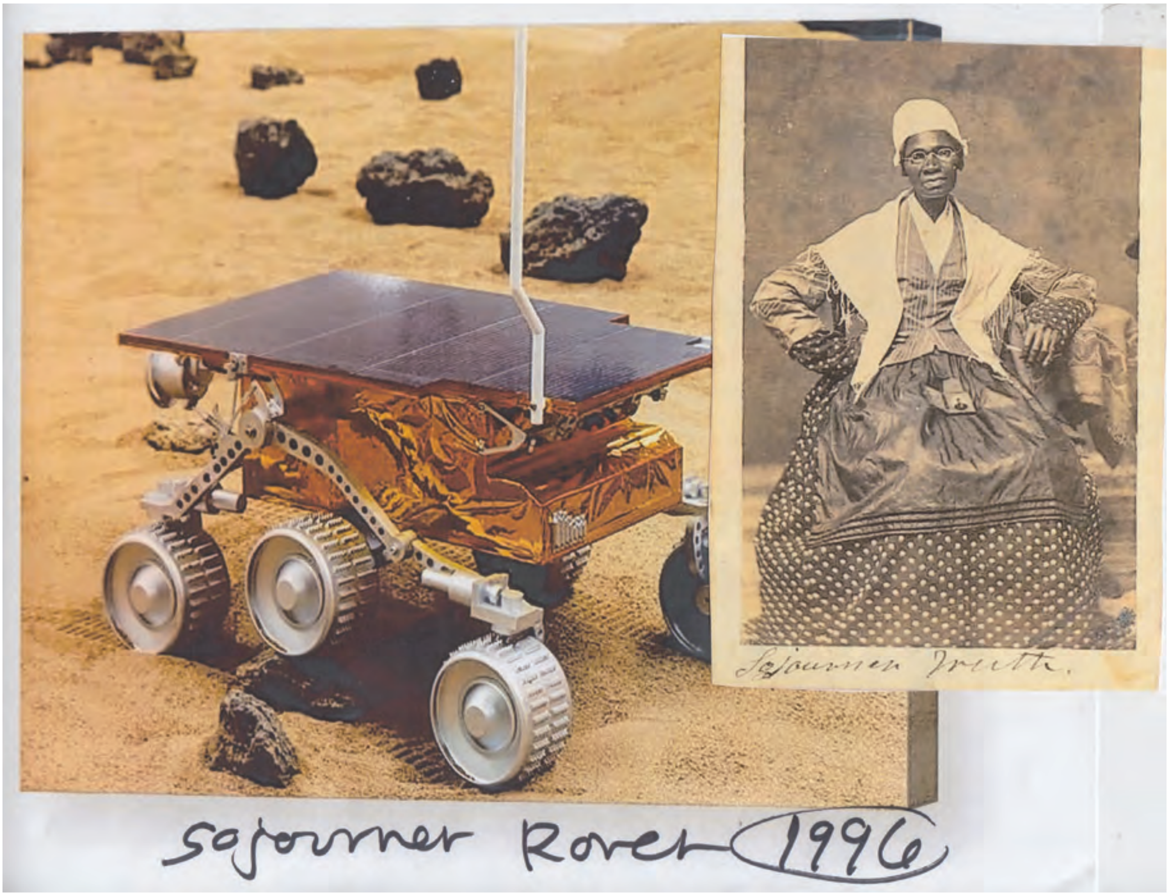
Read more about Tristan Duke's research into glacier ice and glacial time at www.lacma.org/art/lab..

Haleigh Nickerson

Awarded: Year 10 (2023–24)
Project Dates: 2023–ongoing

NASA landed its Mars rover in the Red Planet's Ares Vallis region on July 4, 1997, as part of its *Mars Pathfinder* mission. For eighty-three days the six-wheeled robotic vehicle, built by NASA's Jet Propulsion Laboratory, explored the surface of Mars, taking close-up photographs and analyzing soil and rock samples. To mark this historic event, the rover was named *Sojourner*, a tribute to the achievements of African American abolitionist and women's rights activist Sojourner Truth (c. 1797–1883). Born enslaved, this visionary escaped to freedom in 1826, and in 1843 changed her name to Sojourner Truth. On May 29, 1851, at the Women's Rights Convention in Akron, Ohio, she delivered a legendary speech, now known by the title "Ain't I a Woman?" Like its namesake, the *Sojourner* rover overcame obstacles and roamed freely. Haleigh Nickerson's *Sojourner's Rovers*, an engineering and community art project, aims to share and revive the legacy of *Sojourner* through local community engagement and explorative youth education.

A multidisciplinary artist with a background in film, Nickerson has proposed a series of free-roaming rover artworks in collaboration with Watts Community Core. This nonprofit organization was established in 2019 to provide recreational opportunities for youth residing in Nickerson Gardens, a large public housing complex in the Watts neighborhood of Los Angeles. The *Sojourner's Rovers* workshops are



Haleigh Nickerson, *Sojourner Notes Scan*, 2023 envisioned as hands-on environments in which youth participants learn about new technology, community, and innovation. They also collaborate in building rovers inspired by *Sojourner* and mirroring the techniques and technologies that JPL used. The planned culmination of the project is a rover launch at Nickerson Gardens Skate Park in Watts.

In an interview with Travis Diehl for Hyundai Artlab, Nickerson described the significance of the project: "In terms of Black and Brown communities, the project is largely about seeing ourselves in the future, in opposition to being left behind. What are ways that we can cultivate life here? What are ways that we can dream here? What are ways that we can build worlds of expansion and freedom here and now instead of thinking it's somewhere else? Before the *Sojourner* Mars rover made history, there was a youth contest to name the rover. The winner was a twelve-year-old Black girl named Valerie Ambroise, who said it was a 'no-brainer' for the rover to be named Sojourner because it can move over obstacles. In this way, I've been interested in how this technology is Black-coded and connected to Sojourner Truth's legacy as a radical activist and abolitionist."

Artist's Reflections

I reimagine an iconography of identity and representation in my multidisciplinary practice. I deconstruct the act of world-building through personal fantasy and archive as I draw from culture and memory. My project *Sojourner's Rovers* explores how we can imagine radical possibility. This art project reimagines the *Sojourner* Mars rover through community. I have been creating a series of free-roaming artworks for empowerment, engagement, and youth education as I join forces with Watts Community Core. Watts Community Core is an organization that is committed to making a difference in the Nickerson Gardens and surrounding

Watts community, and reimagining and building new functional rovers.

Sojourner's Rovers extends exploration, play, and an empowering experience of hands-on learning through the creation and envisioning of our histories, narratives, and futures. The act of construction allows us to build our worlds. It gives us an ultimate sense of empowerment and possibility. It lets us see things in new ways, opening up space for a greater universe. *Sojourner's Rovers* aims to inspire the participating youth, our communities, and beyond to create and speak for ourselves, to honor the past as we move towards our future.

The spaces we build and cultivate matter.
Our histories and communities matter.
Our futures matter.

We are utilizing Sojourner Truth's powerful legacy in NASA's *Sojourner* rover as a catalyst for how we can imagine ourselves in the future. We are trailblazing forward, creating new destinations, and embarking on new pathways of futurity—a practice for the future.

Listen to more from Haleigh Nickerson regarding her vision for *Sojourner's Rovers* at vimeo.com/681028266.

Gala Porras-Kim

Awarded: Year 10 (2023–24)
Project Dates: 2023–ongoing

Everything related to a museum's holdings is stored, conserved, and displayed according to the parameters of the institution's collection management system. Such parameters are designed to capture certain factual details about an object and its history, as well as curatorial notes. But as Gala Porras-Kim points out, they also impose significant limits on our ability to describe cultural output. She has been investigating these issues in her project *Expansive Data Fields* (begun 2023).

Porras-Kim is a Los Angeles–based artist whose practice analyzes how the values and meanings attributed to cultural artifacts—particularly sacred objects—are shaped by the institutional contexts, including their histories of collection, conservation, display, and interpretation. "To me, it's always been more interesting to look at the framing of historical material than the objects themselves." From these investigations she produces drawings, sculptures, and installations that invite viewers to see artifacts liberated from modern systems of classification and preservation.

For the exhibition *A Universal History of Infamy* at LACMA in 2017–18, Porras-Kim researched questions of provenance, naming rights, and ownership of ancient objects from western Mexico in the museum's Proctor Stafford Collection. In a letter to curators, she questioned why donor names dominated object labels while other histories remained unmentioned:

Gala Porras-Kim, *202 mineral objects at Carnegie Museum of Art or at Carnegie Museum of Natural History*, 2025 (detail), color pencil and Flashe on paper, 96 × 72 in., private collection

"they were also possibly in the 'unmarked grave looters in west Mexico collection,' and further back the 'deceased peoples of west Mexico' collection before that." In conjunction with this research, she created a large drawing of 109 objects from the collection, which are ordered in rows by scale, rather than other taxonomical categories typically used by museums. She also made six clay sculptures created in shapes typical of Colima ceramics. Each sculpture had a GPS tracking device so that in contrast to the artifacts in the museum's collection, their movements will be recorded continuously.

In recent years, museums have increasingly committed to decolonizing their collecting and exhibiting practices. One important aspect of this work is decolonizing museum collection management systems. As museum registrar Rachel DeNagy argued in an article published in *VRABulletin*, "Databases are extensions of an institution's framework and reproduce the colonial method of organizing objects hierarchically according to the preferences of the collector or of Western society.... Decolonizing databases involves understanding how colonial ideologies affect cataloging practices, including the nature of cataloged information for historic or modern collection materials." For *Expansive Data Fields*, Porras-Kim has turned her attention to LACMA's collection management system. Current museum registration and conservation practices, she argues, prioritize a Western model of taxonomy that obscures the multiple lives objects continue to have. Today's museums evolved from the cabinets of curiosity formed by wealthy European collectors in the sixteenth and seventeenth centuries. Over time, museums—especially those with collections of objects made by Indigenous peoples—became entwined with colonial histories.

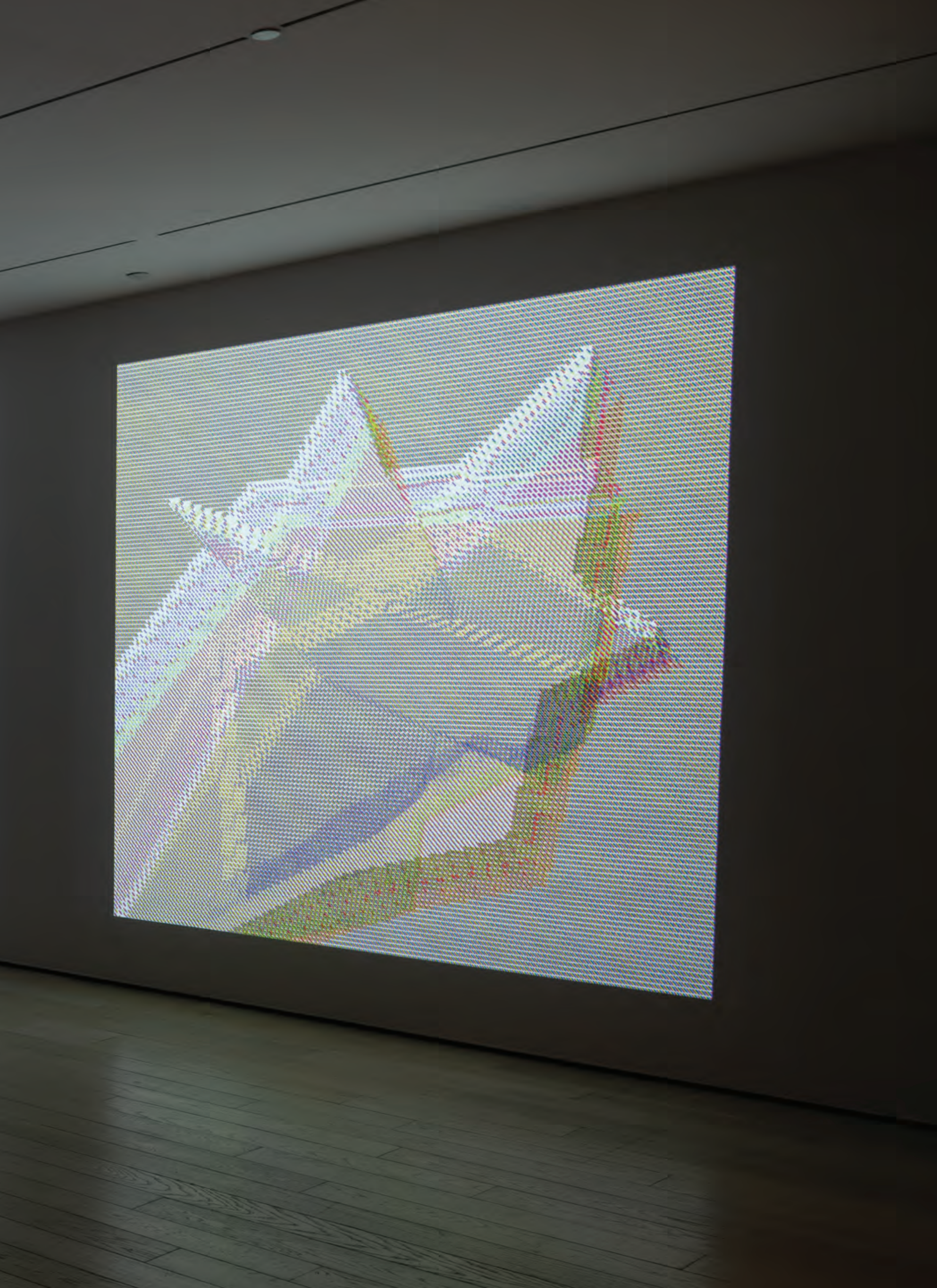
In her project, Porras-Kim has been focusing on objects intended to serve what she terms "perpetual,"

Gala Porras-Kim, *147 photographs at Carnegie Museum of Art or at Carnegie Library of Pittsburgh*, 2025, graphite on paper, 96 × 72 in. each, private collection

pp. 242–43
Casey Reas, *An Empty Room*, 2023, commissioned by the Los Angeles County Museum of Art

often sacred functions that may be at odds with their present role as subjects of cultural or aesthetic contemplation behind glass. Can we see such materials not only through our own cultural lens but also through one that allows for a multiplicity of readings? Through conversations with registrars, curators, and cataloguers, Porras-Kim proposes complementing existing database fields with additional categories that reflect different relationships to objects. These might include “spiritual conservation notes” or “expiration date,” as well as perspectives that move beyond human-centered viewpoints—such as “tastiest for the moths,” acknowledging the agency of the materials themselves and the organisms that interact with them. The project also addresses challenges specific to contemporary art, such as how to register and conserve immaterial works, which resist representation within existing museum frameworks.

Related Projects



EPOCH: *ECHOES*

ECHOES was an experimental collaboration in 2022 between EPOCH Gallery and LACMA's Art + Technology Lab featuring Lab grant recipients and organized by artist and EPOCH creator Peter Wu+. The exhibition's virtual landscape, an artistic digital creation, was inspired by the construction site of LACMA's east campus, where the David Geffen Galleries would eventually debut, as well as neighboring locales around Wilshire Boulevard. Participating artists included American Artist; MUXX; Jacqueline Kiyomi Gork and Rhett LaRue; Lawrence Lek; Jen Liu; Ronald Rael and Virginia San Fratello; and Sarah Rara.

EPOCH's virtual exhibitions often evoke a mood of wonder and unease, presenting speculative, narrative-driven worlds that are both immersive and critical of contemporary issues. Environments range from seemingly peaceful, "tomb-like" spaces overlooking disasters to lush, post-apocalyptic landscapes. When exploring these virtual spaces, visitors encounter cinematic environments that move beyond the traditional "white cube" gallery model to offer deep architectural and thematic immersion. *ECHOES* was staged from February 4 to May 13, 2022, inside of the excavation that had been dug to make way for LACMA's new building's foundation. As visitors moved through the exhibition, the distant snarls of traffic cut through the oddly vacant landscape, lending it an unsettling charge.

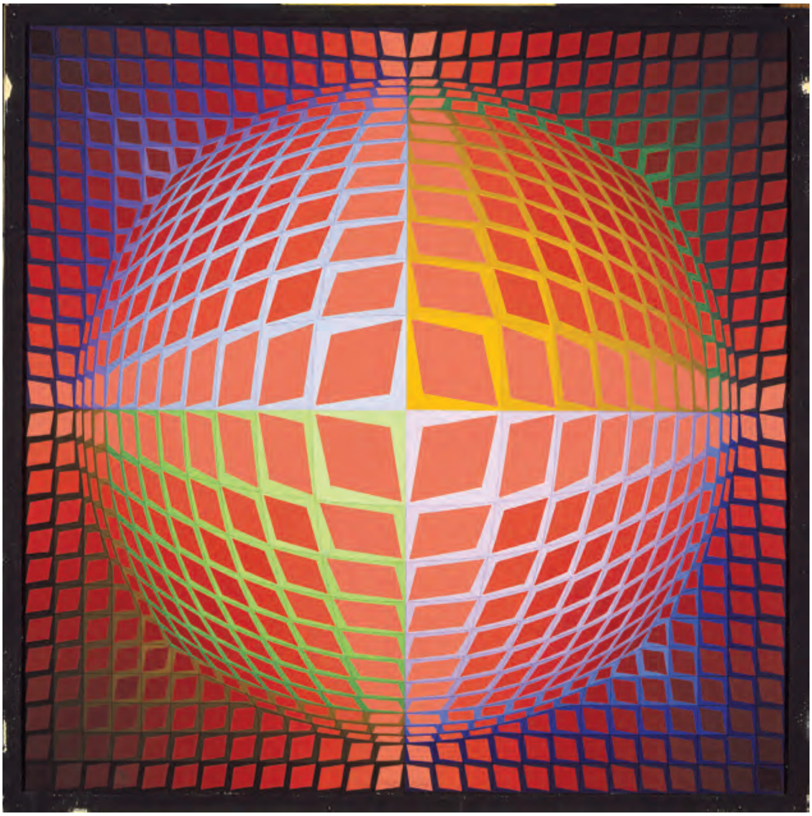
As Wu+ noted, "*ECHOES* was conceived, curated, and built in under three months, an uncommon swiftness for projects of such scale within institutions."

The project moved forward with “the kind of precision usually reserved for a kitchen line at peak dinner rush, fast, focused, and carried by an unspoken ‘yes, chef.’” Wu+’s curatorial approach, along with EPOCH’s use of smart contracts and a shared revenue model, showed how artist-led projects can use new technologies to rethink how digital work is presented and supported in a museum context. The entire virtual exhibition, including the artworks by the participants, was released as a single NFT, with profits and royalties split between participating parties.

The *ECHOES* NFT was released in an edition of five, with an artist proof going to each participating artist and EPOCH. Sales proceeds were split among the participating artists and EPOCH, and a portion helped fund future Art + Technology Lab artist grants. Certificates of authenticity were provided through UNCOPIED, a digital system that records ownership and metadata about each work. At LACMA, *ECHOES* served as a springboard for other use cases of blockchain technology that would demonstrate the benefits of its security, transparency, and scalability. *ECHOES* has been acquired by LACMA’s permanent collection, “preserving a moment in time suspended within the virtual.”

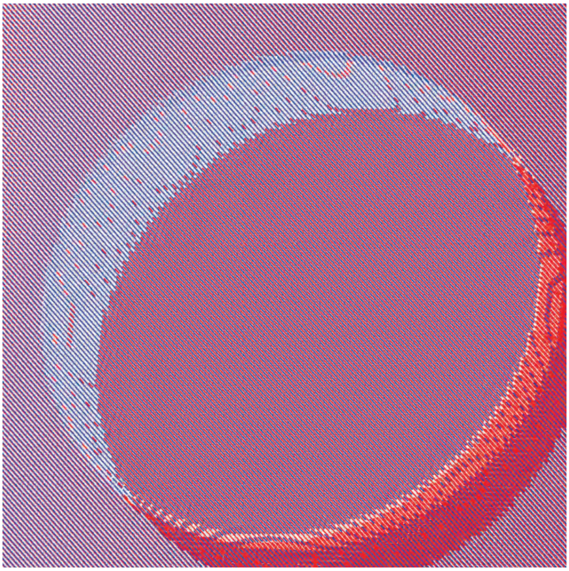
Installation view of *ECHOES*, February 4–May 6, 2022

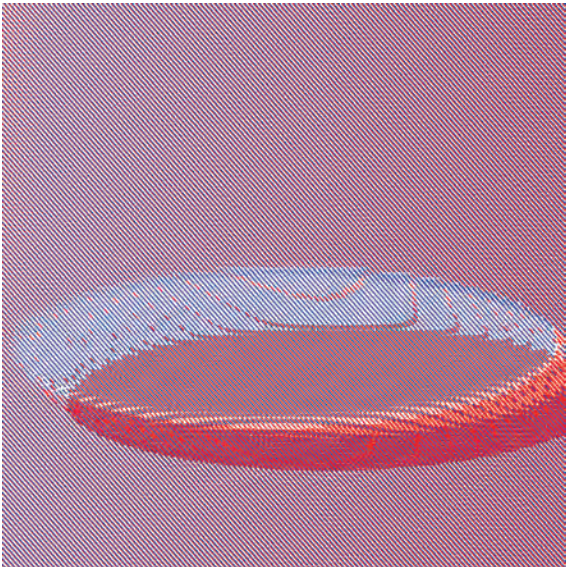
METAVASARELY and *An Empty Room*: An Interview with Casey Reas



Taking as a base any one of my programmations, we are now able to recreate the work and a countless number of other compositions the machine proposes. In this way, the limitations due to the artist's method of working in a studio would be overcome.

— Victor Vasarely's proposal to LACMA's Art & Technology Program (1967–71)





Casey Reas's two-part project, METAVASARELY *and* An Empty Room *was created in conjunction with the Art + Technology Lab and the exhibition* Coded: Art Enters the Computer Age, 1952–1982*, serving as both simulation of and homage to Victor Vasarely's unrealized proposal for LACMA's original Art and Technology Program. Vasarely envisioned a machine of lights arranged in a grid that would generate millions of visual patterns related to his paintings—a concept that IBM deemed prohibitively expensive (see pp. 343–44). More than fifty years later, Reas brought Vasarely's vision to life in digital form (www.lacma.org/lab/project/metavasarely). This interview, conducted by Joel Ferree, originally appeared on LACMA's Unframed blog in February 2023.*

In the late 1960s, IBM estimated that it would cost two million dollars (approximately nineteen million in 2023) to create the machine Vasarely envisioned. What was it like to evolve the concept and manifest it in a digital space?

My first instinct was to build the machine. The electronics needed to produce Vasarely's machine have advanced so much since then. But, thinking more, the idea of simulating it in software felt more flexible and exciting. I'm glad that I made this decision because I think the machine Vasarely imagined at that time was far less interesting than what he was doing with more traditional materials. In his painting practice he developed his diverse "plastic alphabet" of forms and colors that he combined in endless variations. When he created a painting with this alphabet, the way he combined the forms was complex. In contrast, the machine specified in the Art & Technology proposal is limited to only circles of light; it didn't have the same flexibility. In re-imagining the machine in software now, I can explore his full visual palette while still keeping to the core idea of Vasarely's Art & Technology machine proposal.

In the 1960s, Vasarely was working on this Planetary Folklore and Permutations and Algorithms series of works. Like the proposal he created for LACMA, these artworks included a regular square grid. (His iconic artworks that warp the grid came later.) In each grid element, he would place one or more shapes (e.g. a circle or square) and each shape would have a different color from a custom palette defined for each artwork. I spent months attempting to create a software system that could produce a wide range

opposite
Victor Vasarely, *Vega-Köntösh*, 1971, tempera on panel, 25⅝ × 25⅝ in., Los Angeles County Museum of Art, gift of Mr. and Mrs. Donald Winston through the Contemporary Art Council, M.72.35

above
Casey Reas, work-in-progress images from *An Empty Room*, 2023

of images that felt like they might have been produced by Vasarely. I was able to sketch out "the big picture" but looking at his work with even more detail, nearly all the artworks contain exceptions to the rules he defines within them. Although they appear so rational and structured, they have idiosyncratic details that are completely essential. So, I switched directions and created what you see now. I found it was far more interesting to make an instrument that allowed me to perform, rather than automate, Vasarely's idea.

In general, I think it's a logical transition to think about Vasarely's paintings as software. As he wrote in his Art & Technology proposal: "In fact, as of this period all my works are programmated; colors, tones and form all being reduced to a simple code." He was walking the walk, it was more than an idea. He reduced his color and form palettes and assigned a number to each. He arranged numbers into grids as ways of making patterns before seeing them as images. His mind was in the space of coding—before the technology of digital computers could meet his needs.

You've been working with software for over 20 years and are a pioneer of digital art. What forms do you think your work would take if you were making art before the arrival of the personal computer?

I've been asking myself this question for a long time. My life as an artist really started with writing software. I had ideas about things that I wanted to make that I couldn't make any other way, so I learned to write code to create my earliest artworks. The ideas that are closest to me (simulation, emergence, systems) require software—my work and ideas are bound to what computers can do. At the same time, the work that I make wouldn't exist without the traditions of drawing, painting, film, video, and performance from the last centuries. I've spent countless hours in museums looking at paintings and watching films. With my work, I draw from the histories of abstraction in painting and drawing as well as in avant-garde film and experimental video.

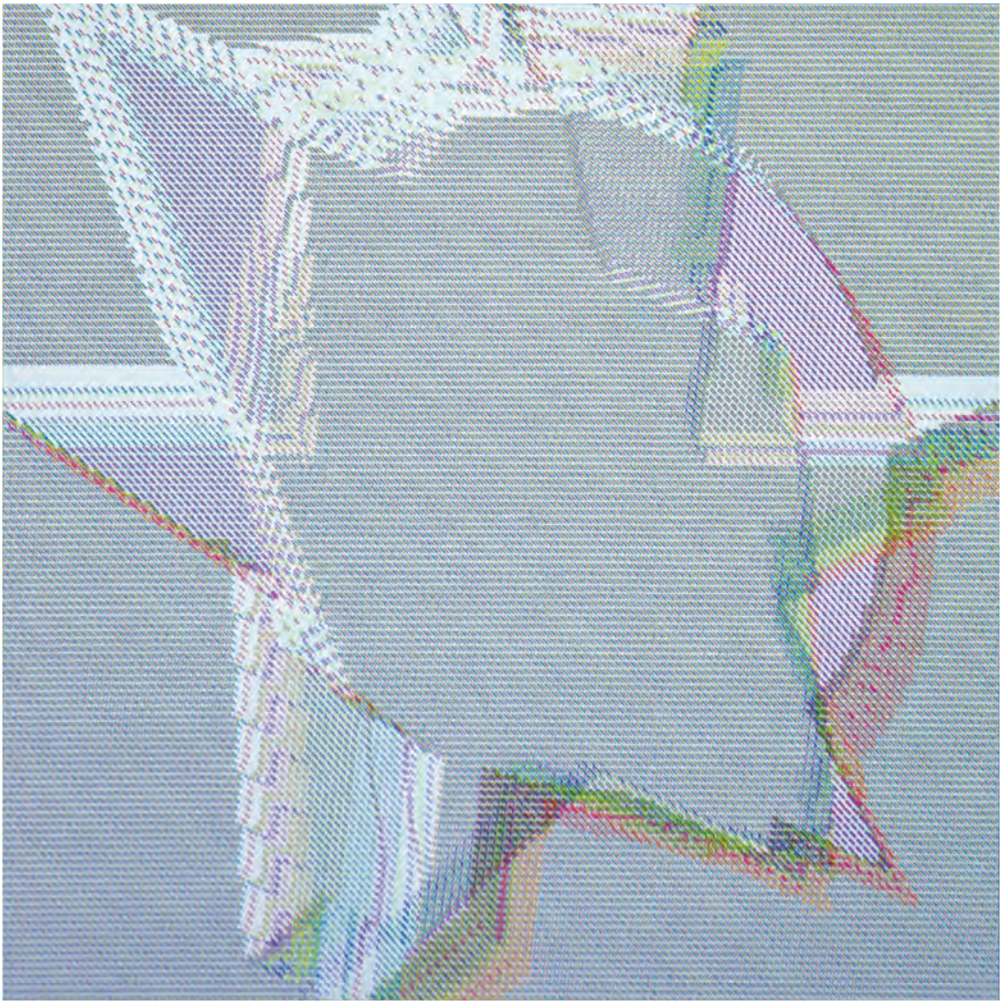
As we see in *Coded*, this history of artists working with software and digital computers goes back over sixty years. In the first decade, there were some amazing experiments in film, but the majority of the work used computers to create drawings, specifically drawings that were rendered by physical machines. This was the era before most computers had screens and before digital printers. Artists would see their images for the very first time as they were being slowly rendered by huge machines. In contrast, working with computers now, we see what we're making immediately—we have constant feedback.

I've made works on paper created through code since the beginning of my career and I've also experimented with plotter drawings, but the essence of my work requires changes in time. I think of myself as an expanded experimental animator who writes software rather than working with film for video. If I was born earlier, I like to imagine I would have found my way into experimental film, like Stan Brakhage and Paul Sharits.

In addition to Victor Vasarely, you've recently been developing similar tributes to artists including Vera Molnár and Jesús Rafael Soto. Can you share some background on these projects and why you focused on these artists?

The last few years, I've focused on a series of works titled *CENTURY*. This work started in 2012, but it's been a stronger focus lately. This work takes two forms: artworks that I create that relate specifically to painting and drawing in the twentieth century in some way, and visual research that informs the first category. For LACMA, I'm creating one of each. *METAVASARELY* is an homage to the work of Victor Vasarely from the 1960s and *An Empty Room* extrapolates what I learned from *METAVASARELY* into my own ideas and visual language. I've focused on Vasarely, Molnár, and Soto through commissions. Outside of those commissions, I've created work in relation to Kazimir Malevich, Bridget Riley, François Morellet, Ellsworth Kelly, Herbert Franke, and Agnes Martin. The idea is that "generative art" has its foundation outside of computers, and many painters in the 20th century were working in a way that's very similar to artists working with code now.

My *Hommage á Molnár* just opened last week in the *Machine Imaginaire* exhibition at DAM Projects in Berlin. This show celebrates Molnár's ninety-ninth birthday and it includes drawings and paintings as well as early computer drawings. My contribution is a software instrument that I imagined Molnár could have used in the 1960s to explore the precise visual language she was working with at the time. I used the extensive



In general, I think it's a logical transition to think about Vasarely's paintings as software.

— Casey Reas, 2023

Casey Reas, work-in-progress image from *An Empty Room*, 2023

collection of Molnár's work in the Spalter Digital Art Collection to do the research and my instrument allows anyone to move through her iconic visual language from the time to discover new possible drawings.

METASOTO was a commission from Tina Ryan, curator at the Albright-Knox Art Gallery, for her *Peer to Peer* exhibition hosted on Feral File. Twelve other artists and I were invited to select an artwork from the museum's collection to create a new work in dialogue with it. I've been an admirer of Jesús Rafael Soto's work since I first saw it and this was an opportunity to dig deep into his artwork *Bois-tiges de fer* (1964). I created sixty-four new software works, each a response to *Bois-tiges de fer*.

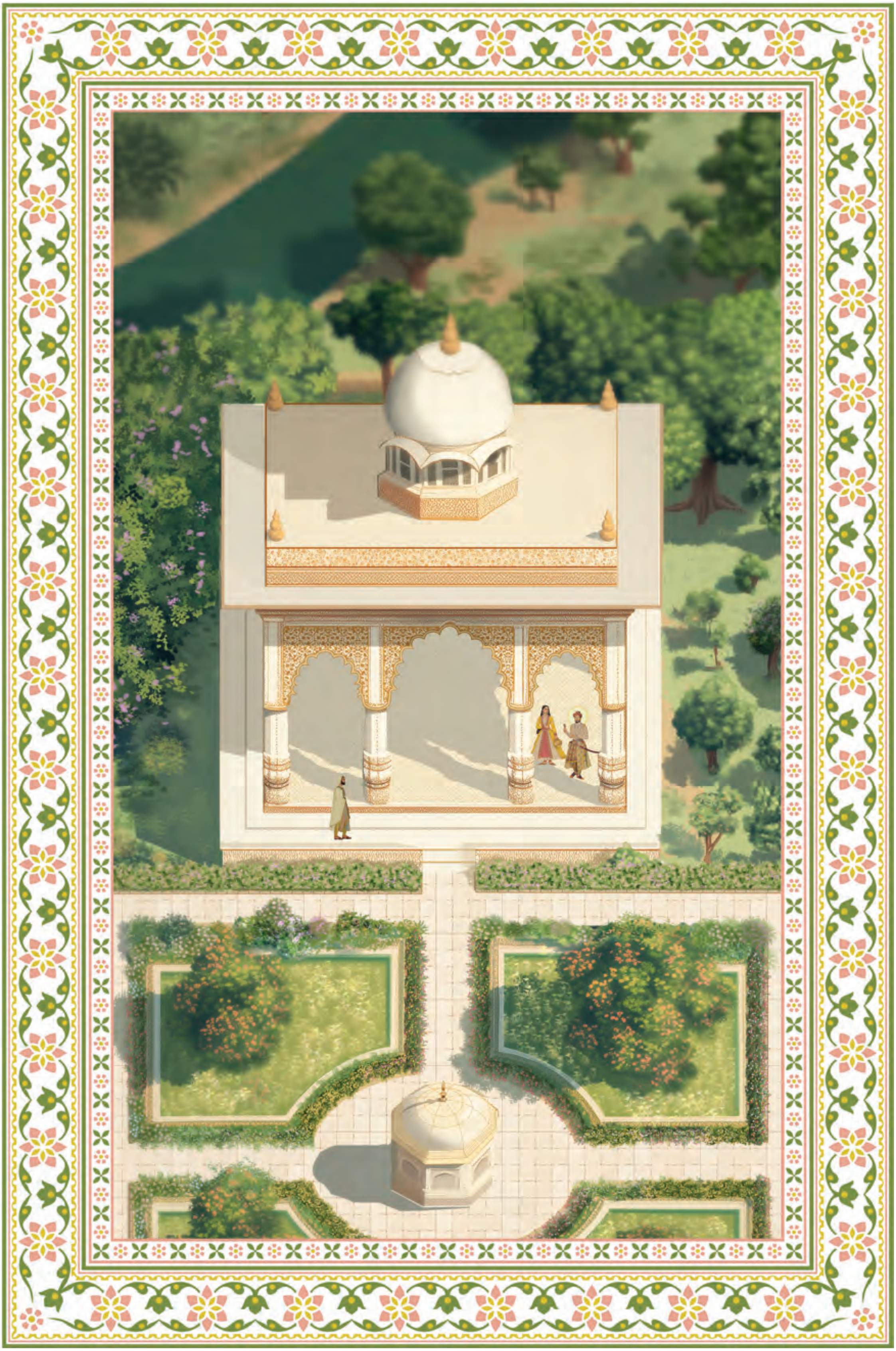
Parag K. Mital: *The Game of Whispers*

On December 15, 2024, LACMA's Art + Technology Lab debuted Parag K. Mital's *The Game of Whispers* at the Serendipity Arts Festival in Goa, Panjim, India. Co-organized by the Serendipity Arts Festival and LACMA, the project was an interactive and generative video game that drew parallels between the political intrigue of the Mughal Empire in India during the reign of Shah Jahan (r. 1628–58) and the role of AI-driven disinformation in today's world. Set within a rendition of Delhi's historic Red Fort, the piece explored how rumors, manipulation, and shifting power dynamics mirrored the ways modern technology—particularly AI—shaped narratives and distorted truth.

At the heart of the work were nonplayable characters (NPCs)—game characters not controlled by players but by AI—which were modeled after figures from Mughal-era miniature paintings in LACMA's collection. These NPCs were driven by advanced large language models, like those that power ChatGPT, allowing them to engage in lifelike conversations that created new layers of intrigue and deepened the cycle of disinformation. As the characters spread rumors and reacted to the actions of others, viewers witnessed how a single falsehood could ripple through the palace, influencing decisions and relationships.

The artwork also spoke to India's contemporary political climate and highlighted how history, much like modern disinformation, could be twisted to serve competing ideologies. In doing so, the work invited reflection on the fragile nature of truth in both the past and an AI-driven present.

Parag K. Mital (collaborators: Breanna Browning, Arturo Castro, Seth Rosetter, Jacobo Heredia Zurita, Ruipeng Wang, Sanaya Ardeshir, Krishna Jhaveri, Udit Duseja, Maria Kuraeva), *The Game of Whispers*, 2024, commissioned by the Los Angeles County Museum of Art

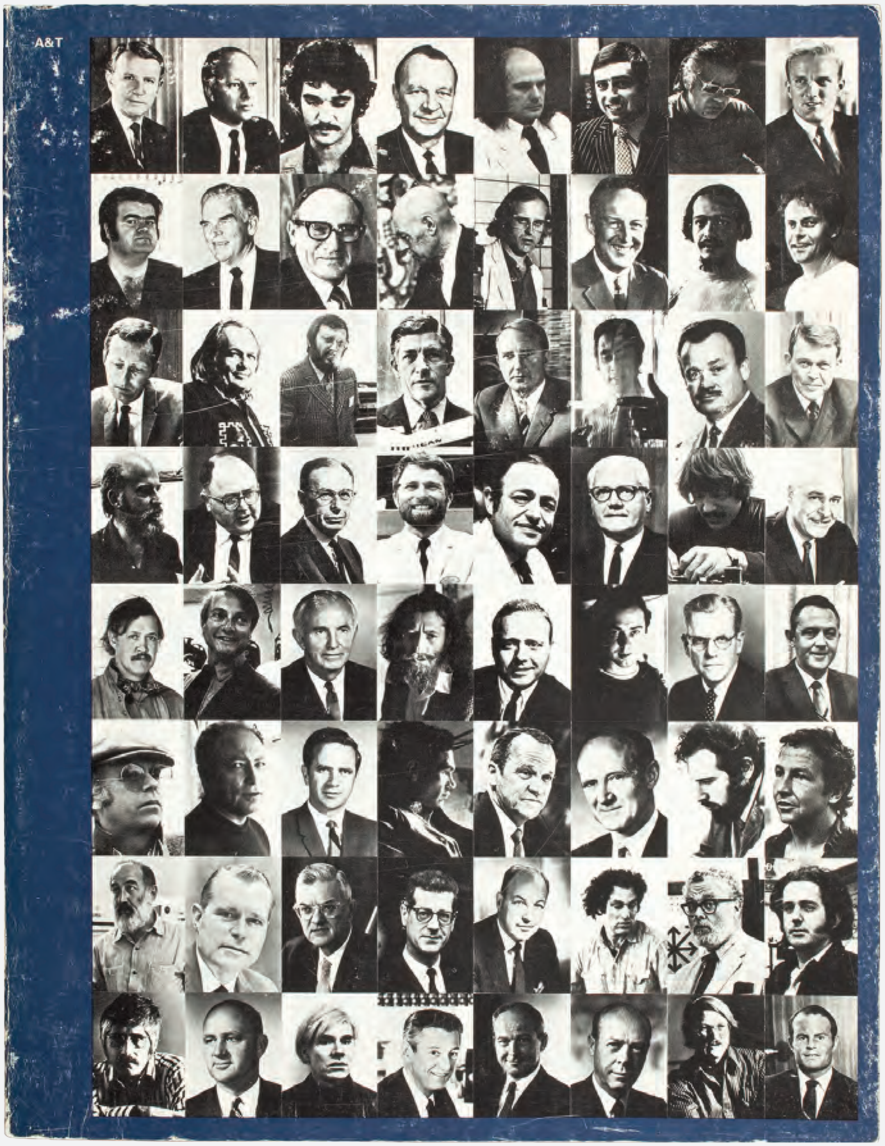


Looking Back at *A Report on the Art and Technology Program of the Los Angeles County Museum of Art, 1967–1971*

Assembly of Claes Oldenburg's *Giant Icebag* at LACMA, 1971

The Original Report: An Assessment

William Hackman



Cover of the paperback edition of *A Report on the Art and Technology Program of the Los Angeles County Museum of Art, 1967–1971*, showing sixty-four of the program's artists and business leaders

The original Art and Technology Program found a mixed reception, delighting some visitors to the 1971 LACMA exhibition while leaving others cold. The latter were often joined in their reaction by artists and critics, who found much to object to, from the project's original conception to questions concerning how and why artists were chosen and the aesthetic value of the final projects. Yet, as often happens, the judgment of history has diverged in important ways from contemporaneous opinions. And nothing has been more central to those evolving attitudes than the book published in conjunction with the exhibition, *A Report on the Art and Technology Program of the Los Angeles County Museum of Art, 1967–1971*.

Although the publication bore some formal resemblance to a typical museum exhibition catalogue, it was emphatically nothing of the sort. It was, as its title stated, a report, filled with detailed documentation in the form of correspondence between the museum and artists, memos from corporate executives and employees, and artists' notes and drawings of works in progress. No doubt one of the reasons the book still fascinates so is its extraordinary candor. The book's contributors—Maurice Tuchman, Jane Livingston, Gail R. Scott, and Betty Asher—provide rare insight into the process of organizing such a challenging program, including costs, logistics, challenges, obstacles, contracts, letters, and misunderstandings. Their summaries reveal the financial and logistical deliberations among the museum's staff and its board, meetings with executives from relevant industries throughout Southern California, the trial and error of matching artists and participating corporations, and the variety of challenges, conflicts, and successes of artists' endeavors once those matches had been made—from conception to realization.

One of the themes underscoring these summaries is the often disparate thinking of artists, curators, and engineers involved in each individual project. Livingston notes, for instance, the differences in the demands of American and European artists, such as the exchanges with French artist Jean Dubuffet regarding the exact dimensions of the work he wanted to create and whether the museum would pay for first-class airfare between Paris and Los Angeles. Dubuffet was by no means the only one to raise this question, but unlike, say, the American Claes Oldenburg, Dubuffet's objections could not be assuaged. Dubuffet typified another response more common to European than American artists: he was solely interested in securing technical and financial support for a project he had already decided on; not for him the iterative give-and-take process of working through a problem and arriving at a solution with engineers.

Oldenburg, for his part, had submitted a detailed proposal for a radically revamped contract between artist and museum, one decidedly more favorable to the artist. Tuchman offered an equally detailed response, explaining why the terms of the contract were non-negotiable. Both Oldenburg's critique and Tuchman's reply were reprinted in full in Tuchman's introduction to the report and are included here. Also reproduced here is the section concerning Robert Rauschenberg. One of the prime movers of the widely heralded Experiments in Art & Technology (E.A.T.), also established in 1967, Rauschenberg was in a unique position to compare and contrast the two programs. "You started from the idea of art," he wrote to Tuchman and his curatorial colleagues. E.A.T., he claimed by contrast, was "not involved in esthetics." Yet, despite the two programs' differing points of departure, he added, "I don't think your problems… have been any different from ours."

Of particular interest to students of the Los Angeles art scene was the unrealized collaboration among artists Robert Irwin and James Turrell and engineer Ed Wortz (of the Garrett Corporation's Life Sciences Division). Irwin and Turrell had both recently begun making works that challenged ordinary perception and were interested in learning more about the psychology and physiology involved. Wortz introduced them to such phenomena as Ganzfeld effects and anechoic chambers, in which the silence is so absolute that occupants can hear their own blood coursing through their veins. The team discussed creating an installation at the museum that would combine these two phenomena, but soon rejected it as impractical. Then, to the surprise of his collaborators, Turrell, with little or no explanation, suddenly announced his withdrawal from the project. The report attempts to grapple with this mystery and notes that, while Turrell withdrew, Irwin and Wortz developed an ongoing relationship out of their LACMA collaboration, organizing a National Symposium on Habitability, which brought together a dozen scientists to explore ways to create a more livable world.

The following essays reproduce the curatorial essays and entries by selected artists.

William Hackman is a Los Angeles-based arts journalist who has written extensively about art, music, and theater.

Introduction: A Report on the Art & Technology Program of the Los Angeles County Museum of Art, 1967–1971

Maurice Tuchman

In 1966, when Art and Technology was first conceived, I had been living in Southern California for two years. A newcomer to this region is particularly sensitive to the futuristic character of Los Angeles, especially as it is manifested in advanced technology. I thought of the typical Coastal industries as chiefly aerospace oriented (Jet Propulsion Laboratory, Lockheed Aircraft); or geared toward scientific research (The Rand Corporation, TRW Systems); or connected with the vast cinema and TV industry in Southern California (Universal Film Studios). At a certain point—it is difficult to reconstruct the precise way in which this notion finally emerged consciously—I became intrigued by the thought of having artists brought into these industries to make works of art, moving about in them as they might in their own studios. In the beginning, as I was considering this idea as just an abstract concept, I had few concrete visions of what might actually result from such exchanges. Indeed I was not certain whether artists of caliber would desire such involvement with industry. And if they did, and an organized program could be instituted to give them such opportunities, I had no idea how to go about persuading corporations to receive artists into their facilities—nor for that matter, why they should want to.

In reviewing modern art history, one is easily convinced of the gathering esthetic urge to realize such an enterprise as I was envisioning. A collective will to gain access to modern industry underlies the programs of the Italian Futurists, Russian Constructivists, and many of the German Bauhaus artists. Within these movements, no intensive effort was made directly to approach industrial firms in order to harness corporate machinery or technology, or systematically to expose artists to their research capabilities. Still, the impulse to do this is well documented. A need to reform commercial industrial products, to create public monuments for a new society, to express fresh artistic ideas with the materials that only industry could provide—such were the concerns of these schools of artists, and they were announced in words and in works.

During late '66 and early '67, I began studying the nature and location of corporate resources in California. In November 1967, I went to the Museum's Board of Trustees, members of which were significantly involved with over two dozen West Coast companies, to outline my proposal and to elicit advice and support. As individual entrepreneurs, the Board members were rather indifferent to the experiment, and as Trustees they resisted having the Museum commit itself, and me, to such an undertaking. The proposal appeared to them too vague and open-ended, and the budget almost impossible to predict. I argued that I would raise personally the great majority of funds to get the project underway, and that if I failed to do this, we would then simply drop the scheme before it was made public, avoiding any embarrassment or significant financial loss to the institution. Other than on a practical level, I maintained that this project was a proper undertaking for a museum, and represented an opportunity to play an innovative role. It would draw attention to the acknowledged need in the U.S. for institutions responsive to the interests of society—in this case, the interests of artists and perhaps even of businessmen. The Board gave me tacit consent to go ahead and study the possibilities, with the program still subject to their approval.

I prepared a case with which to solicit corporation involvement, centered on three main lines of approach that I calculated to be of interest to the business community. I argued that corporate donations to the arts, which were infinitesimal compared to support of medical and educational facilities, should be enlarged. This would benefit them as much as the recipient museums, operas, theatres, etc., since businesses benefit from proximity to thriving cultural resources in attracting talented personnel. I also pointed out that the companies' collaborations with artists might well result in major works of art, and I decided that one work of art made with any significantly cooperative corporation should be offered to that corporation. (It became clear very early that a high proportion of the companies would view this possibility as a salient motive for collaboration.) Most importantly, I argued that companies might benefit immeasurably, in both direct and subtle ways, merely from exposure to creative personalities.

These arguments may have been substantive, but there remained the problem of presenting them to the right people. I had drawn up lists of corporations I felt should be solicited, but it was difficult to obtain appointments with their presidents. (I realized then that it would be fruitless to see public relations people—or anyone other than the man at the top who could sign the check and delegate authority.) In spite of the aegis of the Los Angeles County Museum of Art, it would typically take six phone calls and two letters, over a period of six months, to effect a meeting, and even with such protracted efforts few interviews were arranged. When I did get past the front door, the response from corporation executives was usually encouraging, but the overall rate of progress was much too slow.

In June 1967, an article in the *Los Angeles Times* mentioned my plan to "bring together the incredible resources and advanced technology of industry with the equally incredible imagination and talent of the best artists at work today." Mrs. Otis Chandler, wife of the *Times*' publisher, was intrigued with the story and telephoned me about it. I asked Missy Chandler for her assistance in arranging appointments with corporation executives. She asked whether the Museum's Board was not the appropriate vehicle for this operation. Informed that no Trustee had shown much interest in participation when I had presented the Board with my idea, she agreed to help. Mrs. Chandler's intervention proved immediately effective. She became primarily responsible for the involvement of over a dozen corporations in the now accelerated program.

In late 1967, we began the process of contacting over 250 companies, of which eventually thirty-seven joined the program in various ways. As encounters with corporation executives took place, the logistical guidelines and the scope of the program were gradually clarified. I soon realized that, for practical reasons, the program would have to be limited to companies located in the state of California. (Much later, we were able financially to extend outside the state, and companies located in Indiana, Illinois, Ohio, and New York State joined Art and Technology.) We could not, in the beginning, know how much money a company might donate to the Museum's general fund on Art and Technology before an artist took up residence. We discussed various figures, from three to fifteen thousand, before settling on $7,000 as the amount we would request as each corporation's initial financial obligation. This somehow emerged as the optimal sum, beyond which very few companies would commit. Later, we learned that many corporations calculated their pledge in a ratio of two to one: the $7,000 donation to the Museum suggested to them an expenditure of $14,000 to the artist. There was also the question of how long the companies would agree to have artists in their facilities. We realized that most companies, before signing a contract, would want an escape clause in writing to which they could refer should they desire early termination of the project. It would have been preferable to keep this open, allowing the artist and company to themselves decide when to end the relationship. Unfortunately we were forced to see that no company would initially agree to have an artist in residence for longer than three months.

Many executives, however, indicated that if the collaboration developed interestingly, they would allow it to continue naturally. In fact, when the artist wanted to extend his residence, he was able to do so. Still, there was an intrinsic sense of limitation suggested to certain artists by the expectation of a three-month project. Anticipating a restricted time span, some artists undoubtedly inhibited the scope of their esthetic conceptions.

Yet another factor needed clarification before we could outline the terms of company obligations. Many executives wanted to know rather precisely how much financial support and staff time would be expected from them after an artist came to work. But it would have been impossible to estimate budgets from companies as diverse as, for example, Rand and Lockheed or JPL and Kaiser Steel. And it was imperative to have identical contracts with each participating company—as it was to have identical contractual agreements with the artists. We naturally wanted to avoid setting any advance financial limits on collaborations. Obviously a key motive in the program was to allow the chance of one or both parties being stimulated to extend their commitment out of sheer enthusiasm.

Few corporations questioned our total right to select artists for them. It should be noted that corporations had the option to "approve" the artist before he took up residence: such approval is of course implicit, but by making it explicit a certain degree of company wariness was eliminated.

In April 1968, I met with the Board of Trustees for the second time to deliver a progress report. I anticipated that we could enlist the financial support of at least twenty corporations, to the amount of $140,000, as a straight donation to the Museum for use as needed in operating the program—to cover artists' payments, transportation, and installation costs. According to my prospectus these twenty companies additionally would each take an artist into residence. I requested $70,000 from the Museum as its share in supporting Art and Technology for the 1968-69 fiscal year. (Perhaps unconsciously, I had adopted the businessman's strategy—but in reverse ratio.) The Board sanctioned the plan, provided that I obtain written agreements from ten corporations before announcing the program officially. I drew up a contract which took into account three different kinds of corporation participation. I knew that certain companies would be eager to have an artist in residence, but for various reasons, often having to do with anticipated stockholder reaction, would elect not to write a check to the Museum. Other companies would financially support the program and might desire collaboration, but an artistic use of their facilities was technically unlikely. We established categories of corporate involvement: Patron Sponsor Corporations, who would agree to take an artist into residence and also donate $7,000 to the Museum; Sponsor Corporations, who would take an artistinto residence but donate less than $7,000 or nothing at all; Benefactor Corporations, asked to simply donate at least $7,000 to the Museum; and Contributing Sponsor Corporations, who would donate only services or less than $7,000. Patron Sponsors had the "option to receive one principal work of art resulting from the collaboration"; the other categories of corporations did not have this option. [See pp. 358–62 of this volume for the complete text of the Patron Sponsor contract, which differs from the others only in regard to the factors just noted.]

A brochure was drafted and printed at this time for corporation executives:

> Art and Technology is the working title[1] of a major project now being planned at the Los Angeles County Museum of Art. The purpose of this enterprise is to place approximately twenty important artists "in residence" for up to a twelve week period within leading technological and industrial corporations in California. Works of art resulting from these cooperative endeavors will be exhibited at the Museum in the Spring of 1970. International developments in art have provided the impetus for this project: much of the most compelling art since 1910 has depended upon the materials and processes of technology and has increasingly assimilated scientific and industrial advances. Nevertheless, only in isolated circumstances have artists been able to carry out their ideas or even initiate projects due to the lack of an operative relationship with corporate facilities. Our objective now is to provide the necessary meeting ground for some eminent contemporary artists with sophisticated technological personnel and resources. Naturally we hope that this endeavor will result not only in

significant works of art but in an ongoing union between the two forces. It is our conviction that the need for this alliance is one of the most pressing esthetic issues of our time.

During the past six months, we have made numerous preliminary contacts with corporation presidents in California. These discussions have served to corroborate our feeling that the advantages to participating corporate concerns are manifold. Since the project will be fully documented by CBS television for a network special, as well as being systematically publicized through other media, promotional benefits to industries can be considerable. It is expected that collaborating technical personnel may gain experience directly valuable to the corporation, as indeed has already occurred in the plastics industry. All expenses, including corporation staff time and materials, are tax deductible; in addition, Patron Sponsors will have the option to receive a work of art issuing from this collaboration. In many cases, the art works will exceed in value the total expense of the corporation's contribution.

Corporations are asked to participate in one of five categories:

1. A Patron Sponsor Corporation takes an artist into twelve-week residence within one of its corporate facilities to work in a specific area with the corporation's personnel and materials. A Patron Sponsor Corporation also contributes $7,000 to the Los Angeles County Museum of Art to help defray the extraordinary expenses of the project. As noted above. Patron Sponsor Corporations have the option to receive a work of art issuing from the collaboration.

2. A Sponsor Corporation is a manufacturer who arranges to have an artist work within its plant, using specified personnel and materials, but makes a smaller contribution to the Museum's special fund for the project.

3. Contributing Sponsors donate materials and/or services to the Los Angeles County Museum of Art for this project but do not take an artist into residence.

4. Service Corporations provide specialized services such as transportation, housing facilities for visiting artists and technical consultation.

5. Benefactors are non-technical, non-manufacturing firms who donate $7,000 to the Museum's special fund for "Art and Technology."

Industries located primarily in Southern California are now being approached for their cooperation. By May, 1968, a preliminary list of ten corporations should be made public. Beginning at this time and throughout 1968 and 1969, artists will be contacted by the Museum and asked to submit project proposals. Artists will be approached largely on the basis of the quality of their past work and expressed interest in specific technological processes. Projects to be implemented will be chosen by the Museum on the basis of both potential esthetic stature and practical feasibility. Corporations will be presented with an appropriate work proposal for their approval in principle; scheduling will then be arranged by the corporation, the artist, and the Museum. The initial proposal submitted to corporations will be sufficiently clear to indicate the extent and nature of the corporation's involvement. It is understood that this preliminary plan may change considerably during the course of the collaboration between corporative personnel and artist.

Participating artists will sign a contract drawn up by the Museum setting forth rules and conditions. Non-local artists receive round-trip economy air fare plus $20 per diem expenses and Honorarium of $250 per week. Local artists receive the same Honorarium.

Corporations will enter into a written agreement with the Los Angeles County Museum of Art in advance of the scheduled residence periods.

In May 1968, IBM and American Cement Corporation signed Patron Sponsor contracts and becamethe first contracted participants in Art and Technology. In October we officially announced the program. Press coverage in the *New York Times* and *Los Angeles Times* occasioned by this announcement were to help us in attracting most of the remaining corporations we required to make the program work. Two months later we listed the companies contracted to date in the first of eleven monthly reports:

PATRON SPONSORS
1. American Cement Corporation
2. Ampex Corporation
3. International Business Machines Corporation
4. Kaiser Steel Corporation
5. Litton Industries
6. Lockheed Aircraft Corporation
7. Teledyne, Inc.
8. The Garrett Corporation
9. Universal City Studios, Inc.
10. Wyle Laboratories

SPONSORS
1. Eldon Industries, Inc.
2. Hall Inc. Surgical Systems
3. Hewlett-Packard
4. Norris Industries Inc.
5. Philco-Ford Corporation
6. The Rand Corporation
7. TRW Systems

CONTRIBUTING SPONSOR
1. Twentieth Century Fox Film Corporation

BENEFACTORS
1. Bank of America
2. North American Rockwell Corporation

Much of our energy now shifted from negotiations with companies to the task of selecting and touring artists. Our discussions with artists were often strangely intense, and there was more opposition on their part to the goals of Art and Technology than we had expected to encounter. I had, for example, a particularly emotional conversation with Robert Irwin, who told me that many artists resented certain aspects of the program as they understood it: they felt that it was unfair for the Museum to take possession of the works created; that the Museum was primarily interested in producing an exhibition, rather than in arbitrating the process of interaction as an end in itself; that artists would be pressed by the Museum into making works for these reasons; and that they would not in fact be given access to experimental situations within companies which were not demonstrably related to the materials or processes of their past work. It was not difficult to disabuse Irwin and others of their misconceptions about property rights to the works of art, since the Museum, under the terms of the contracts, had no right whatever to receive works of art; this was made clear both in the corporation agreements and in the contract we were to make with artists.

The issue of our intended exhibition of the works made through Art and Technology was more complicated. My primary motive in attempting to make the resources of industry available to artists was emphatically not to simply mount an exhibition. I thought it would be fascinating to observe a potentially vital reciprocal process, and I expected personal and professional gratification from my role as catalyst in establishing the vehicle for such connections. I believed that it was the process of interchange between artist and company that was most significant, rather than whatever tangible results might quickly occur. Obviously, the probability that works of art would be created was not to be ignored—I knew that many artists would want nothing more than physically to realize esthetic ideas that may have remained in their minds only because of the technical difficulty of executing them. In short, one could reasonably expect that from twenty artists, each working several months in twenty corporations, some kinds of exhibitable things were likely to emerge. I did not regard the “success” or “failure” of the project as resting mainly with the quantity or even quality of the “results.” But I also tried to indicate to Irwin that, given the rationale for such an experiment (which he admitted willingly), and given that we were *an art museum* of the county of Los Angeles, it was only reasonable that the institution would attempt to show something to its audience for its efforts. I did not feel that this would result in undue pressure being placed on the artists to produce certifiable art objects. Interestingly, Irwin himself was to provide perhaps the outstandingly valuable example of a purely interactive situation, issuing in no exhibitable object, although he did seriously contemplate making an environmental work based on his research at the Garrett Corporation’s Life Sciences Department. I firmly believed, moreover, that to schedule an exhibition—and thus work toward consignment deadlines—would not only give us an advantageous psychological goal, but would prove helpful in eliciting cooperation from industry. By gearing our efforts toward a culminative event, a quality of excitement and an increased dedication were brought to bear on our labors for this nebulous and prolonged endeavor. Art and Technology was an experiment—and it had to be made coherent and explicit in order to be validated.

The question of selecting artists for participation and deciding which artist should go where was a difficult one and related critically to the problem of making possible true "collaboration" as opposed to mere "artmaking." We wanted viable, productive connections to come about, but it was important to us that these reciprocal endeavors be challenging and rewarding to both the artist and the scientist or engineer by provoking them to reach beyond habituated patterns. However, we did not suppose that artists of character, accustomed to working with a particular vocabulary of forms, would be likely to abandon suddenly the esthetic means developed over a lifetime merely because they were cast into an unfamiliar situation by taking up residence in a company. It was our intention simply to offer uncommon opportunities for those artists inclined to exercise them. How these opportunities might be used was exclusively the artist's concern.

Our intention from the outset of Art and Technology was to pay artists for time spent on the project, while they were in corporate residence, and later when installing works at the Museum if their presence was needed. Funds raised from company donations allowed us to remunerate artists at a considerably higher rate than was conventionally allotted by non-profit institutions—international symposia, print workshops, etc. We also attempted to structure a situation whereby most of the works of art made collaboratively would become the property of the artist. To overcome any potential conflict between the property rights of artist and company (the issue arises only with Patron Sponsor, not Sponsor Corporations), we advised artists concerned with ownership of works to plan their work in series, so that they would acquire most of the results. A t the same time, companies were informed that they should expect artists to make multiple works if the artists so desired. The decision as to what constituted the "principal work" (the term stated in the contract for Patron Sponsor ownership) resided with us.

We drew up a contract for artists to include these points and to make clear that they were connected to the Museum, rather than the company, in terms of monies and possible obligations.

Most artists signed the contract, but Claes Oldenburg dissented and raised some interesting questions. Oldenburg had been devoting considerable energy to the study of artists' contracts with dealers, galleries, printmakers, etc., over the previous year. He is possessed of a forensic acumen that makes attorneys—including his own—envious.

He wrote to me on January 27, 1969:

> These are my recommendations for a changed contract for the artist involved in the Art and Technology project. I want to emphasize again that the contract is an integral part of the collaboration of art and technology. To ignore contract-making would be to remain with the old separation, where the artist says: I don't care as long as the thing gets done, a snobbish attitude which I don't feel fits the present and very American context of artist-industry cooperation. We're not engaged in creating property for the County Museum, but working out terms which are bound to influence future collaborations of this sort.
>
> 1. Travel: I'll have to travel out to L.A. several times (see my proposed schedule letter of January 18). I have already taken my allowed round trip (coach! which I changed to first class, paying difference myself) just to meet with Disney reps. According to Museum further trips will come out of my combined honorarium/diem (letter of January 17).
>   - I demand that each round trip be paid for, first class, not from the hon./diem.
>   - I also demand transportation be paid for materials I may bring out and their return. Don't corporations get spec. rates?
>   - Also that transportation back be guaranteed for works not acquired by the Museum though made during the Museum project.
>   - Also for the "principal work" in the event it is rejected by the patron sponsor and the museum.
>
> 2. In working with the unknown quantity of an industry, the artist engages in a risk esthetically, and he must have safeguards which assure him complete control over the result.
>   - I demand that the artist should have the option to resign from the project at any time if he is not satisfied with its progress.
>   - Also that the artist should have the option to reject the "principal work" or any work made that does not meet his standards, and refuse the exhibition of the work by the Museum.
>   - Problems in installation of the piece may

arise and the installation of work by the Museum, if the Museum exhibits it should be subject to the artists approval. Also, if installation help is needed, the Museum should pay the artist's trip to LA to help plus expenses.

3. Paragraph 8 has been amended so that the artist retains ownership of work made during the project not "integral" to the "principal work." "Integral" should be defined as part of the work, or essential to it. Not for example preparatory sketches or models.
   - Also, the artist does not sign over his copyright of any work made during the project including the "principal work."

4. The artist takes a risk in exposing himself and his work to commercial exploitation promised in the prospectus to industry: "…promotional benefits can be considerable." Not however to the artist.
   - Therefore, publicity by the Museum or industry must be subject to the artist's approval and/or guaranteed not to violate his best interests. An example of this occurs in the Times article where a spokesman for the industry (Disney) states his expectations of what will occur: "I think show-biz is a good thing for an artist to learn. It helps him to clarify his ideas…" Granted, this info was obtained by the Times reporter, not from a release, but seems to me ominous.

5. A reading of the prospectus to industry will indicate how much the burden of sacrifice is on the artist, not on the other collaborators. Industry gets a tax deduction for help and materials provided, and presumably also for their donation of $7,000 to the project and their donation of the "principal work" to the Museum. That they will donate the work is tacitly supposed, though they are also promised the benefit of receiving art works (plural) which "will exceed in value the total expense of the corporation's contribution."

The other "collaborator"—the Museum, receives free a work of the artist it might otherwise have had to buy, depriving the artist and his agent of a sale. This gift comes with no strings attached and the right to resell—without any percentage to the artist—to anyone, after five years, the right to exhibit or not, etc., all the benefits had they bought a piece.

The artist receives no tax breaks, and is to work at a reduced rate for three months, supporting himself in a foreign place at an impossible per diem rate, and in addition, expected to pay his own transportation etc. Say he will work at approximately one fifth his normal rate. This is not a "collaboration" and is not set up to encourage the artist to do his best, rather to get it over with as quickly as possible, if he was unfortunate enough to sign the contract.
   - Therefore, I demand an increased "honorarium" of $6,000, which may be paid on an installment basis out of which no other expenses are to be lifted, such as plane tickets.
   - A realistic per-diem expense of $40, considering hotel rooms, eating out, need of a car to get to Glendale. This to be paid any time the artist is in LA working on the project including installation time in 1970.

One should consider that the artist may be thinking about the project in his home base before, during or after his execution of it in LA— this is time not mentioned in the contract. Also that no studio facilities or housing arrangements are guaranteed or provided, and that a certain amount of time will be used up in just getting settled.
   - If it is at all possible to arrange, the artist should participate in any tax benefits of the gift to the Museum of his work. He should definitely receive a percentage in the event the work is sold by the Museum, especially if it is to a private party.

I replied to Claes on February 11, 1969:

> Let me address myself to your comments point by point. The four starred points you make in "1" cannot be accommodated for any artist under the present budget of the project. Changes of this nature would have to hold, of course, for

all of the artists, and if these changes were made, the complications and added—unpredictable—expenses would obviate the project entirely. Considering that all the expenditures made by the Museum, including preparations of different kinds and fund-raising, are for the purpose of a single exhibition, and not for acquisition of works of art, I think that the provisions for artists are fair.

In regard to "2": The artist has implicitly the "option to resign" in his contract, and to "reject the 'principal work' or any work made that does not meet his standards, and refuse the exhibition of the work by the Museum." If you would like these points stated more explicitly in your contract, we can do this. So far as installation is concerned, I know you understand that in *any* exhibition of a number of artists' works, every artist could not and has never had the right to place his work where he wants it regardless of other works. However, in some cases, specific works may be designed with a particular installation area in mind, and thus the artist would of course have that location reserved for his work. If you wish to select a site in advance of the completion of your project, we shall do our best to accommodate you. We would naturally solicit the advice of artists as to placement of the works in any event, and if help is needed, of course the Museum should pay the artist's trip to Los Angeles for this purpose plus expenses.

Re "3": "Integral" clearly does not refer to preparatory sketches or models; and there can similarly be no doubt that the artist "does not sign over his copyright… "

Re "4": Beyond the safeguards taken by the Museum on the artists' behalf, it would be impossible to guarantee that some independent journal will not negatively criticize an artist's work or in any number of ways "violate the artist's best interests." I know you realize this and I doubt that you would want it otherwise. So far as comments by corporation personnel go, which is what you have in mind, the Museum, while it cannot require that every company man clear an answer to a press question with us, has emphasized and will continue to request of corporations that every reasonable effort be made to clear public statements with the Museum.

Re "5": It's not clear to me what you mean by corporations "are also promised the benefit of receiving art works (plural)…" since a Patron Sponsor has only the option to receive a single work. Other works automatically belong to the artist; moreover, all works executed by Sponsor Corporations (as opposed to Patron Sponsors) go to the artist. Almost half of the corporations involved do not stand to receive any work of art. Furthermore, it is quite possible that none of the Patron Sponsors will offer a work to us. This should indicate that we have not structured the project to gain "free" art works for the Museum. Your point about the Museum's right to resell a work should it be offered as a gift to us can be changed to suit you, since it is most definitely not our intention to sell any major works from the collection. If you like, you may stipulate that any gift of your work made to the Museum may not be sold in your lifetime.

The honorarium figure was the maximum sum the Museum could budget and it will not be possible to change it at this time for any, and therefore all, of the artists. I very much agree that a $40 per diem expense is more realistic than the present expense, but our figure is based on County of Los Angeles regulations. This has always been a serious problem for Curators and to date an insoluble one. I can only offer to alleviate your expenses by covering them as much as possible while you are here, and by arranging to pay you for a special event or two which could make up the monetary difference between your desires and what is called for in the contract. I do not think that time spent in planning the project can be estimated or budgeted. I do think that any possible tax benefits accruable to artists should be encouraged, but I cannot yet conceive of how this might be effected.

Despite a certain suspiciousness of the project on the part of some artists (exclusively American artists, incidentally, and particularly Los Angeles ones), only three artists, out of the total of sixty-four we approached, were categorically opposed to association with the Art and Technology program from the outset. They are all extraordinary artists, and I was at considerable pains to make certain that they did not misunderstand the premises of Art and Technology. Frank Stella simply couldn't abide even the idea of working in an industrial plant. Jasper Johns felt similarly; he patiently explained to me that the content of his art is about the move of a hand from one point in space to another nearby, and that to him the possibility of moving in a social situation to make art was unthinkable. Ed Kienholz, on the other hand, though not opposed to the idea in principle, could not imagine what industry could do for him that he couldn't do for himself.

Every other artist we approached was in theory willing to pursue the collaborative opportunity at least to the extent of touring corporations. Personalities as diverse as Jean Dubuffet and James Byars, Jules Olitski and George Brecht, Roy Lichtenstein and Jackson Mac Low, were interested in exploring the notion of coming to California to work in a corporate setting. I had expected resistance from artists, aside from the reluctances discussed above, on "moral" grounds—opposition, that is, to collaborating in any way with the temples of capitalism, or, more particularly, with militarily involved industry. This issue never became consequential in terms of our program, perhaps because the politically conscious artist saw himself, to speak metaphorically, as a Trotsky writing for the Hearst Empire. However, I suspect that if Art and Technology were beginning [in 1970] instead of in 1967, in a climate of increased polarization and organized determination to protest against the policies supported by so many American business interests and so violently opposed by much of the art community, many of the same artists would not have participated.

As we set about contacting artists we had certain definite guidelines. First of all we were determined to involve artists of quality, regardless of their style of work, and we were not especially seeking artists whose approach was "technologically oriented." If anything, we may have been prejudiced against those artists who had been deliberately employing the tools of new technology for its own sake, because so many recent exhibitions centered on this notion had been of little interest artistically. We were also determined to discuss Art and Technology with as wide a range of artists as possible—Europeans and Americans, Japanese and South Americans; artists of great repute along with unrecognized figures; artists in their sixties and artists in their twenties. We felt that only by exposing diverse types of artists to corporations could the value of the premises of Art and Technology be tested. Therefore we tried to approach not only painters and sculptors but also poets and musicians (thus involving Karlheinz Stockhausen and Jackson Mac Low). We tried to prepare for unanticipated requests from artists, and fortunately the structure of Art and Technology permitted us a degree of flexibility when necessary. For example, certain artists we approached wished to collaborate with a fellow artist (Irwin and James Turrell, Stockhausen and Otto Piene, Robert Morris and Craig Kauffman) at a particular company; or an artist might extend his period of residence over a year, or even two, by leaving and returning to the plant several times (as did Lichtenstein, Rauschenberg, Richard Serra and Jesse Reichek).

Over a period of more than two years, from late 1967 to 1970, while we were contacting artists, we also received seventy-eight unsolicited proposals from artists who had read or heard about Art and Technology. All of these proposals were studied carefully and many were reconsidered several times with various companies in mind. None, in the end, were accepted. These projects involved, most often, the areas of transduction; of plastics used in a variety of ways; of computers; and of lasers and holography. Many artists wanted to make total, elaborate, and integrated environmental situations. Generally, the unsolicited proposals were made by relatively unknown artists. There was a rather high percentage of proposals received from pairs or groups of artists wishing to work together. There was also a high proportion of women artists. Few engineers or scientists approached us. There were one or two cases of eccentric, "primitive" or folk-traditional artists who wished to make mad machines through Art and Technology. We were usually reluctant to follow through on proposals which seemed too completely designed or thought out in advance, so that the corporation's role would simply be a question of executing a previously conceived plan, rather than collaborating actively in both the conception and execution of an idea.

Our method of approaching artists did not substantially vary from the outset of the program. Each artist was visited, or came to the Museum, and was shown material on one or more (usually four) corporations that we thought might be of personal interest. Each artist was invited to tour corporations before deciding on the nature of work he might wish to do.

These tours were usually conducted by a corporation public relations man, often a former engineer, who would introduce the artist to department heads in each division. Often a conference of these departmental chiefs, along with other executives, would be held to answer the artist's questions. Sometimes a film on the company's total operations was shown—this was often helpful. Cal Tech physicist Dr. Richard Feynman, who served as Consultant to Art and Technology, might attend, and one of us—Jane Livingston, Gail Scott, James Monte, Hal Glicksman or myself—was always there. It was quickly apparent that the presence of a congenial company representative was a critical factor. With an alert, sympathetic engineer, the tour was likely to be lively and stimulating. Without such a person to lead us into interesting areas of discourse, the facility itself would have to be intrinsically compelling, with an obvious potential art medium, for the tour to succeed. Generally one or the other of these conditions prevailed. If they did not, the tour could be a lugubrious and wearying exercise.

In originally considering appropriate artist-corporation matches, certain apt connections came to mind readily and with forcefulness: Dubuffet at American Cement Corporation, Vasarely at IBM, Oldenburg in Disneyland, Lichtenstein at Universal Film Studios, Andy Warhol at Hewlett-Packard (for holography). These five combinations seemed natural but not too pat. We expected other matches to come about less on the basis of our suggestion than through the process of exposing artists to various companies. Many of the observations made in regard to these few artists apply as well to other collaborations; I cite them as key examples of the kinds of issues and problems confronted throughout the program.

Each of these artist's work suggested to us a process which was then available in a contracted company. For several years Dubuffet had been working with cement, making sculptures and bas-reliefs on a limited scale. Vasarely's plotted paintings called to mind a computer company like IBM. Oldenburg's proposals for monuments and his anthropomorphizing of objects and animals made the facilities at Disney seem almost necessary. Roy Lichtenstein had started making his first sculptures, and Universal's exceptional capacities for non-load bearing construction (with staff, a material made of plaster and fiber) seemed of likely interest. (In fact, the artist ignored this possibility and went directly to work with film.) Warhol's work suggested to me a latent relationship to holograms.

We approached each of these artists primarily with the companies noted in mind, and each was responsive. Most of these artists became deeply involved with Art and Technology and eventually made unusual works of art as a consequence of their connections to companies, although not always with the particular company with which they were first associated. Lichtenstein stayed with Universal, but Oldenburg and Warhol were to work with different companies and techniques than those visualized originally. The other two artists also became involved in the program but did not develop work to a point of resolution. The experiences of both Dubuffet and Vasarely were similar. Each is European and over sixty. They responded to my presentation of Art and Technology with a carefully planned proposal for a monumental work. Their plans called for fabulous expenditures, straining even the grandiloquent capacity of American industry; but there was a distinct reluctance on these artists' part to engage with engineers and administrators in a true give-and-take manner. The concept of personal dialogue—critical to the nature of Art and Technology—was not at all intriguing to these artists.

In contrast to the Europeans, most American artists chose—often from a bewildering array of possible techniques—a relatively simple process, approaching the problems implicit in it with single-minded tenacity. This was clearly observable early in Art and Technology in the experiences of Lichtenstein, Oldenburg, and Warhol. American artists tended to focus on a single technical principle or device. To do this properly, it was found, was no easy matter. Lichtenstein's project at Universal seemed "primitive" to their sophisticated technicians, at least until the real nature of his desire became apparent, for Lichtenstein wanted a pictorial *quality* many times more precise than is needed by Universal for their own purposes. Andy Warhol finally opted to *reveal* an integrally imperfect mechanical system, rather than make a virtuoso display by any conventional definition. Oldenburg was exclusively concerned with making mechanized versions of monumental sculptures: "make mechanics obviously stated," he wrote to himself at one point. Such a frank, or even ironical, attitude toward the machine has long been characteristic of many American artists (Sheeler, Schamberg, Rube Goldberg), albeit with a certain romantic or comic nuance.

Aside from these artist-company connections, which got the program underway, we generally went to artists with less specific notions than these in mind. Few artists we approached (Donald Judd may be the sole exception) expressed interest in reducing possible action with a company to *in absentia* fabrication. An artist might indicate to us his interest in a specific process, as, for example, Robert Morris who referred to heating and cooling devices, leading us to research our companies for this capacity. More often an artist would have no notion at all about what a corporation might have to offer, but almost all wanted to have a look at them. After touring several companies most artists formulated a more or less specific plan of attack: either a proposal for an art work or a request to explore a particular facility in depth. There were actually only four exceptions to this, that is, artists who toured companies but saw nothing to inspire an idea or a desire to work within them. These four artists were Philip King, who flew from London to visit Kaiser Steel, Wyle Laboratories and American Cement; James Rosenquist, who toured Container Corporation of America, Ampex and RCA; Peter Voulkos, who went to Norris Industries; and John McCracken, who visited Norris Industries, Litton Industries and Philco-Ford Corporation.

Most of those artists who became acquainted with corporation facilities wanted to take up residence at a particular firm. Over fifty artists *wished* to collaborate; twenty-three of those actually did, spending varying periods of time at a company or companies. (This was roughly the percentage of successful matches we had anticipated achieving when we drew up the budget a year earlier.) We can now conclude that two factors largely determined whether or not a collaboration would result from our preliminary efforts. The first consideration had to do simply with the artist's personality—most particularly his ability to communicate with diverse kinds of people. This was of course a subtle factor, not quantitatively definable, but observable nevertheless. Les Levine's somewhat casual, free-wheeling manner, for example, did not ingratiate him to the people at Ampex; Iain Baxter's seeming frivolity was worrisome to Garrett; Len Lye's definiteness about his demands and impatience with apparent technical limitations did not inspire the Kaiser personnel. But of course each company responded differently: IBM personnel were perhaps offended by Jackson Mac Low's unconventional appearance and dress and possibly by his politics, but another computer company (Information International) found him entirely acceptable. Much depended on whom the artist might meet at the start while touring a company: Robert Whitman met optics engineer John Forkner at Philco-Ford, and the two personalities were immediately sympathetic, despite a general doubt on the part of the company itself, while Robert Morris could never find a true line of communication with anyone at Lear Siegler, Inc.

Often contracted corporations would hesitate to take an artist into residence when, for technical reasons, they anticipated having to sub-contract a major part of the project. They wished to utilize indigenous techniques and materials. This was the second key factor determining the ease or difficulty of setting up collaborations and was basically more important than the issue of personalities. This problem occurred frequently, but it could not have been avoided. The central premise of Art and Technology rested on a one artist-one company nexus. Early in the program, the need for a number of back-up companies to provide raw materials was anticipated, and in fact we sought commitments from firms such as Rohm and Haas, for plastics. But it was quickly apparent that companies required singular identification with an artist in order to produce and perform significantly. Companies would not give impersonally, so to speak, any more readily than patrons of museums make donations anonymously. To alleviate this problem we invented the category of Benefactor Corporation: we solicited $7,000 donations from banks and other nonparticipatory firms to be allotted largely for the acquisition of materials or specialized services not made available by a sponsoring corporation. However, we persuaded only three companies to enter Art and Technolog in this category.

The factor of anticipated sub-contracting implicit in an artist's proposal was primarily instrumental in the failure of Michael Asher, Hans Haacke, Max Bill, Stephan Von Huene, Takis, Otto Piene, Karlheinz Stockhausen, Eduardo Paolozzi, and others to make corporation connections. Some corporations also rejected project proposals for reasons of excessive in-house expense, of course, but this happened less often: IBM studied Vasarely's plan for weeks and concluded that it might cost up to two million dollars to build and then would only have a life of four years (due to the narrowing life expectancy of successive computer generations); Litton declined Vjenceslav Richter's plan, claiming it would cost over a million dollars; RCA similarly declined to work on Glenn

McKay's project, the cost of which was anticipated at $500,000.

Most of the vital collaborative work done under Art and Technology took place during 1969 and early 1970. Within this period of time, some artists toured the company, returned home, formulated a detailed proposal, entered into residence at a corporation for about three months, executed as much work as time allowed, and left. This was basically the experience, for instance, of R. B. Kitaj, Oyvind Fahlstrom, and Jean Dupuy. These were the comparatively simple exchanges to consummate, partly because the corporations with whom these artists collaborated, or specific divisions within them, are primarily industrial (Lockheed, Heath, Cummins) and partly because of the orderly and sequential manner of working characteristic of these particular artists.

Few cases were so simple. Most artists, as has been stated, extended their residence at a company over a year-long period, leaving and returning several times. This rhythm allowed for generally advantageous results. We observed a definite strengthening and maturing of concepts in the work of Robert Rauschenberg, Rockne Krebs, and Tony Smith, for example. Rauschenberg first visited Teledyne in September 1968, beginning an unusually long series of visits to the company, entailing discussions, the gathering of particular data, acquisition of materials from all over the U.S., testing, etc.: it was not until October 1970 that a final period of residence occurred, and work accelerated; the project is to be realized in February 1971. Krebs' and Smith's experiences with companies were also protracted and concomitantly enriching. However, there were dangerous moments in these prolonged collaborations, for the absence of the artist from a company tended to reduce corporate availability. It was at such times that the Museum's active role was necessary to keep the connection viable.

Since Rauschenberg, Krebs, and Tony Smith each worked with the company they had originally selected, there was a certain coherence in these collaborations in spite of the unusually lengthy period of time involved. With virtually all of the others, however, substantial involvement on our part was mandatory to keep the "marriage" together. Often artists had to leave one company for another. After contracting with us, John Chamberlain developed an ambitious scheme for a work involving diverse odors at a division of Dart Industries' Riker Laboratories. The president of the company rejected the plan. After other trials, Chamberlain became the Rand Corporation's artist-in-residence (following upon Larry Bell's stint there). Wesley Duke Lee came from Brazil to work at Hall Surgical Systems. After two months the company declined further participation, prompting thereby the odyssey of Wesley Duke Lee through Southern California: the artist worked at over a dozen small sub-contracting firms to develop his project, which had been defined at Hall, racking up fourteen thousand driving miles, in a project that was to last eight months. It is still not completed.

The outstanding case of a project taxing the limits of our capacities was that of Robert Whitman at Philco-Ford. Whitman is probably the most experienced "collaborative" artist in the U.S., and, as I noted above, he had the good fortune of locating a brilliant and engaging optics engineer, John Forkner. With the implicit support of the company, a Patron Sponsor, plans for a radical work—technically innovative and esthetically compelling—were drawn up, only to have the company administration flatly refuse *any* funds for construction. The realization of this work required far-flung resources: the artist redesigned his work; the engineer came up with entirely altered plans for construction; a display-fabricating firm was hired to create certain parts; the Laguna Beach Unitarian Church Fellowship pressed one hundred citizens into voluntary service; and finally the United States Information Agency provided scores of laborers (when the work was first shown at Expo 70) for the final stages of construction. Similar nightmarish complications threatened to inhibit the construction of works Oldenburg researched and defined at Disney Productions, but in this case we induced Gemini G.E.L. to take over the production of one of Oldenburg's several models, and they did so with unusual efficiency and dispatch.

Given such obstacles as these, twenty artists nevertheless are expected to bring projects to a state of culmination. In virtually every case there was a particular corporation individual who made himself responsible, along with the artist, for the success of the collaboration. Such a man might be primarily an authoritative officer who delegated responsibility, such as R. H. Robillard at Lockheed, or a genuine technical collaborator, such as Forkner at Philco-Ford. In many cases, when a company did give generously of its resources, we came to find hidden, if not unusual, motives for its doing so. Jet Propulsion Laboratory's involvement with Newton Harrison is probably accountable, in part, to the company's desire to move out of space exploration exclusively and identify itself with the larger area of environmental research. Some corporations apparently became involved with us in order to promote a particular product or process (Cowles' Xography) or an area that the company wished to make better known (Garrett's Life Sciences Department). General Electric was eager to modernize their image. Two major companies—involved, not coincidentally, with consumer-type products—contracted with us because of their presidents' social connections with Mrs. Chandler. Three companies—the smallest ones—joined with us solely for the publicity. Some companies were exceptionally cooperative because of a tradition of cultural support dating back for years (Container Corporation of America, IBM, Cummins), but other companies, whose presidents are art collectors, proved difficult to work with, precisely because that knowledge of art created a restrictive bias.

In April 1969, after reading a second article on Art and Technology by Grace Glueck in the *New York Times*, Phyllis Montgomery of Davis, Brody, Chermayeff, Geismar, DeHarak, Associates—the Exhibition Design Team for the United States Pavilion at Expo 70—called me to discuss the possibility of my organizing an exhibition including works made under Art and Technology for the Pavilion. Accordingly, we entered into extensive negotiations with the USIA's Commissioner General (later Ambassador) Howard Chernoff, Deputy Commissioner General Jack Masey, and the Exhibition Design Team. In a formal contract, signed on May 30 1969, we consented to postpone the Museum show for one year and draw from it a smaller preview exhibition for Expo.

The commitment to deliver in time for Expo 70 was a distinct gamble. Our original deadline was tightened, since we had planned to exhibit results of the collaborations in April 1970 at the Museum, whereas all works for Expo had to be installed—in Japan—by March 15 1970. Also, certain inherent conditions restricted the range of potential works for Expo: only American artists could be selected; and a traffic flow of up to 10,000 persons per hour was expected throughout the seven-day week, six-month long run at the Fair. (This astonishing estimate proved to be correct: 10,800,000 visitors poured through the Art and Technology Exhibition in the U.S. Pavilion before Expo closed in mid-September.)

I felt that the risk was worth taking. A fundamental belief in the necessity of giving artists access to industry lay at the heart of Art and Technology, and Expo 70 seemed to me a perfect occasion for demonstrating the validity of this concern to an international as well as an American audience. We had six months' time in which to deliver eight "rooms" of art, for that was basically the way the art exhibition space was designed in the Pavilion. Inevitably those six months were crisis-fraught. The complexity of the logistics involved may be indicated by the fact that when these eight remarkable works were shipped to Osaka, they comprised 15,000 separate components, occupying eighty crates and weighing forty tons. Installation in Japan took ten weeks and involved my continual presence, extended visits by five of the participating artists, several U.S. engineers, a team of designers and architects and hundreds of workmen.

The only "object" in the Expo exhibition was the first work encountered outside the main entrance door of the New Arts Section: Claes Oldenburg's *Giant Icebag*, which was in complex motion for nineteen minutes and forty-five seconds and rested for fifteen seconds. This was the only work that actually existed before the Expo installation: it was tested, and performed perfectly, in Los Angeles in January 1970. Each of the other seven works arrived in Japan in the form of disconnected system components, which were never entirely combined and put into operation until their mounting at the Expo site. The fact that none of us could accurately visualize the Expo show beforehand—even the artists did not know precisely what their works would do in the unforeseen conditions—caused a certain amount of understandable anxiety, as well as excitement. Inside the exhibition space the viewer first found himself in Boyd Mefferd's room. One hundred twenty wall-mounted strobe units flashed in program, causing intense, apparently hallucinatory retinal images (provided the viewer took at least fifteen seconds to allow this to happen; very few did). One next entered Tony Smith's cave, made entirely of corrugated cardboard and illuminated from above by shafts of light. Thousands of octahedra and tetrahedra, shipped to Japan in scored flat sheets, were individually assembled on site and mounted architecturally according to a complicated twelve-foot model the artist had made. After the viewer traversed ninety feet through the Smith tunnel, he came up against Robert Whitman's optical tour de force: a twenty-three foot semi-circular space containing various illusionistic phenomena. Placed against the semi-circular wall from floor to eye-level were one thousand corner-shaped mirrors which reflected to each viewer, regardless of where he stood or walked, *only* his own image, repeated a thousand times. Mounted above eye-level were five pairs of five-by-seven foot pulsating mylar mirrors, in front of which hovered ten eerily bright three-dimensional objects (a pear, drill, goldfish bowl with live fish, a knife, a clock, ferns, etc.). From Whitman's room one stepped into Newton Harrison's forest of five thirteen-foot high plexiglass columns, each filled with glowing gas plasmas, programmed to create varying color-shapes of pure light. In Harrison's room, as in Whitman's area, the viewer was in the dark, seeing mysterious shapes being formed out of light. So too in Krebs' laser room, entered from Harrison's, one perceived light patterns in a dark environment: the piece formed a complex web of red and blue-green pencil-thin beams, crossed, interlaced and in one place extended (through two enormous parallel mirrors) "into infinity." The sense of immateriality in Krebs' sculpture was strengthened by the fluctuation of the light patterns. Into a large alcove at the far end of Krebs' room were placed two 35mm rear projectors for Roy Lichtenstein's two movie screens. Each screen measured seven by eleven feet; the projected film image on each screen was a "moving picture." One image combined film footage of ocean and sky; the other screen depicted ocean surface and a dot pattern above; both screens were split with a horizon-like black line, and the images rocked. From this paradoxically anti-filmic evocation of "nature" one turned to Andy Warhol's work, which also dealt with man's transformation of nature into artifice: it was a giant field of three-dimensional printed flowers, seen through sparkling transparent curtains of water falling like rain.

Even with the wide diversity of artistic styles presented in the Expo exhibition, certain singular characteristics were shared by the eight artists. In fact, many of these qualities now seem to apply to most of the other artists in the Art and Technology program, such as Robert Rauschenberg and Jesse Reichek. Primary among these is an emphasis on transient images and evanescent phenomena. At Expo, there was no object which sat in a traditional relationship to a ground. Flicker and vibration were omnipresent—but not in the pretentious manner endemic to much mechanical art. Distinct and tangible images presented themselves but they would become transformed or disappear. Much depended on one's particular vantage point—your neighbor was never seeing what you were seeing at the same time. This was true even though certain of the works, which had potential for individual participation, were forced to relinquish this aspect because of the enormous crowds at Expo. There was a notable absence of visible housing for each work, allowing a purity and directness of confrontation with technique rather than mechanics. But no works were designed to parade technique; almost every artist in the program displayed a certain reserve before the tools of technology. As the artists de-emphasized the look of the machine, they were able to maximize a sense of penetrating psychological immediacy. One did not feel a palpable sense of virtuosity in these works, but rather a character of restraint and esthetic sureness.

After Expo opened, I reported to the Museum's Board of Trustees on our experience with Art and Technology in Japan, and we turned to the consideration of the Museum's exhibition. Our budget, estimated in 1968, had been proving close to the mark. We had raised over $40,000 more than expected from corporations and had therefore been able to place several more artists in residence than anticipated.

Based on what we learned from the Expo experience, a further—even an unprecedented—commitment is now required by the Museum to mount the new exhibition. Virtually all the works produced through Art and Technology are conglomerates of component parts, dependent for their very existence on elaborately constructed formal matrices. The works shown at Expo will, with the exception of Oldenburg's *Icebag*, be fundamentally reworked due to the much greater design flexibility of the Museum space. Moreover about twelve additional artists' projects are expected to be resolved for the Los Angeles show.

The accounts of interaction among seventy-six artists, over 225 corporation employees, and Museum staff members comprise part 3 of this report. Both the emotional complexities and the sheer logistical difficulties implicit in this five-year engagement emerge cumulatively through these accounts.

1 The reader will note reference to "Art and Technology" as a "working title." This nomenclature was never comfortably accepted by us. Years later, after lists of other titles were drawn up and discarded, we could not improve on Art and Technology. Terms like "synergy" and "interface" were considered, but abandoned for obvious reasons. We wanted to include reference to industry, but this word invariably summoned misleading evocations of *industrial design*, and that was a confusion we were determined to avoid. [author's original note]

Thoughts on Art and Technology, 1967–1971

Jane Livingston

Art and Technology has had as one of its first premises the assumption that it is possible, and perhaps valuable, to effect a practical interchange between artists and members of the corporate-industrial society. The various cultural attitudes surrounding such a premise are deeply ambivalent. On virtually every level, including the popularly shared ideas and fears about the influence of "advanced technology" on the life of the masses, as well as the many subtle analyses of writers and critics evaluating the relationships between art, or the humanities, and technology, qualities of emotionalism and partisanship prevail.

Without delving extensively into recent historical antecedents to some contemporary aspects of the art/technology issue, one or two skeletal observations are called for. The attempts to embrace a socialist technology by the Russian Constructivists and by the Italian Futurists, during the early part of this century, were guided by a utopian (if nominally iconoclastic) view of progressive technology but did not fully succeed in transcending a romantic and somewhat anachronistic level of awareness on the part of its exponents. The Constructivist and Futurist artists seldom achieved *internal* stylistic manifestations of new technology, but instead represented the appearances of industrial/mechanical things. A serious ideological limitation holds also for the Bauhaus precept regarding the relation of art to technology, in as much as technology was equated with *craft*; one might say that the Bauhaus theorists were aiming to *reduce* art to craft, in a sense, and reversing the proposition, that the role of organized technology would be to elevate craft to art. The impulse which informed the Bauhaus rationale and its antecedents in European Constructivism toward a *socialization* of art in a public context has developed to the present time, but insofar as it survives in its original spirit has to an extent continued to remain identified with a European sensibility. Victor Vasarely's conviction that art should evolve out of its traditionally aristocratic, "unique object" framework and be mass-produced for public consumption is an extension of a classically Bauhaus idea. (A certain reaction to the "precious object syndrome" has certainly become a part of the American art scene in the '60s and early '70s, but is manifested in approaches which generally differ in kind from that of Vasarely.)

To some extent, artists currently are discouraged from engaging in "collusive" relationships with organized technological concerns by pressures from the intellectual/critical circles of which they are inescapably a part. The contemporary pressures, both internal and external, against collaborative activity between artists and industry are of two sorts; first there is anti-technological sentiment on political grounds and second, there can be argued substantial precedent militating against commonly held images of "technological art" on esthetic grounds. I shall deal here more extensively with the second than the first factor. My thought is to point selectively to a few components of what is an intricately complex subject. With reference to the overtly political question, the fact is that, despite a certain amount of reluctance by some of the artists we dealt with through Art and Technology to participate with "war-oriented" industries for reasons of moral objection, there were no final refusals to participate in the program on this ground alone.

The question of esthetics in relation to technological/industrial artworks is bound up with certain attitudes about collective artistic activity. These attitudes devolve naturally upon several definable antitheses.

One of the fundamental dualisms inherent in the question of technology's uses in a humanist context has to do with the conflict between the belief that, in a word, technology *is* the metaphysics of this century and therefore has to be accommodated from within, and the view that technology is somehow self-perpetuating, implacable, and *essentially* inhuman, and that therefore humanist and artistic endeavor must function separated from it and even in opposition to it. Nearly all the positions taken by artists and by their scientific counterparts with respect to the art/technology relationship are conditioned by one or the other of these antithetical beliefs.

An increasingly prevalent concern of many artists and scientists is to overcome the traditional and presumably obsolete separation of academic and professional disciplines. Systems analysis, with its assumption that only by starting from an interdisciplinary or total-context approach can social institutions be made to operate productively, provides procedural methods and models for such reform. In principle, the espousing of a *systems esthetic*—illustrated preeminently under Art and Technology in the Irwin/Turrell/Garrett Corporation endeavor—represents a less rhetorical theory than any (including the Constructivist, Bauhaus and "socialized art" manifestations) which has preceded it. It implies the grasp of a powerfully efficacious means for revolutionizing art within the total cultural setting. (Jack Burnham gives an extended analysis of what I am terming a systems esthetic throughout his book *Beyond Modern Sculpture*.)[1]

Although the "systems-conscious" attitude is increasingly felt to influence artists of various persuasions, certainly including some of the artists who worked in Art and Technology, it is not by any means a shared attitude among all or most artists. One of the characterizing sentiments expressed by both those artists and scientists/engineers who are resistive to an information or systems esthetic has to do with a suspicion harbored by virtually everyone at times that we are all victims of a technocratic macrostructure over which no one or no institution has real control. In the light of this inescapably sinister possibility, the traditional privilege enjoyed by the artist to function independently and to remain, in a sense, one of the last freelance agents in society is not easily relinquished.

A natural outcome of an artistic/technological endeavor which employs a systems philosophy might be an art which conditions human sense perception and radically sensitizes people. Along with this might develop possibilities for esthetic forms that would in effect cultivate and enrich the "man-made" nature which has already replaced nature to such a remarkable degree. For those who firmly believe that society is undergoing a gradual but radical reshaping of patterns of consciousness, the changes predicted as issuing from a generation of drug users and the increasing body of Western initiates into the various Eastern meditative practices appear to represent an inevitable and potentially corrective metamorphosis. Artists who wish to explore the means and consequences of perception-expansion need specialized information; and, reciprocally, scientists gain insight from artists in this enterprise. Both parties might maintain that anything less than directly "manipulating" human sensory response to advance new esthetic terms constitutes merely a superficial elaboration of existing esthetic conventions.

Again, in reaction to this kind of pursuit, with its potential for subliminal coercion, there are many artists who unequivocally eschew this kind of activity. I have heard the area of "systems" or "information" esthetics dismissed as a "Fascist game."

Seen against most recent efforts in the area of technological art, which are generally identified with electronic light and sound media, the results of Art and Technology are unlike anything we could have predicted. They far transcend the genre of work ordinarily called to mind by "tech art." Owing to the great variety of techniques and processes and materials made available by the corporations contracted with us, the program issued in not one esthetic type of work, but in several.

On reviewing the development of Art and Technology, three kinds of collaborative experience seem to me distinguishable. First there is the approach taken by those artists interested basically in industrial or industrial-mechanical fabrication. Second is that relating to the use of more esoteric technological media; and finally, that marked by a participatory, informational esthetic without primary regard for object-making.

A longer tradition attaches to the first category of activity than to any other manner of endeavor undertaken through Art and Technology. Sculptors have for centuries enlisted the assistance of heavy industrial methods and materials to make monumental works. Yet we have observed a significantly greater sense of anxiety and discernibly more recalcitrance on the part of those artists engaged in industrial execution than has been conveyed by the artists using advanced scientific media. Oldenburg, Kitaj, Fahlstrom, and Tony Smith all experienced some amount of frustration and expressed occasional skepticism during the course of their projects. (Oldenburg's enumeration of "comparative attributes" between the qualities required of the studio versus the technological artist distills the substance of these doubts.) The special difficulty for artists depending upon industrial execution relies on the fact that they have usually in the past worked alone and thus carefully controlled every stage and every nuance of their works' making; thus the intervention of middlemen, not only handling the components but making occasional technical decisions, is difficult to accept. The artist under these circumstances is automatically placed at a greater remove from the process of execution than would follow if his esthetic end required a process of developmental research in close communication with a technical counterpart. These artists found themselves coping rather frequently with a command chain of bureaucratic procedure. Possibly for just the reason that neither the artist nor the Museum was a paying client of the various corporations, the art projects were not given especially high priority and thus often moved forward at an exasperatingly slow pace. In short, a definite cumbersomeness attended the several ambitious industrial collaborations. But even given these natural adversities, something remarkable happened. Smith, Oldenburg, and Fahlstrom all saw the realization of artistic inventions of the grandiose type which generally never exist beyond sketches or models. Oldenburg's *Icebag* and Smith's cave sculpture especially represent critical milestones in their respective careers. Fahlstrom and Kitaj both established rapport with the specialized craftsmen who built their tableaux. One would not expect these artists necessarily to make a career of collaborative endeavor, but unquestionably they and other artists would utilize more often than has been possible the resources of industry were they more readily available.

In the context of heavy industrial fabrication it is worth considering the approach taken by Richard Serra at Kaiser. Serra regarded the availability of Kaiser's steel-producing plant as an opportunity basically to experiment in huge scale. In using the company's formidable scrap resources and men and equipment he did not attempt primarily to come away with a permanent or transportable artwork, but instead to learn what he could in a few weeks' time about making sculpture comprising thousands of tons, rather than pounds, of material.

Roy Lichtenstein's film project certainly does not belong in the class of industrially fabricated artworks, but neither was it conceived in a spirit of philosophical commitment to the principles of technological or industrial coaction. He expressed even more strongly than the foregoing artists an attitude of real doubt and hesitation about his very association with the Art and Technology program. Lichtenstein, like many other artists in Art and Technology, has repeatedly worked in a collaborative manner in his various printmaking and multiple sculpture series. The making of a lithograph, for example, is an operation requiring an intensive cooperation between at least two people. Lichtenstein's engagement in the cinematic project undertaken with us was not, it seems to me, very different in essence from his manner of working to produce prints and multiples. It is true that he (or indeed any other artist) has never before utilized cinematic technique in precisely the way he did in this endeavor; and certainly the technical difficulties and expense inherent in his Art and Technology film project were far greater than are ordinarily entailed by printmaking methods. Nevertheless, Lichtenstein determined early exactly what he was after in the cinematic works, and once he had established his criteria he strove mostly to refine and perfect the quality of the images much as he would in making lithographs.

A second general category of work done under Art and Technology includes those artists, like Robert Whitman, Newton Harrison, Rockne Krebs, and Boyd Mefferd, who sought to exploit the kinds of techniques ordinarily regarded as typifying advanced technology. The approach taken by such artists necessarily depends to a greater or lesser degree on a working relationship with engineering specialists whose expertise they themselves could not acquire without years of research and training; it often depends as well on the equipment and laboratory facilities available only in large corporations. In using media such as lasers, advanced mirror optic systems or gas plasmas, artists are venturing into areas which are without much esthetic history. However, in evaluating such artworks, it seems to be the case that the more directly and the more purely the medium is handled, and the less the artist relies on extraneous housings, the better the result. It was our conscious intention to include in Art and Technology artists whose past production specifically in the domain of advanced technology conformed to this evaluative guideline, and the works accomplished by them with us are commensurately remarkable.

There was an important element of simple luck involved in locating individual scientists and engineers, within the vastness of all these companies, who desired to enter into prolonged collaboration with an artist. Art and Technology was not, after all, a situation like the one structured by E.A.T. [Experiments in Art and Technology],[2] through which engineers so inclined voluntarily make themselves available to consult with artists. Once those fortunate connections were made, the several advanced technology projects set in motion were characterized by a strong sense of mutual commitment. The artists consistently demonstrated qualities of pragmatism, efficiency, and singleness of purpose toward the end of realizing their projects. We sensed in these exchanges very little communicative difficulty on the practical, one-to-one level of exchange.

There are by now several American artists who can be considered fairly experienced in the field of collaboration with engineers. Robert Whitman stands out in this connection; so does Robert Rauschenberg, though he has of course continued to work "traditionally" as well. Experience in dealing closely with technical personnel in making art probably does give an artist a certain advantage in expediting the progress of a given undertaking. But interestingly enough, those artists inexperienced at collaboration with scientists, such as Harrison, Jesse Reichek, and Jackson Mac Low, worked equally effectively.

It should be noted that the use of technological media by artists has not by any means always implied interdependency with scientists or engineers. Both Krebs and Mefferd, for instance, have in the past accomplished much of their work unassisted, finding out on their own about their equipment and its potential by reading, experimenting, and consulting only occasionally with manufacturers or engineers. One of the principal benefits of Art and Technology for an artist like Krebs was the great *speeding up* of information accession made possible by his contact with corporation personnel; he conveyed great excitement about the "luxury" of being offered instant access to data and expertise it would have taken years to acquire on his own. This sort of advantage was given similarly to Harrison, Whitman, Mac Low, and Reichek, but has so far been largely denied Mefferd, for whom we never really found the fortuitous personal connection.

There is little doubt that a number of serious artists will continue to assimilate technical knowledge and will evolve an increasingly sophisticated and refined body of technologically oriented works of art. It is, however, open to question whether or not this development will find sustained impetus from organized corporation support or must tend to rely perennially on the contingencies of sporadic intervention by scientists and the determined self-education of artists.

In considering a third order of artist-corporation interchange in Art and Technology, no inclusive term or concept suffices to define the situations being encompassed. A few artists shared an attitude which is distinguishable from the ascendant, short-term concerns of the others. These artists from the outset wished to investigate a psychological or experiential mode of activity *primarily*, instead of occupying themselves fixedly with technics. Two assumptions are, in retrospect, implicit in these artists' projects. One is that the function of gathering and exchanging information is important as an end in itself; the other is that *participation should be made self-aware and be used as a form of esthetic endeavor*. Behind these assumptions may lie another one—that there potentially exists in any collaborative situation between scientists and artists a special dynamic, and that if the particular conflicts and sympathies inherent in this dynamic can be made to surface, one can learn and state and do something with them. The artists referred to here further may be said to have regarded the people with whom they dealt as *themselves* "media," rather than viewing them as *personnel*, or as simply parts of a larger machine dedicated to the end of engineering and fabricating systems or objects.

The Robert Irwin/James Turrell/Garrett Corporation project is the preeminent example under Art and Technology of an endeavor based on a directly systems-conscious premise. Irwin, Turrell, and the scientist Dr. Ed Wortz have not only made it their business to explore and assess the dynamics of their interchange, but were explicitly engaged in researching aspects of perceptual psychology. Their mutual investigations were not terminated at the end of an arbitrarily set time interval, but have continued organically to develop. John Chamberlain at Rand and James Byars at the Hudson Institute set about to establish participatory events; both, in a high spirit of "unofficial playfulness," proclaimed themselves as gatherers of information. They made themselves subtly effective catalysts in a process of evoking attitudes. The compilations of actual "data" resulting from their efforts, in contradistinction to those accumulated in the course of the Irwin/Turrell/Wortz researches, are poetic and inconclusive: they do not at all reveal the dense complex of occurrences stimulated through the respective processes of obtaining them. Both Byars and Chamberlain treated their periods of residence in two of the nation's leading think tanks as self-validating, purely participatory events. The work accomplished together by Jesse Reichek and IBM's physicist Jack Citron represents a consummate prototype for a truly informational exchange. Reichek and Citron succeeded in organizing a computer program which functions as a powerful image-producing tool. Both would confirm that the principles involved in their discoveries transcend any immediate results materializing from them.

With Andy Warhol at Cowles Communications, the element of participation came to issue in a startlingly literal way. Warhol agreed to design a work incorporating Cowles' 3-D printing process. But he ended by acting really as a kind of legitimizing aegis for the enterprise rather than its sole author and designer. Although he conceived the work's basic structure, he then proceeded to function as an agent, prompting crucial involvement in actual esthetic decision-making phases by his technical colleagues and even by ourselves. Despite the fact that his piece at Expo was a distinguished, if somewhat bizarre, work of art, the object itself was in some ways less important than what it represented of the multilateral esthetic participation behind its creation. In a sense Warhol has not done anything fundamentally unprecedented through the program: he has for years used technique unofficially, as it were; it is after all Warhol who, more than any other artist, made respectable commercial methods for art-making such as inexpensive screen-printing techniques.

The concept of *unofficialness* in the artist's mode of working with corporate technology is of pivotal consequence to the overall dynamics of Art and Technology. It corresponds immanently to the notion of what may be termed a participatory esthetic.

Wylie Sypher, in his book *Literature and Technology: The Alien Vision*,[3] speaks of the state of "alienation" and "maladjustment" faced by technological personnel on every level in our society. He suggests that the goal priorities assumed within the corporate job structure run counter to the positive nature of technological endeavor, which is innately a form of *play* and *participation*. The artist, who has maintained his traditional "prerogative to use science and technique unofficially," might become a catalyst toward the end of humanizing technique. Though Sypher's contentions in the abstract too far overreach the practical sense of what occurred through Art and Technology to extrapolate here *in extenso*, his hypotheses offer the single point of correlation uniting every artist who worked with us. Each of them—some more overtly than others—approached their various projects with a sense of *playfulness*, or "unofficialness." It was their option to serve in multifarious ways as humanizing agents.

One thing none of us foresaw when we embarked on Art and Technology was what now amounts to a nearly unanimous disregard for permanent, officially installed art monuments. If many of the corporations initially hoped their participation would result in an icon representing their products and able to be owned and displayed by them, those hopes were unfulfilled. The significant fact is that the companies did *not* insist upon proprietary rights to the works made—and usually the proposals accepted by them for realization were known beforehand to be inappropriate for such purposes. The program did not become or even threaten to become a vehicle for commissioned works of art. If anything, the artists were more concerned than the companies to come away with a finished work—yet most of the artists made works transitory by definition.

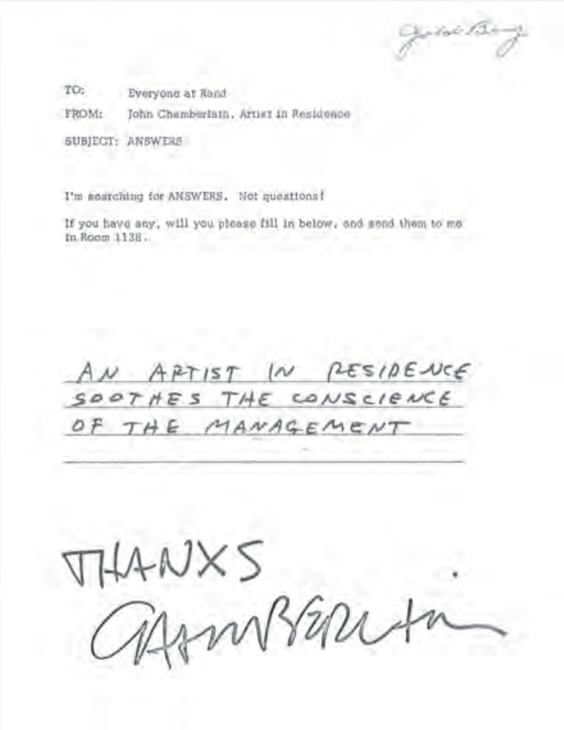
The development of the various experimental interchanges in Art and Technology was on the whole a polymorphous, discursive, and nonorganic process. Indeed it now appears simply that the relationship between artists and technological corporations is an intrinsically nonorganic one—at least on an *a priori* basis. The circumstance of corporation involvement in Art and Technology failed to embody a unified patronal ethic comparable to that kind of already "humanized," and standardized, morality inherent in past systems of academic sponsorship. Concomitantly, the artist—in the by now established absence of either academic or avant-garde provinces—is startlingly free from imposed sanctions. Contrary to the myth of the "corporate image," there is seen to be no programmatic framework in the present condition of corporation patronage to support an official art of any description. A situation allowing room for play and participation—the latter term denoting a mode of activity in which inheres a self-sufficient esthetic statement—is established through the paradoxical open-endedness of the present state of corporate life. The artist retains his options.

1 Jack Burnham, *Beyond Modern Sculpture: The Effects of Science and Technology on the Sculpture of This Century* (G. Braziller, 1968).

2 Experiments in Art and Technology was founded in New York in 1966 by artists Robert Rauschenberg and Robert Whitman and engineers Billy Klüver and Fred Waldhauer. See Rauschenberg's comments regarding E.A.T. in this volume, pp. 328–33.

3 Wylie Sypher, *Literature and Technology: The Alien Vision* (Random House, 1968), pp. 177, 216, 249.

John Chamberlain



TO: Everyone at Rand

FROM: John Chamberlain, Artist in Residence

SUBJECT: ANSWERS

I'm searching for ANSWERS. Not questions!

If you have any, will you please fill in below, and send them to me in Room 1138.

AN ARTIST IN RESIDENCE
SOOTHES THE CONSCIENCE
OF THE MANAGEMENT

THANXS

Chamberlain

One response to John Chamberlain's "Answers" questionnaire

John Chamberlain's name emerged repeatedly during our early staff selection sessions, through late 1968 and early 1969, as an artist whom we felt might do something extraordinary with—or to—a corporation. We had no special preconception of what medium he might wish to explore, and as it developed he approached the project in ways that could hardly have been predicted based on his past work.

It wasn't until April, 1969, that we finally contacted Chamberlain; Jane Livingston saw him at his New York studio. Chamberlain at that time had been working on a series of written proposals for participatory works. Most of these would simply have involved designing and building objects or environmental structures of foam, wood, or steel, within which the spectator would move or manipulate props in specific ways. They did not seem especially appropriate to A&T. The notion of doing a film project, with a corporation like Ampex, RCA or CBS, was also discussed. It seemed worthwhile to have Chamberlain tour Ampex, in Redwood City, which he did with us when he came to Los Angeles in May. The idea John had chiefly in mind when he visited the Ampex facility was something suggested to him by Douglas Huebler; Chamberlain called it *42nd Parallel*, and it involved making video tapes in each of fourteen towns along the United States 42nd parallel, then showing these tapes simultaneously on fourteen screens. John saw at Ampex a demonstration of their *100* video machine. He was left with a feeling of ambivalence, if not indifference about seeing through a project there, and the idea was abandoned.

The next day, May 9, 1969, Chamberlain visited the Riker Laboratories Division of Dart Industries with Jane Livingston. Riker makes and packages several drugs and inhalant medicines. He had no specific medium or project proposal in mind, but (Patron Sponsor) Dart was still available, in theory at least.

On the way from the Museum to the Riker plant in the San Fernando Valley, Chamberlain conceived the idea of making a multiple work consisting of packaged odors. These would be chemically formulated to simulate particular odors of his choosing, and manufactured in the form of inhalers or sachets, in a large edition. With this newly conceived proposal In mind. Chamberlain toured the Riker facility and asked specifically to consult with a chemist there who could gauge the feasibility of implementing such a proposal. Riker's organic chemist, Francis Petracek, discussed the problem at some length with the artist. Petracek indicated that in principle it would indeed be possible to actually gather and distill odors. He mentioned “the smell of downtown Tokyo,” which prompted Chamberlain to want to extend the range of odors beyond simple products or substances to locations. Petracek demonstrated to Chamberlain samples of chemical odors commonly known, notably a potion which strongly evoked dirty socks. We suspected that the actual process of travelling with technicians and equipment and distilling various scents would be beyond the capability—or degree of commitment—of Riker or any other division of Dart Industries.

Shortly afterward, Chamberlain left for New Mexico, where he was shooting his film *Thumbsuck*. During this time he wrote up a formal proposal for the *SniFFter* piece and sent it to us. Our dealings with Dart Industries on this project resulted in the suggestion that Chamberlain might collaborate with a Florida-based cosmetic branch of the corporation, and got no further. The *SniFFter* proposal was then sent to International Chemical and Nuclear Corporation with a letter mentioning that it might be used as a giveaway multiple during the time of the A & T exhibition.

> SniFFter. SniFFter is an olfactory-stimulus-response environment articulated in sets and units proposed by John Chamberlain through the research and production auspices of International Chemical and Nuclear Corporation.
>
> A list of kinds and types of odors (specific as to source, intrinsic, and project quality and similar categories for unit modification) is presented. Researchers then to edit and synthesize a given number of odors. The original extraction or essence and the produced extraction or essence are both utilized in the final articulation.
>
> SniFFter is proposed as a three-unit multiple: Unit A to consist of 100,000 inhalers of 27 different odors; Unit B to consist of 1,000 humidors, each containing 69 inhalers of various strange, pleasant, unpleasant and otherwise uncommon odors; Unit C, a small number of humidors containing 69 inhalers containing the original extractions and essences.
>
> The numbers involved might be modified as might be the types of odors.

Unit A is proposed as a giveaway, a random occurrence for the Osaka Exposition. The number is arbitrary and may be expanded or reduced.

Unit B contains a multiple programming of odor qualities, perhaps color-coded to indicate the “tone” quality and general area of a specifically included odor. Unit B takes its source in the list of apprehended odors; Unit A may borrow from that list; and Unit C locates the original odor as essence or extract.

Unit C locates and presents the original odor essence or extract from which the others may be derived. The common and specific odors are presented here. With a the [*sic*] presentation becomes specific and with an uncommon odor the designated odor remains specific in itself. I surmise that there is a probability that certain odors in the specific range would contain the occasion, diet, psyche-factors, and other conditional factors, the odor becoming unique at its source, and subtle in its difference from the general in that area. Similarly, gasoline would be of a particular variety, cow manure from a particular place—say, the Chicago stockyards in July.

Certain odors would be undistinguishable from others until a sophistication (re-education, orientation) in detection of peculiarities of particular odor origin is acquired by the sniffer of the SniFFter.

In SniFFter presentation, a booklet containing the molecular structure of each component odor on a separate page would accompany the unit presentation. More research—the sophistication in odor perception among the blind, the detection of odors by animals apparently unavailable to humans and so on—may present many possibilities in the restimulation of the adventures of the nose.

EOP = Extra-Olfactory Perception

SniFFter list of proposed odors:
1. Negro revival meeting
2. baby milk throw-up
3. castor oil
4. burning cellulose
5. arsenic

6. dill
7. adhesive tape
8. French roast coffee
9. Lew Alcindor's tennis shoes after a game
10. third floor of the L.A. County Art Museum
11. mother's milk
12. motorcycle race track
13. downtown Miami Beach
14. Fulton Fish Market 1
5. ozone
16. reptiles—cobras, etc. could be from a specific zoo
17. second grade classroom
18. Campbell's vegetable soup
19. Bowery flop house—NYC
20. dirty socks—specific
21. downtown Las Vegas
22. San Diego Zoo's rarest animal
23. gasoline
24. new car
25. newly lit match
26. female skin in sun
27. cocaine
28. corpse
29. amyl nitrite
30. singed hair
31. sea bass
32. billiard hall
33. sweat and copper (pennies in hand)
34. marshland. Savannah, Ga.
35. air at 11 ,000 feet in New Mexico
36. rubber
37. operation room
38. electric welding rod
39. leather
40. Chinatown—San Francisco
41. musk
42. cut clover
43. German shepherd
44. marijuana
45. Siamese cats
46. wet paper
47. paint
48. nail polish remover
49. clay
50. photographic fixer
51. New York taxi cab
52. orange soda
53. pigskin
54. scorched nylon
55. nicotine and skin
56. Courvoisier
57. Sicilian kitchen
58. cordite
59. Rembrandt painting
60. American flag at Pendleton, California, Marine Base
61. burnt toast—specific
62. Chino Women's Prison Cottage #13
63. moonshot at Cape Kennedy
64. Pittsburgh steel mill
65. dirty sponge
66. city dump Tampa, Florida
67. bakery
68. Catholic Church—specific
69. beehive
70. sauna bath
71. dry cleaners
72. mice
73. wrestling arena—specific
74. butane
75. OK Corral—1969
76. cough medicine
77. sheep
78. toads
79. wet fur
80. bergamot
81. vanilla
82. oil refinery
83. ashtray
84. precinct station—specific
85. snuff
86. face powder
87. bad ale
88. chalk
89. Brigid Berlin's ink pad
90. heather
91. downtown Venice, Italy
92. money
93. menthol
94. eucalyptus
95. bamboo
96. Fillmore East—concert night
97. Charlie McCarthy
98. Larry Bell's studio
99. Hostess Cupcakes
100. mildew
101. Max's Kansas City disco
102. etc.…

International Chemical and Nuclear Corporation, whose main research facility is at Irvine, California, referred us to their strong, Cobb, Arnder [*sic*] pharmaceutical division in Sunland, California, as a potential facility for collaboration with Chamberlain. There were several telephone conversations with the manager of this plant, but we were unable to elicit a commitment to pursue the project beyond this. ICN had, interestingly enough, been most eager to join with A&T. Their involvement actually got no further than this unsatisfactory exchange and a tour of their facility by Mark di Suvero.

Chamberlain was planning to return to Los Angeles from Santa Fe in August, and was definitely interested in pursuing our open offer to work with a corporation. We suggested the availability of two radically different facilities: one was a division of Norris Industries which makes porcelain bathroom fixtures and enamel coated bathtubs (Jane Livingston and Hal Glicksman had both toured this plant and were intrigued, not just with all those toilets but also with the huge kilns used to bake them); the other was the Rand Corporation, which had already taken Larry Bell in residence but were willing to take on another artist. Chamberlain immediately opted for Rand, where he was to spend six weeks. He was persistently avoiding the idea of making sculptural objects as such, and continued to think in terms of participatory works in general. In response to a letter sent in May 1970, from Maurice Tuchman requesting comments about the artists' retrospective views on their experience with A&T, Chamberlain said, answering the question "Why were you initially interested in participating in ART AND TECHNOLOGY?":

> I'm initially interested in anything I don't know about. I'm interested because I need something to lean on. And any material or physical contact, mental contact, whatever has possibilities for lessons. The idea being that as artists we tend to confuse and create chaos involving these facilities so as to come out on some other side.

Brownlee Haydon, Assistant to the President of the Rand Corporation, who served as our principle contact there throughout our mutual dealings, had said in a letter written to us in February, 1968:

> We think Rand has something special to offer the creative artist: an intellectual atmosphere and the stimulation of being amid creative individuals working in many disciplines. In this milieu, the artist may find influences on his work apart from the other "materials" that he may discover in the Rand environment.

It would appear that Chamberlain's reasons for working at Rand and Rand's attitude in receiving an artist would have been fundamentally compatible.

On August 7, John Chamberlain visited Rand and spent an hour or two with Robert Specht (Haydon was out of town), during which interview a great deal of mutual bafflement prevailed. John was then given an office to use as he saw fit, and left to his own devices.

In a letter of April, 1970, Haydon described in brief the extent of Rand's contact with Chamberlain from his point of view:

> Rand made an office available to John Chamberlain, and provided the small amount of secretarial help needed to prepare various memoranda circulated to the staff inviting their participation, ideas, etc. Some staff members "dropped in" on John to talk about his and their ideas—but it would be difficult to put any number on this interaction.

In a meeting early in September 1969, Chamberlain talked about the progress of the collaboration to date (he'd been working for about three weeks). He said:

> I couldn't make any headway in the beginning. I suggested that Rand should dissolve the corporation, or cut off the phones for one day, or have everyone come out in the patios and we'd take some pictures for a day. None of these things got any response.…
>
> I also thought of doing a thing with a blown-up [aerial view] photograph of Rand. I'd airbrush out the existing building.… But it might not really be all that amusing, or mean anything. Because I'm not really against the concept of Rand, its uniqueness since 1946, through '56, even until 1960. Past '60, it's gotten, evidently, somewhat stodgy and constricting. The humor [in my approach] is supposed to pull some of that constriction out. But I don't know about this—and I'm not pretending to be some sort of psychiatrist at Rand.… But I'm there, and I'd like to deal with them.… I can't get into any of their circuits. After all, what do I know about weather modification? What do I know about cloud formations? What do I know about the war in

Viet Nam? What do I know about the psychology of reflexes in New York City when faced with a police car? I don't know anything about the police car syndrome in New York City. However, it does seem that you can deal with the people. The people are uptight, I feel. They're very 1953… you know, like the girls wear too much underwear. On the other hand, the few under-30 people tend to be much more relaxed.…

Chamberlain finally decided to arrange several screenings at Rand of his film, *The Secret Life of Hernando Cortez*, starring Ultra Violet and Taylor Mead, because, he said, "It represents a piece of work done in defiance of a particular structure." The film was run once a day for three days, and was then discontinued. According to the artist, "Word must have gotten to Washington, D.C. that Rand was showing dirty flicks on lunch hour." A detailed version of the "banning" of *Hernando Cortez* was supplied to us some months after Chamberlain's experience at Rand by a resident Consultant in Rand's Communications office. She was interested in and sympathetic to John, and was concerned that in documenting the project, we not portray the Rand personnel as being narrowminded and hostile in their response to the artist. (She freely said, however, "There is certainly a large contingent of very prosaic people here who are deep into the discipline they practice, and who are frightened by play. It was difficult for them to see John as a provocateur, an eccentric, a seer—people couldn't make the leap out of conventional discourse into his imaginative world.")

She described the events surrounding the presentation of Chamberlain's film. It was originally scheduled to be shown on five consecutive days, during lunch hour, for the benefit of any Rand employees who wished to view it. It was shown for three days, and, she said, "accepted by the majority of the people who saw it—on the third day there was even some applause." However, there were several complaints from staff people who felt it was "dirty, corrupt, and disgusting." A meeting was held among several supervisory personnel who have received complaints, and, with the rationale, according to our informant, that "Rand must attempt to preserve some sense of decorum"—it was decided to hold no further showings of the movie. In any event, a considerable number of Rand employees saw the film, and judging from the amount and nature of their various reactions to it, the experience influenced their view of the artist significantly. These reactions were manifested specifically in response to a questionnaire circulated by John after the film screenings.

The purpose of the questionnaire was to elicit material, the form of "answers," for John's final Rand project. Describing the conception and early results of this idea during the September 9 taping session. Chamberlain said:

The next thing I did was sort of muddle around, talk to people .... Mostly through talking to Irwin Mann [a Rand consultant] , I decided to go for answers. Then it occurred to me that they might answer Jim Byars's questions. So I sent out questionnaires, asking for answers. Yesterday and today I got my first office-full. I'm getting everything from "Drop dead" to "Why don't you leave Rand." I'm not getting much, in short, that I can use.

TO: Everyone at Rand
FROM: John Chamberlain, Artist in Residence
SUBJECT: ANSWERS
I'm searching for ANSWERS. Not questions!
If you have any, will you please fill In below,
and send them to mc in Room 1138.
[handwritten:] You're fired!

TO: Everyone at Rand
FROM: John Chamberlain, Artist in Residence
SUBJECT: ANSWERS
I'm searching for ANSWERS. Not questions! If you have any, will you please fill In below, and send them to mc in Room 1138.
[typed:] THERE IS ONLY ONE ANSWER: YOU HAVE A BEAUTIFUL SENSE OF COLOR AND A WARPED, TRASHY IDEA OF WHAT BEAUTY AND TALENT IS.

TO: Everyone at Rand
FROM: John Chamberlain, Artist in Residence
SUBJECT: ANSWERS
I'm searching for ANSWERS. Not questions! If you have any, will you please fill In below, and send them to mc in Room 1138.
[handwritten:] The answer is to terminate Chamberlin *sic*

…I would have liked maybe to use the answers to express a viewpoint about Rand people in terms of their intelligence. Because I'm not so sure about it—I mean, I see people who speak Spanish and misspell simple words, and have sort of dumb fifth grade attitudes about everything.

Though John felt in the beginning that the answers might correspond to Byars's questions, and perhaps even be used in conjunction with them as an art work, the two artists did not actually coordinate their efforts, and partly for this reason the end results of their projects are essentially unrelated. Both were to some degree unsuccessful in drawing enough interesting material from their "subjects" to constitute a satisfactory artistic product, and thus often resorted to their own inventions in working out the final presentations.

One of the factors accounting for the depressingly hostile tone of many of the replies to John's first questionnaire was simply that instead of giving John disinterested (or interested) answers, his subjects instead used the questionnaire as a vehicle for conveying their resentment, or fear, of the film. In an attempt to reverse this trend, Brownlee Haydon, at John's request, sent out the following memo, with a second version of the "questionnaire" drafted by John:

> Before he left for the East, John Chamberlain gave me the attached memo for distribution. Because of some of the responses to his earlier memo asking for 'answers,' I think everyone should understand:
> 1 . John has nothing to do with the experimental redecoration of Rand's halls and offices (see Roger Levien).
> 2. John is a guest artist-in-residence, sponsored by and paid by the Los Angeles County Museum of Art.
> 3. His question about answers was not intended to elicit reviews of or comments about his film.
>
> TO: Everyone at Rand
> FROM: John Chamberlain, Artist in Residence
> SUBJECT: MORE ANSWERS
> I would like to thank everyone who has participated in my quest for answers.
>
> Now, I would like to be more <u>explicit</u>. I had hoped for a more specific poetic imagery to induce, or suggest, an alternative to thinking if or when asked to pair with it, a question or statement. The altruistic answer is nice, but less interesting… the challenging being from without rather than from within. [handwritten in margin: AW, COME ON!]
>
> While in the East, I expect to visit Rand's New York and Washington offices seeking answers. My intention is to return to Santa Monica in a week or so.

The response to this memo was scarcely more satisfactory than the previous round of "answers."

> Mr. Chamberlain: One of the functions of the artist is to *communicate*.* I can't find one person who understood either your first communication or your second. We would be happy to share our spiritual experiences with you if we knew what you are trying to express. Could you please rephrase paragraph #2 (Ernest Hemingway you ain't!) so we can understand what the hell you are driving at—or do you know yourself?
> *Definition from Webster's Dictionary: "characterized by full clear expression"

Finally, John made up a small edition of more elaborate "questionnaires," in which he listed a number of "answers" formulated principally by himself, and requested that his subjects comment on each one. Chamberlain's "answers" are in bold type; the subject's responses are written above each of the artist's phrases. The following are excerpts from one of a dozen responses to this lengthy questionnaire received by Chamberlain.

> So is life. The correspondence between the two is a function of self-image. Only an optimist has a heaven. "Adequate" implies fulfillment to some degree . . . how can you be fulfilled and still disillusioned?
> **Divinity is adequate disillusionment.**
>
> Computers are impersonal fellows. The whirr and cycle and hum of contentment comes from knowing that they are digesting a delicious database. The data is, however, a surrogate for truth; hence the disk represents lifelessness. Death is cold and dank. Dirty comes from not dusting.
> **Dirty dank cold disk taste.**
>
> The concept of equality implies a condition of parity and balance. The essential consideration;

however, is that equality does not mean the same as identicalness. It implies equivalence on a scale weighted with different significance vectors. We don't know how to weigh the vectors; and that is what the argument is all about.
There is argument only in equality.

Countries are environments. They have their own subsets. Objects are entities and concepts. We articulate concepts. We fight in environments. Perhaps we should try to articulate environments and fight in concepts.
Throw the object from one country to another.

Look at the edge. That's what really counts. It is gray.
Black on one side and white on the other.

The way through is also the way in. You always go from something to something, capturing a bit of each place you have been through. It includes ideas, places, and space. You cannot wait too long in any media. You will suffocate. The way through life is also the way into life.
The way through is the way out.

Destroying mediocrity while sub-optimizing existence.
Competitive elimination.

Are we really big enough to challenge our environment? Cadillacs and expressways say yes. Starving people and pollution say no. Are we a population of clubfoots?
The foot determines the fit.

There is no doubt that Chamberlain made significant impact on those Rand people with whom he had more than passing contact. Even now, a year after his residence at Rand, there keeps emerging commentary about the artist from various sources there. A mathematician recently characterized the artist's approach as:

> … thinking maybe there was a way of hunching your way through science instinctively or with your emotions without bothering with a bunch of mathematical theorems. Maybe you could get at things through your senses. Some people here with more dogmatic and more formalized backgrounds just didn't want to talk about it.… For me it was a refreshing and welcome interlude. It was refreshing to talk with him and see a man more oriented to talking with people through impressions, forms, and sound rather than graphs, mathematical formulas and so forth. At the same time, his idea of communicating science through art rather than through the written word seems remote even though it was definitely worth discussing and probing. I don't say one day it couldn't be done, but that now it seems remote.

And a computer specialist said:

> I think John's visit came to nothing. In general, the interaction was low. He didn't make any effort to meet many people. He installed himself in the office he was using or out on a patio with a tape recorder and let a few anointed come to him. He didn't walk around and just talk to a stranger. And not many people came to him.
>
> People remember his film, but I don't think many dug it. We're too literal to get very far into something like that. Literalness is the nature of science as a discipline.
>
> He'd have been a lot better off if they'd put him in a place with *materials*. We have no materials and no process and few who are willing to talk in McLuhanesque form.
>
> My opinion is that the artist thinks he can create something by turning to technology. He wants the technician along to explain how things work, but then he wants the technician to stand aside. And he wants the scientist only in the role of technician. I guess what happens is, they don't want anybody else's help. They just want you to show them how to turn on the machine.
>
> There wasn't much catalytic effect. It's too bad that something nicer didn't happen by way of people who like art meeting others who like art.
>
> Most of the ideas around here are not all that abstract. We can say pretend such and such is true and let the notion carry us where it will. But wondering why a guy would crush auto bodies and call it sculpture is a different game. Abstract the way the scientist means it is perhaps a different world from the one we live in, but

nonetheless a well-defined world. I don't really know what the artist is doing. Maybe pleasing himself.

Chamberlain's final Rand Piece consists of statements suggested to him from various sources (few of his "answers" are entirely original, and many can be recognized as, for example, McLuhanese in altered form), but the statements seldom came to him directly from Rand personnel in the course of his questionnairing process. John hoped that either Rand or the Museum would publish the Rand Piece in a relatively large edition, but neither institution had the means to do this. At the time of this writing, the work is still unpublished, except for its inclusion here.

The following are eight excerpts from the work, which is thirty-four pages long, divided into two sections. The first part, called *WHAT ARE THE CIRCUMSTANCES TO THESE RESPONSES*, consists of answers; part two, *WHAT IS THE RESPONSE TO THESE CIRCUMSTANCES*, consists of questions. It is prefaced by this statement by Chamberlain: "The Rand piece is constructed to be used by anyone or groups as far as the imagination or curiosity can carry it. All possibilities are considered to be valid at least by me."

Baby dumpling.
You can find out who your friends are by seeing how they take it.
Coal-black habit; empty creature.
Fairly Kosher.
His trouble could be yours or mine.
It's important that everyone cheat.

Once the problem is posed, it is insoluble.
Go to Atlanta and make a right turn.
For the size of his attitude, he has quite a stance.
A hot Danish process.
The hinge that holds them together is as real as the line that divides them. Freedom to breed will ruin the egg.

A box of fat.
Purple, pink and oblivious.
Fifteen carpeted steps.
All legs and no backbone.
The ULTRA naked astronaut.
Cold grey honey.

Anguish, remorse, and woe.
They're always doing something Chinese to it.
Between the sheets.
By jiggling your horoscope.
Black is the color—none is the number.
It was inserted in the wrong end.

Which quantity is purifiable?
When was congruency established?
Is arbitration possible under these conditions?
What are the shades of waiting?
What will keep the dancers clean?
Who is responsible for the preservation of rhetoric?

Where is love's mansion?
Where does the progression initiate?
Is this the time of the assassins?
How did you get past the union authorities?
When was the siege accomplished?
Have you committed to memory the paradigms of concern?

Which works do you seek of the ones you serve?
Is it endlessly extended?
What will the song be like?
Is eleven enough?
How many pictures are concealed in this rabbit?
Why don't you do what you're watching?

How is it wise to leave and enter at the same port?
What is the dialogue of conduct?
Which map describes the territory?
In what way is continuity related to direction?
Which performances are protected by their ambience?
What are the underlying sentiments of contrivance?

Jane Livingston

Robert Irwin
James Turrell

top
James Turrell and Robert Irwin in the anechoic chamber during their collaboration with Garrett Corporation

bottom
Ed Wortz applies EEG electrodes to Gail Scott in advance of an alpha-conditioning session

One of the first artists with whom Maurice Tuchman seriously discussed joining A&T was Robert Irwin. Irwin's initial reaction to the idea of working within a corporation was to express skepticism—not about his own ability or desire to collaborate intensively with engineers or scientists, but about the structuring of the program. Once the artist was persuaded to visit corporations and sign a contract with us, his involvement developed into a virtual life commitment. Indeed the ramifications of the "Irwin/Turrell/Garrett project" so far transcend the immediate parameters of A&T that it is not possible for us fully to know, much less to document, every phase or outcome of the ongoing work set in motion by the original A&T connection.

In August of 1968, Irwin toured two Patron Sponsor Corporations recently signed with us—Lockheed Aircraft Corporation and IBM. With him and our staff on the Lockheed tour was R. B. Kitaj; they visited Lockheed's Rye Canyon research center, as well as the Burbank aircraft production complex. It was evident even during this preliminary view of a corporation that Irwin, unlike Kitaj, was not interested so much in industrial fabricating techniques as in the more abstract areas of theoretical experiments in perceptual psychology. At Rye Canyon, there was an anechoic chamber (a room heavily insulated against outside noise stimuli and thus non-reverberant) and a chamber into which sound and visual stimuli could be introduced for the purpose of testing human responses to various sensory phenomena. These were precisely the kinds of research facilities to which Bob wished to gain access. According to notes made by Gail Scott following this tour, he asked to locate a Lockheed specialist with whom he could discuss "acoustic coatings—what he wants is architectural acoustics. Wants to do an environment using optics, acoustics, lasers, etc. without any mechanism exposed."

On the IBM tour Bob was accompanied by Caltech physicist Dr. Richard Feynman; they spent two days at IBM's enormous San Jose complex. Again, Bob was most drawn to investigate the laboratories researching human responses to special environmental situations. The IBM San Jose facility is equipped to deal in areas seemingly far afield from the production of computers—there are elaborate physics and chemistry labs, for example—and, although nothing came to develop between Irwin and IBM, the tour, especially through his close contact with Dr. Feynman, was an extremely rich experience for the artist.

A match between Lockheed and Kitaj was effected in September but Irwin arranged to consult with Lockheed's Don Christiansen, of their Public Affairs office. Bob drew up for Christiansen a rough listing of techniques and experimental phenomena he wished to study:

> Space craft cabin/support environment: investigations necessary to determine what perceptual awarenesses are necessary for basic orientation and stability.
>
> sound—what kind, how much, interrupted? natural environment noises for attention, sleep, etc.
>
> visual stimulus for attention, orientation, space, sitting
>
> tactile—touch orientation to instruments, space of capsule
>
> how much can be corrected through training or assumed/what kind of training?
>
> what kind of equipment was used to gather this information? Ganzfield sphere, anechoic chamber, etc.
>
> How was this information applied to the design of the capsule? visual information of instruments, sound information, how much sense of control was built in and not entrusted to the astronauts.
>
> all information where man's sensual awarenesses were tested with conclusions of degrees of awareness/ human prowess (sighting of specific objects on the earth) basic necessities for maintaining sanity.
>
> Materials:
> Morano
> light properties of paint, ceramics, materials with abilities to diffract, diffuse, curve light—high absorption or reflectivity. Materials with special sound properties—deadening high reflectance, etc. how do they protect the men from the sound during liftoff? ability to change any perceptions of sound.
>
> Optics:
> any materials with optical properties, diffraction gratings screening materials—diamond or triangular shaped thread, rear screen projection screens, glass or plastic.
>
> gases for flames/optical projection screening
> lights—xenon, quartz-iodine point sources
> (as close as poss.)
>
> lenticular screening materials, polarizing any particular surface, wavelength, etc.
>
> Light, color, weight and density in the open air:
> Vandenberg vapor trails
> chemiluminescence or electroluminescence
> coronas and halos and "glorys"
> ice crystals, iron filings
> lightning balls—plasma
> visual observation and photos of sound waves
> Schlieren images and shadows images
> electrical fields around the earth—glowing
> Van Allen belts

When he gave us a copy of this outline, he spoke to us about his general intentions, here recorded in memo form:

> Bob knows exactly what he is interested in technically (see his own report of his fields of interest), and was very persistent in asking the various experts at Lockheed for specific information. He will carry on himself with Don Christiansen, although he will not be working at Lockheed. He wants to collaborate on a project with Jim Turrell, perhaps at JPL.
>
> Generally Bob is involved with perceptual psychology: Processes of receiving and reacting to information. He wants to find out more about the application of studies and equipment used in recording people's reactions to light, sound, color, weight, density, etc., before he even starts to work out a project.

We learned at this time that Irwin had been in close touch with James Turrell over the summer of '68 and that the idea of collaborating with the younger artist on a project for A&T had apparently been in his mind for some time. There can be no doubt that Turrell had suggested to Bob many of the concepts he was exploring with Christiansen at Lockheed and with Dr. Feynman. Significantly, he attached to his outline for Christiansen a bibliography compiled by Turrell of books and articles on perceptual psychology. Turrell, having had considerable academic training in psychology at Pomona College, had more direct access to literature in the field and had a greater understanding of experimental methodology than Irwin. Bob, however, had for years been intuitively dealing with certain subtle aspects of the psychology of perception through his work. When the two artists met and entered Into a period of intense dialogue, they both felt a sense of extraordinary potential—it was as if each had found in the other an ideally complementary source of information. Irwin brought to the relationship his long experience as an artist and his highly evolved esthetic sensibility; Turrell had an intellectual background and thus a verbal knowledge of theory and technique, which could open wide new possibilities for application by Bob or both artists together.

When it was proposed to us that the two artists enter into corporation residence collaboratively, we agreed without hesitation. We weren't certain whether Jet Propulsion Laboratory, where they were eager to work, could provide a satisfactory degree of commitment since they were not a Patron Sponsor Corporation and had placed definite limits on the extent of time and money they could afford to put into the project.

There was, however, another aerospace-oriented corporation contracted with the Museum as of May 1968—The Garrett Corporation—which we had not yet matched with an artist. (The young Canadian artist Iain Baxter and kinetic sculptor Len Lye had both toured Garrett, but nothing came of these encounters.) In November 1968, it was arranged for Irwin and Turrell to meet with Tom Vanides, our contact man at Garrett, and Dr. Ed Wortz, Head of the corporation's Life Sciences Department in Torrance, California. This preliminary meeting—attended by us and Dr. Feynman, as well as the artists—was one of the most exciting and spontaneously productive occasions of its kind we attended during the entire course of A&T. It was immediately evident that Dr. Wortz's interests and field of research were precisely parallel to those of the two artists. Wortz has a Ph.D. in Experimental Psychology from the University of Texas. He has been with Garrett since 1962. The nature of his work at Garrett is directly concerned with human perceptual responses in special conditions: the Garrett Life Sciences Department has been importantly involved in developing life support systems for manned lunar flights. 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 phases of his exertions, etc.

On the basis of several preliminary meetings between the two artists and Wortz, it was agreed to proceed with an artist-corporation match. Artist contracts were signed, and the collaboration proceeded. Irwin and Turrell met frequently with Dr. Wortz—sometimes at Garrett, often at one of their studios, or at Wortz's home—from November through July of 1969. In January, Wortz moved with his family to Manhattan Beach, primarily in order to be nearer the two artists.

The areas of investigation pursued during these months were manifold. For the first two months, the artists were definitely working toward the designing of a structure for the Museum exhibition. (This plan was later abandoned for several reasons.)

The following statement was formulated in January 1969 as a tentative proposal for a course of action:

> Project Art and Technology's time schedule is seen in three parts, first six months devoted to development of overall perceptual thesis between the principals, Dr. Ed Wortz, and artists R. Irwin and J. Turrell, the basic perceptual research to begin in January 1969, with the cooperation of Jay Dowling, UCLA Psychology Department, with students of that department and forms of stimulus complexity/uncertainty considered for the project.
>
> Begin planning physically, forms and means considered, development of a number of possible working spaces, and various ways of implementing the physical needs of the thesis.
>
> Research in depth, tools, materials, and people necessary to implement or expand project.
>
> The second six months, having arrived at the basic format and physical plan, a space will be leased to build and then refine the actual working space, methods of entrance, exit, control of elements, input of stimulus, etc.
>
> Research will continue with a variety of subjects

in actual working space, to determine and refine time spans, positioning and final working of the project.

Physical structure will then be dismantled and reassembled in the Los Angeles County Museum, in keeping with the time schedule for the "exhibition."

The project is seen now, by the principals, to involve four periods of perceptual change, plus and minus, each working with the states of consciousness.

PART 1 A queuing area, to be seen as a part of the museum, but isolated, sound dampened, 2 or 3 persons at one time. This area to develop a time span and positioning for Part 2.

PART 2 Sensory Deprivation

a. one person for a period of from 6 to 15 minutes using an anechoic type space.
   1 . This space to be fully sound dampened and in total darkness.
   2. Time span to be experimented with using subjects to determine optimum lengths.

b. Person to enter with as little orientation to size, shape, and his position in space, as is possible.

   1 . Entrance should obscure outside scale, and position of room within museum space.

c. Within first minute or two, stimulus to be introduced/visual, audio/to define a space on his senses and to focus and heighten attention on his sense awareness. This is to be done near his area of expectancy.

d. Events not to be repeated. This will leave him with a lingering anticipation and a form of participation; in his sense isolation his focus should fall back on his own sense phenomena.

   1. The sounds of his own system, retinal color fields, etc.
   2. He could back into a subtle form of meditation.

e. Sensory deprivation seems to alter the orders of our established sensory dependence.

PART 3 Sensory participation/controlled input, person to enter directly from deprivation space, to spend 6 to 15 minutes.

a. Content of this space to be seen as a singular sense experience, to see space as surrounding and positive.

b. Stimulus information to avoid any imagery identification/non object/a major objective is to make all stimulus harmonious.

   1 . Development of sensory crossovers/the support of any awareness or positioning by the use of more than one sense.

Over a one-month period, from mid-January to mid-February, James Turrell periodically wrote up formalized notes on the Garrett project, outlining the possibilities for the Museum "sensory chamber" and stating general observations about his own—and, by implication, the team's—overall intentions and philosophy.

PROJECT WITH GARRETT 1-15-69
Possible setup with three spaces:
1. queuing area—preparatory area
   sound dampened, less complex than the outside world, time: 5–10 minutes

2. anechoic chamber
   entrance from chamber 1 is obscured by either a blind wall or curve.
   visitor is seated in chair in reclining position with head mounted in center of space
   size of room: a cube, approx. 12 × 12 × 12
   sound dampening elements flocked back
   The chair the visitor is seated in is constructed of moveable parts which will slowly flatten as it is hydraulically lifted up to the third, upper chamber so that the visitor will end up prone on the floor of the

upper chamber.
there will be no light or sound stimuli at first in the chamber, and any that will be presented will be determined by forthcoming experiments;
expected stimuli will be something on the order of sub-threshold light flashes and sound flashes "reorienting stimuli"; these stimuli will increase gradually to the point which seems to be between hallucination and reality.
time spent in chamber will be between 5 and 10 minutes.
This chamber is a sensitizing situation for the following chamber as well as a unique experience in itself.

3. upper chamber
   domed, cylindrical, semi-translucent for back projection, constructed of seamless plexiglass, visitor's first sensation of this chamber will be that of experiencing a Ganz field.
   The space will have a sound quality and a light quality which will be manipulated; we do not plan to use any images per se, but are more interested in changes in light quality, color temperature of light, intensity of light, pulsating effects. We are interested in having changes take place behind the person, or on his periphery, therefore there is a need for a tracking device to determine the position of the viewer.

4. Leaving the upper chamber:
   The platform reforms itself into a chair. The visitor sits on it and descends back into the anechoic chamber which is lit, a door opposite from the entrance opens, and the visitor exits through it via a tunnel to outside of the museum; the tunnel becomes gradually less sound absorbing as it approaches the outdoors.

We are working with states of consciousness and awareness.

Find out about the sound device that makes a wall act as a speaker. Bob Eriser deals this product for a company called Rollen Star.

To decide the best use of the anechoic chamber we will do some experiments with the chamber at UCLA studying the effects of:
- length of time in the chamber
- visual stimulation
- auditory stimulation
- kinesthetic stimulation
- and combinations of these variables

We will seek results dealing with the S's thresholds, JND limens, likes-dislikes, and their impressions of any hallucinations or changes in psychic state while in the chamber.

We'll also try to find how to produce the proper set for the next space, the next experience.

Subliminal word "spacing," tatistascopic [tachistoscopic] exposures

PROJECT WITH GARRETT 1-21-69
Technology is merely a means—not an end. Technological instruments are extensions of ideas, i.e.: they measure what you already think is there, what you have decided to measure.—Symptoms—not necessarily what is significant.
Allowing people to perceive their perceptions—making them aware of their perceptions—We've decided to investigate this and to make people conscious of their consciousness. We're concerned with manipulating the conscious state.

Sense of sensing: awareness of perceptions, a reflexive act. Working with the sense of the senses—a change in value.

working with non-verbal experience

This project, we believe, is an extension of our work, just as our work is an extension of some mainstream of modern art. A problem may arise with this project in the minds of the art community who may regard it as "non-art"—as theatrical, or more scientific than artistic, or as being just outside the arena of art. Although it is a strong alteration as far as methods, means, and intent, we believe in it as art, and yet recognize the possibility of a redefinition needed to incorporate it into the "arena."

The necessity for this statement stems from the fact that this project will ultimately be dealt with by the art world, not so much the scientific world, though this might not be unwarranted, and therefore we are held to the dialogue of the art community and are subject to its reviews and criticisms. Thus we feel we must make our position clear, that we feel our project is not inconsistent with what has come before. (How can it be?)

If we define art as part of the realm of experience, we can assume that after a viewer looks at a piece he "leaves" with the art, because the "art" had been experienced.

We are dealing with the limits of an experience—not for instance with the limits of painting. We have chosen that experience out of the realm of experience to be defined as "art," because having this label it is given special attention. Perhaps this is all "art" means—this Frame of Mind.

The artist singles out that which he feels needs to be experienced. Possibly because it hasn't been experienced enough—is rare—When it has been experienced (on a cultural level) this isn't necessary and may no longer be within the bounds of "art." Hence, everyday, common objects, acts, forms of another culture (i.e., Japan) may seem close to art for us but to those of that culture they are just part of their everyday experience. The object of art may be to seek an elimination of the necessity for it.

Much art today appears unprofessional, some artists as revolutionaries, attacking existing structure, others are involved in construction of new structures, all artists pass through many stages in their development. Need for some perspective to tell where trends are going and where artists are in relation to each other.

Plans for continuing to work together after completing this project include retaining the space that will be rented for this project. There we can build environments and so experiment ourselves, and/or interest universities to carry on with some of the facets of our work. The project may open new areas of work to be involved with.

Discussion of an experiment: S's isolated up to 72 hours with auditory, visual, and tactile deprivation.

Results: ½ S's had progressions of alpha, beta, and delta rhythms, others experienced digressions of these rhythms—effects of deprivation ran both ways—maybe effects are dependent on the attitude of the S (whether he got into or withdrew from the experience).

We can consider this study to be done on poor experimental design, and we don't accept the results that sensory thresholds were not changed after deprivation. This is because the deprivation consisted of being blindfolded, earmuffed, and hand tied.

One finding relevant to our work was that the changes in the brain rhythms depended in part on the time of the day, for example, circadian rhythms exist only in late afternoon and early evening.

Sensory experience is heightened when sense modalities act in phase. Consciously trying to bring them into phase destroys the effect: not necessarily true.

The work we have selected to deal with is interesting to art by the fact that it is what artists have previously been [involved] in, yet have never approached exhaustively. The works of previous artists have come from their own experiences or insights but haven't given the experience itself. They had set themselves up as a sort of interpreter to the layman. A change of this trend began with non-objective painting, the abstract expressionists, who were involved with the idea of "it is the thing itself." Today, Pop artists are into extensions of this thinking. Our interest is in a form where you realize that the media are just perception.

Dealing with states of consciousness is like a drug experience: most people hold back from going through—experiencing—the new until they have correlated it to something already known, whereas the artist may be unique in that he seeks the new experience, and lets himself go accepting it as a unique experience.

In the project we have designed, there is a cleansing situation where the people may relax and be able to open up—to be able to experience something unique.

PROJECT WITH GARRETT 1-25-69
Make certain viewer is aware that the experience is formed within, that *he* forms the experience, gives it substance.

While he is in the anechoic chamber, the visitor is being set up for the experience in the upper chamber, if a different space is even to be used, so aside from it being an experience in itself, the anechoic chamber is also a preconditioning situation.

The viewers must assume the responsibility, they get into the experience, and they make the art—they are the actuality.

Concerning the statement we are writing about the project: "what we tend to accomplish is to bring you to an awareness of perception, of perceiving yourself perceiving, pressing the information against the senses—making the sense of reality a sense of the senses."

"…instead of placing our images on an object, we will define a non-object situation in setting up the boundaries of experience to be perceived…"

(now explain what we are trying to accomplish)
The experience is the "thing," the experiencing is the "object."

Instructions to visitors?
That's asking them to make enough of a change from their normal state. The quality of their involvement is dependent on the degree they play the game, but we need something where the setup of the thing makes them want to play the game. Hit them at the level of expectancy so they become engaged and then manipulate them to our level—a seductive act.

Therefore, whatever we do should begin at *their* level of expectancy, i.e., in the anechoic chamber, the presentation of the first light stimulus can act to define the space and that will excite them, yet at the same time it will do what we want, to get them looking at their retinal field after the flash, therefore getting them looking at their own eyeball (to look at their looking), and listening to their own ears.

PROJECT WITH GARRETT 2-10-69
Queuing or conditioning area:
Start with realm built with selected vocabulary, non-literal. The space will be museum-like, with 2 or 3 people keeping them there as long as we desire. We can program people there using words to produce a thought-idea continuum which would have no literate context. The words can either be presented audibly or visually or combined somehow. They can start off as subliminally presented moving toward conscious presentation. The more spatial the presentation, the more effective it will be.

Find words through dictionary and thesaurus, and form groups of words as we like them. Categorize them as to: object-words, sound-words, action-words, state-of-being-words, place-words, sensual-words, etc.

Must structure the forms we want, so they correspond with experience we want them to have. Also, must think in terms of the multi-level input we are creating and structure it so that it is understated rather than overwhelming.

We must choose words to correspond to the experience the people are going to have, i.e., pick words that describe the space of the anechoic chamber.

What we are dealing with are meditative states. The preconditioning sets up state of meditation, so when they leave the first chamber they will be in that encapsulated form. Then we want to take them slowly out of that form to a specialized space where they change from being oriented inwardly to their own space or a space awareness that extends maximally 6 feet around themselves, to where they push their experience outward to the space outside.

Quote from Blake: "If the doors of perception were cleansed, everything would appear to man as it is, infinite."

Try to deal with the space the words make, as if each word had the power of a mantra. Remove it from any literary connotations, so that the word is denoting portions of your thought-idea continuum or portions of your mental space, rather than connecting itself literally to other words. Thus making the word an image-conjuring, spatial-feeling, sentient-feeling device.

Time is illusionary, events make the time.

There is no such thing as modern art, there was art that was done then, and art that is done now, art is equal.

All art is experience, yet all experience is not art. The artist chooses from experience that which he defines out as art, possibly because it has not yet been experienced enough, or because it needs to be experienced more.

All art-world distinctions are meaningless.

Several experiments were devised, principally by Turrell, to test subjects' responses to special environmental conditions which might be designed for the Museum environment. These were written up in January:

Investigations
The following are a series of studies that we plan to undertake before deciding upon the finished structure and form of the experience we are to present at the end of our contracted association with the Garrett Corporation and the Los Angeles County Museum of Art.

These studies will begin with our own observations in the anechoic chamber and will later involve a number of subjects. The investigations will be amended as necessary to accommodate our findings as the study progresses.

May change order.
May eliminate experiments.
Want results not explanation.
Mainly based upon personal observations.
Will use subjects when whether we sense something (i.e., when we know what we are about to sense) or not is a question.

Experiment Schedule
Experiment I: Investigate a person's reaction to the experience of an anechoic space and length of time in the space.
Experiment II: Investigate the experiencing of anechoic space when the person is brought into the space blindfolded, i.e., without prior visual knowledge of the space. Can't see space.

Experiment III: Investigate a person's reaction to the experience of an anechoic space when the person is brought into the space blindfolded and spatially disoriented, i.e., without prior visual and directional (spatial) knowledge.

Experiment IV: Investigate how the experience is altered when the space is strobed— made visible for an instant, i.e. whether and/or how a person's self-generated space is changed when the actual room space is made known for an instant. Alternative strobe with strongly colored light (violet) so that space is not identified—but a color field is created on retina—some color field is experienced without stimulation.

Experiment V: Investigate the experience of gradually introducing very low levels of light (varying colors gradually diffused) into an anechoic space after the person has been in total darkness and soundlessness. Light to border on its questionable existence—as to its being real or retinal field induced.

Experiment VI: Investigate the experience of gradually introducing very low levels of sound tones into an anechoic space. First hear the quality and kinds of sounds the ear (s) is experiencing in soundlessness—possibly use sound to draw different kind of space. See if subject (idea) of space can be changed in this manner.

Experiment VII: Investigate visual and auditory intersensory relations. (color-tone synesthesia) Area of separate investigation prior to (taste tone, etc. Exp. VIII).

Experiment VIII: Investigate the relations of taste and tone by duplicating the taste and pitch experiments of Holt-Hansen. This experiment should be fairly easy to duplicate and requires a sound setup very similar to that needed for experiments IX–XI. This investigation may satisfy our needs for a great beer while familiarizing us with the auditory sense.

Experiment IX: Investigate the experience of a space and tone (what sounds feel proper in a space—whether the sounds that make a space resonate are perceived as most correct or pleasant, etc.).

Experiment X: Investigate the experience of light and tone in a space.

Experiment XI: Investigate 'word spaces' and whether any programming (loading or priming) prior to the experience of an anechoic space will enhance, heighten, or hinder the experience of that space.

Experiment XII: Investigate Alpha Conditioning.

Not all of these experiments formulated by Turrell were carried out, but Experiment I—with the use of an anechoic chamber made available to Turrell and Irwin at UCLA—was elaborately implemented. All in all, about thirty or forty subjects underwent the experiment, and were asked to record their responses. A questionnaire with one subject's responses follows:

EXPERIMENT I
INTRODUCTION: The purpose of this investigation is to determine a person's reactions to isolation in a completely dark anechoic chamber for a short period of time.

The periods of isolation for three different groups of people will be 4 minutes, 7 minutes, and 10 minutes.

PROCEDURE: The person is told *"We want you to come and sit in this room for a period of time and see what it's like."* (This set of "looking for something" is not unlike coming into an art experience with a "looking sense.") *"This experience is yours alone. No one is observing you. Afterwards we will instruct you as to what to do next."*

The person is taken into the anechoic chamber and seated. The light is turned off, and the door closed for the time duration. Ten persons will experience the four minute duration, then the seven minute, and then the ten minute duration. After the time is up, the door is opened, the light turned on, and the person is casually asked: "How did it feel?" to obtain an initial verbal reaction. The person is then asked to "Please come out and be seated and fill out this questionnaire. Answer those questions you can."

The questionnaire is as follows:
Answer any question that you feel is pertinent. Please add any impressions that you feel were not covered by the questions:

How did the room feel?
Subject: Hard to put a shape to it. Flat in front of me. Hallucinations had shallow depth. On looking straight ahead, I felt light converging on the sides as if from behind, but when I turned it was even darker.

What, if any, was the effect of entering the room?
S: Springy floor. Could be scary since it was dark.

What, if any, was the effect of leaving the room?
S: Waking up, bright, weird.

Describe the overall field after the light went out.
S: Shooting backwards through a tunnel. Blue-gray after-images on a darker-grey field. A shiny object to my left stayed with me then vanished.

What did you see?
S: Gray on dark gray. Rod-shaped blue things and lights swelling in from sides. Hallucinations (e.g., faces from weird angles—mainly looking up at them—focus on eyes and noses— mainly "Christ-like" and "blond-female" types.) and designs (e.g., fractionated planes) and colored objects (e.g., a red and green eye).

Describe the visual space you were involved in.
S: Dream-like. In fact, it was so hard not to close my eyes that much of what I did "see" was partial dreams. Up and flat at 5 feet or so.

What did you hear?
S: Fast vibrating mechanical sound throughout, water sounds, walking sounds, stomach gurgles, bone creakings, when I clicked my tongue—it had a dull, faraway sound.

Describe the auditory space you were involved in.
S: Water sounds off right, walking behind me, vibration in my head, I was elevated from my body sounds.

What did you think while you were in the room?
S: Of falling asleep (felt guilty about this); of trying to think about these questions which I knew I would have to answer (i.e., concentrating on seeing and hearing mainly).

How long did you feel you were in the room?
S: Very long time—I don't know—timeless.

What sensations, if any, were intensified or modified while you were in or since you have come out?
S: Sounds are louder, no hallucinations now!

Did the air seem abnormal in any way?
S: Stuffy, a sneeze stuck with me for a long time.

Did you feel claustrophobic in any way?
S: Yes, when I tried to look around.

Were you relieved to get out?
S: In a sense, so that I would remember "my dream."

Did you want to stay in?
S: No

Do you meditate?
S: No
Age: 25 *Sex:* F

The artists also duplicated an experiment written up by Kristian Holt-Hansen, of Copenhagen University, in 1968, called "Taste and Pitch." The Holt-Hansen paper described:

> …a new method of quantitative determination of taste. In a special experimental situation Subject compares taste and pure tones. The latter are varied in pitch until Subject finds the pitch which characterizes the sample. The method is illustrated by results for two samples, Carlsberg Lager and Carlsberg Elephant Beer. New problems are involved within the psychology of perception.

Irwin, Turrell, and Wortz were successful in confirming that there are definite "pleasure zones" of corresponding taste and tone—when drinking Carlsberg Elephant Beer, the tone (which could be manipulated by turning a dial connected to earphones) that produced a sense of harmony with the taste of the beer was 650 Hz.; when drinking Carlsberg Lager, a less sharp-tasting beer, the pleasurable tone was about 10-15 Hz. Certain tones produced no effect on the taste of the beers, but when the relationship occurred, i.e., when the tone was at the particular pitch cited, the beer tasted distinctly better.

The artists were interested in exploring the relationships between tone and color perception, as well—Wortz at some point provided them with information in this area of colortone synesthesia—though they didn't actually engage in formal experimentation. The principal aspect of their work in visual perception had to do with Ganz fields. According to Wortz's description, a Ganz field "is a visual field in which there are no objects you can take hold of with your eye. It's a complete 360° field, or at least has to include total peripheral vision, and it's entirely homogeneous in color, white in our case. Its unique feature is that it appears to be light filled. That is, light appears to have substance in the Ganz field." The ones constructed by Wortz, Irwin and Turrell were concave hemispheres, no larger than about three feet in diameter. When one of these was illuminated, it appeared, as you looked into it, to be solid, as if there were a flat plane across the top. Wortz says it is a "fairly infinite space. One of the most exciting things about it is that if you have a continually changing light level, the Ganz field will disappear and then reappear."

Perhaps the most important phase of the investigation pursued by Dr. Wortz and the two artists was in the area of alpha conditioning. Alpha is the designation given to certain measurable cycles of brain waves which have for some time been known to occur strongly during states of meditation. Sustained alpha rhythms of between twelve and eight cycles per second can be induced by putting oneself in a meditative state. One can test one's own ability to produce alpha with the use of an electroencephalograph machine, hooked up to some kind of audile or visual sensor which tells the subject when alpha is occurring. Dr. Wortz contrived a device which worked extremely well for himself, Irwin and Turrell. He attached a small light to a pair of glasses worn by the subject while sitting, relaxed, in a comfortable chair; the subject would close his eyes and see through his eyelid the light, which would come on only when the EEG registered alpha rhythms of twelve cycles per second or lower.

One day in July, Tuchman, Jane Livingston, and Gail Scott visited Garrett to meet with the artists and Dr. Wortz, and specifically to undergo alpha conditioning. Each in turn spent thirty to forty-five minute periods alone in the "alpha chamber," having been hooked up to the EEG and instructed briefly by Wortz. Although a single session of this kind of experimentation is not enough to enable one to enter at will a true meditative state and thus sustain alpha production, all three were able to achieve relatively prolonged "alpha states." The experience in itself of *doing nothing* for a half hour—of sitting, relaxed and alone, intensely aware but of nothing in particular, is one to which most people are not habituated. Nothing was being done to the subjects—they were simply training themselves to achieve a special state of consciousness for a few minutes at a time. Several hours after Tuchman, Livingston, and Scott had returned from Garrett to the Museum, all three of them experienced definite, inexplicable sensations of anxiety, or a sense of mental dislocation or dissociation. Since these peculiar sieges of emotional change occurred to all three, and to all within approximately the same period of time, it seems reasonable to speculate that they were effects caused by the alpha conditioning. (This is apparently not an unusual phenomenon from one's first exposure to alpha, but it is said that such "after-effects" disappear with increased expertise in this kind of meditation.)

The experience of alpha conditioning for the two artists and Dr. Wortz was important not so much in itself, but for what each learned through it about states of consciousness, and specifically the potentially life-changing consequences of meditation. In talking to us recently. Dr. Wortz did mention one quite specific result from the alpha experimentation:

> As far as the meditative experiences are concerned, both Jim and Bob were very useful to me, because they provided the perspective for the internal experiences. Their explanations and descriptions were really useful. There were things that I wouldn't bother trying because I didn't expect any results; but they went ahead and tried them, and they worked nicely. This primarily involved visualization. Prior to these experiments, in the literature on this area, it had been assumed that you couldn't do much in the way of visualization while producing alpha. This just didn't hold up at all.... With the alpha, visualization tends to be enhanced in its sharpness, and in the aspect of brilliance.

During the period while they were working intensively with alpha, Wortz formulated a list of exercises for meditation and itemized a number of his own responses during a meditative state which are precisely described and indicate the essential kinds of experience he and the two artists were undergoing:

> EXERCISES IN MEDITATION
> General Instructions:
> Sit comfortably—but erect at all times—head level—preferably full or half lotus but a straight chair will do.
>
> Hands in lap—one cupped within the other—palms up—tips of thumbs together.
>
> Twice a day—Eyes closed.
>
> 1. Counting breaths—1 week
> Breathe slowly and rhythmically with the gut
> Count the exhalations
> Count up to 100 and then backward to 0
> Attend to breathing and to the count
> Try to attend only to the breathing but do not particularly fight other thoughts—when they arise, however, do not pursue them.
>
> 2. Seeing breaths—1 week
> Same as above but try to see the inhalations and exhalations (The Buddhists say that the breath is blue—I struck out on this one).
>
> 3. Hearing—1 week
> Same as 1 and 2 but try to hear the breath as well while breathing as quietly as possible.
>
> 4. Illumination—1 week
> When breathing rhythmically try to increase the level of illumination of the room (seen through the closed lids).
>
> 5. No thought
> Proceed through the meditation period without thought—work at no thought.
> (I think this is the best individual exercise.)
>
> 6. Group effort—Meditate in a group and try

to help others—help them to do what?
It's for you to decide.

7. Koan
Strenuous effort to understand intellectually a purely intellectual question that has no intellectual resolution. (Who were you before you were born? What is the sound of one hand clapping? What's in the meaning of the word Mu?—pick your own.)

8. Eyes Open
Achieve a meditative state with your eyes open—look at the floor about 1–2 meters away—eye lids lowered slightly. No other instructions are necessary.

9. Tantric
Meditate on a mystical phrase or word such as Om. The word is repeated over and over.

Psychophysiological experiences I have had during meditation include:

1. Peripheral vasoconstriction (extremities feel cool)
2. Profuse salivation early in the period
3. Unique stimulating effect of unexpected noises—resulting in a whole body "thrill" sensation and sometimes accompanied by a flash of light
4. Time compression—30 minutes seem like 10
5. Loss of limb localization
6. Apparent and paradoxical spinning of the room
7. "Butterflies" in the stomach
8. Phosphenes
9. Seeing the 'moon rise'
10. Expansion of mind and body
11. Expansion of mind
12. Floating sensation
13. Full feeling in the forehead like blocked sinus
14. Irritated area on the forehead
15. Waxing and waning of a drawing sensation around the nose and eyes at approximately 47 cpm (seems to be linked with threshold movements of jaw muscles)
16. Reduction in blink rate
17. Relaxation of lower eye lid

As they concentrated increasingly on the alpha conditioning, Irwin and Turrell became less inclined—through the Spring and into the Summer of 1969—to carry out their original plan for designing an environment combining an anechoic chamber with a Ganz field for the Museum. One of the reasons for this waning of enthusiasm about constructing an "object" had to do with their feeling that any such work, because of the necessity to have only one or at most three or four participants enter it at a time, could not possibly be exhibited at Expo 70 and would be difficult to handle even in a considerably less crowded Museum situation. But there were, perhaps, other less concrete reasons for their gradual relinquishing of concern for "making a work." They began to become deeply involved in the highly personal experience *itself* of intimate collaboration. Then, in August, Jim Turrell suddenly abdicated from the project. He terminated his relationship with Irwin, though he has continued to the present time to see Wortz. Irwin said later that had Turrell maintained his participation in the project, they might eventually have consummated an environmental piece, but that he didn't feel inclined to pursue it on his own, or with Dr. Wortz.

In speaking individually about the three-way collaboration more than a year after it happened, Wortz, Irwin, and Turrell all made some significant comments to us reflecting on the direction it took. Wortz sees himself basically as a sort of catalyst in the relationship and tends to stress the active role played by the artists in a mutual learning process, with himself as a kind of "passive instructor." He said:

> For me the first part was to learn who these guys were, and how to deal with where their heads were. I was trying to figure out how I could contribute to what they were involved in. I felt I was essentially support personnel. But Bob and Jim didn't agree to that kind of role.... Eventually we decided to turn our heads to specific kinds of projects. And we got very close to carrying some of them off.... for example the sensory experiments, particularly combining the Ganz field with the anechoic chamber....The whole process was such an interactive process that it's difficult to sort out any one person's contribution.

Wortz's comments about the difference in approach between the two artists, made only after some pressing by us, are quite revealing of the dynamics of the collaboration:

> Bob approached information differently than Jim or myself. Jim and I are primarily information

> sops. Bob withholds information. He keeps the information at a distance, which is interesting, because he would arrive at the same observations and the same set of conclusions by holding off information. It was a very effective technique. Jim and I would sop it all up....
>
> We tried all kinds of things. We tried [with the UCLA anechoic chamber] to find out what occurs when individuals isolate themselves from sensory input and have to look inward. From what I know of Bob's early experience with painting, sitting for years looking at lines, I'm pretty well convinced that this sensory deprivation is what he was engaged in. I'm firmly and one hundred per cent convinced that Bob understands a line. I've come to this...over a long time, and I've learned how he understands a line. I don't understand a line, but I know damn well he does....

Wortz indicated that, although the collaboration at a certain point became "non-goal-oriented," it might—had Turrell not opted out—have issued in something concrete. He said at first, "What we learned has mostly to do with our personal development. Whether there are any other fruits beyond ourselves remains to be seen...." But he later stated, "I really am convinced that if this problem [between Irwin and Turrell] hadn't happened, it would have matured into some sort of specific, concrete product." He went on to speculate about artistic collaboration in general:

> People like myself are continually involved in cooperating in all sorts of research, design, etc. In fact we do almost nothing individually, because one person just isn't capable of handling these problems himself. Now if art moves to the level of complexity that my field has attained, I think there's a pretty good chance that artists can work together similarly. If it doesn't move to that level of complexity, I don't think there's any reason for that collaboration [among artists] to occur.
>
> The fundamental purpose of our research was really twofold. We were doing things that were providing us with some new insights into ourselves and perception, and also providing us with insights about how we could work with each other. The business of working with each other came along very nicely, and I still have that kind of relationship with Jim and Bob individually.

The artists both talked with us during the same period (September 1970) as Wortz. Irwin said:

> All this kind of information has very strange social connotations. You find yourself not telling everyone about it, because a lot of people look at you like you've dropped your cookies. It's not a verbal experience.... Wortz and I operate out of common experience. We would do various experiments together, and then begin to talk about them afterward. But when you spend this long playing with non-verbal forms, it gets hard to talk. You don't have a *desire* to talk about it. It doesn't work, and it doesn't feel right.

In response to a question about their abandoning the idea of building an environment, Irwin said, "There was doubt about it from the very beginning. But the thing that stopped it was Turrell's abdicating."

About the collaboration in general, he said:

> Most often, I didn't know who really came up with an idea, or who did what. So when one person dropped out, we couldn't really proceed in the same line.... But I feel extremely accomplished for having entered into the project. I learned a lot about how people handle information; what defines the state of consciousness....
>
> The areas of extended perceptual research we got into have to do with the ability to handle information in non-physical symbols.... So how does man deal with this? What are the states of consciousness that allow him to function in this more elaborate way? That's where we are.

Turrell's comments, after more than a year had passed since he had walked away from the three-way interchange, were quite different from those of Wortz and Irwin. Often his statements seem immensely distanced from the issues at hand and reveal as much about the evolution of his thinking over the last year as about his role or approach during the time of the collaboration. Fragments of his responses to various questions about the project are as follows:

> I don't know that anything really startling came out of the whole thing.... I sometimes feel I've

> found some things out, but they don't apply to anyone else unless they come to them in the same way....
>
> If either art or technology becomes a religion, maybe this stuff will start getting more exciting. There's got to be an Art and Technology Christ....
>
> I have found out [largely through the collaboration] that you can order people's experience. There's really a lot that you *could* control in making people confront something....
>
> You could make this thing [A&T] historically significant if you want to. I have the feeling that whatever is happening here is a symptom of something that's going on—but I think—I hope—it's going to be vastly overshadowed by the thrust of the things going on independently.
>
> We're going to have to work through this time of ego, and of separating artists from all those around them.... We're very involved in our roles as individuals right now. The thing that happens with technology, or [something like] the Manhattan Project...in which people put their energies into a cause where they have to forget themselves.... People are afraid to dissolve themselves into any sort of human cosmic consciousness.... We're standing next to a swimming pool a little bit frightened about jumping in. But everyone's going to get pushed in, or jump in finally. It doesn't make any difference which. There are forces which are about to push us in.
>
> The scientist has reserved the universe of the unknown as his place. What the artist has to reveal seems to be a different order—but it probably isn't, in the end.

The only reply Turrell made to the question as to why he had decided not to continue working with Irwin was:

> [I had to get away from] all ideas of ambitions and PR and constructing yourself in the second derivative, feeding back things, so you're watching yourself in this very peculiar mirror.... very good for the head. Trying to maintain any sense of vanity, and looking at that, was hard.... I decided all that didn't seem necessary.

Replying to a question about his view of the success or failure of some of his experiments, particularly with UCLA students, he said, "One of the surprises was to find that the things you're setting up aren't seen by other people in the same way. That's all." (Irwin, responding to the same question, said, "We learned that the information we were interested in was not that obscure—anyone could get it. I think it had a similar effect on them [the subjects] as it had on us.") Turrell continued:

> All of this is very Pavlovian. You're not really asking much of the person, or yourself. And all you can watch are the surface responses. People were often going through a dance with you.... Then [the project] began to change, and move into sensory interaction, where the senses influence one another. And then into alpha conditioning, which is sort of taking a Pavlovian approach into spirituality. It has no end....
>
> Our culture is going through a strange time—looking at Eastern thought—their work with meditation, their sense of the body and mind and soul. We're approaching it through psychology. We're very physical. When we want to go into the universe, we can't look at a rock, like the Japanese. We have to actually go to the moon. We're so literal. We totally ignore the Eastern way. There are actually meditative sciences, or sciences of the soul. We have devices, sensors, alpha conditioning machines. The machines are just manifested thought. Technology isn't anything outside us.... We just go about it very clumsily and very wastefully. Because we have to actually make all these devices, we have to *go* to the moon, we can't see the cosmos in a rock, and we can't meditate without having this thing strapped on us.

After August 1969, at the point when Turrell resigned his commitment, an important involvement continued between Wortz and Irwin toward a specific new goal (among other involvements)—the First National Symposium on Habitability, which sprang directly from the personal connections instigated by A&T. In the summer of 1969, Dr. Wortz was asked by NASA to consider the problem of formulating a new approach to certain areas of research having to do with "habitability." Wortz arranged a meeting at Garrett with some colleagues in various fields of scientific research and asked both Irwin and Turrell to sit in on the meeting. According to Irwin, he and Turrell "corrupted the meeting. They started out by trying to define the word 'habitability.' NASA's projections of what this meant seemed incredibly limited to us. Our definition of habitability completely altered the premise they were assuming. We broadened the term." (After this initial session, Turrell was no longer involved.)

The details of the process of determining the format and selecting participants to attend and present papers at the Symposium, which was organized in great part by Wortz, are much too complex to recount here. It took place in Venice, California from May 11 to 14, 1970. The following is an excerpt from a letter sent to prospective participants by Wortz in November 1969:

> The symposium will be concerned with "habitability" as a general phenomenon influencing the planning and design of undersea vehicles and stations, lunar bases, space stations, spacecraft, terrestrial vehicles and structures, and urban settlements. The symposium will probe our current understanding of the concept of habitability; the factors which influence the quality of life associated with various environments; the need for and characteristics of habitability criteria; the planning and design of a "habitable" environment; and will further seek to develop testable hypotheses relevant to this subject.

The speakers and panelists finally involved in the symposium were drawn from widely disparate professions. The list of speakers is as follows:

> Dr. Willis W. Harmon, Director, Educational Policy Research, Stanford Research Center, Menlo Park, California
>
> Dr. Kiyoshi Izumi, Architect Planner, Chairman, Human Information and Ecology Program, University of Saskatchewan, Regina, Canada
>
> Dr. William Larson, Chairman, Division for Behavioral Sciences, California Polytechnic College at Pomona, Pomona, California
>
> Dr. Shashi K. Pande, Department of Psychiatry, John Hopkins University, Medical School, Baltimore, Maryland
>
> Dr. Stan Deutsch, Chief, Man Systems Integration Branch, Biotechnology and Human Research Division, National Aeronautics and Space Administration, Washington, D.C.
>
> Dr. William Haythorn, Department of Psychology, Florida State University, Tallahassee, Florida
>
> Dr. Loren Carlson, Chairman, Basic Medical Sciences, School of Medicine, University of California, Davis, California
>
> Dr. Eric Gunderson, Navy Medical Neuropsychiatric Research Unit, San Diego, California
>
> Mr. Allen Louviere, Chief, Systems Support Branch, Manned Spacecraft Center, National Aeronautics and Space Administration, Houston, Texas
>
> Dr. David Nowlis, Consultant on Habitability, Garrett/Ai Research, Los Angeles, California
>
> Dr. Ronald O. Loveridge, Department of Political Science, University of California, Riverside, California
>
> Dr. Seymour I. Schwartz, Department of Systems Engineering, University of Southern California, Los Angeles, California
>
> Mr. Morton Hoppenfeld, Director of Planning & Design, Rouse Corporation, Columbia, Maryland

The panelists were Dr. Art Atkisson, University of Texas, School of Public Health; Dr. Jelliff Carr, Director of Life Sciences, FASEB; Dr. Morton Leeds, Director Plans and Programs, HUD; Robert Irwin, Artist; Dr. Ted Marton, General Electric; Dr. Thaddeus Glen, University of Toledo; Dr. Dave Martin, University of Texas, School of Public Health, Dr. Richard Haines, NASA/Ames Research Center; Dr. William Soskin, U.C. Berkeley; Dr. George Rand, Columbia University; Dr. Robert Ornstein, Langely Porter Institute; Dr. Edward Wortz, Garrett Corporation; Dr. Melvin Zeisfein, Franklin Institute.

The event was extraordinary in several respects. Its physical environment, designed by Irwin, along with artist Larry Bell and architect Frank Gehry, distinguished it dramatically from other conventions of its kind. It was in great part simply owing to the psychological conditions achieved by the special surroundings that the event became the tense and complex encounter session that it did. The space in which the morning sessions took place—organized each day so that four speakers would discuss their previously submitted papers, before four panelists would then discuss them—was located in a large, studio-like room on Market Street, near the sea. The speakers and panelists sat in the middle of the room, in two rows facing each other; above them were two tinted skylights. On either side of the central platform were rows of low, bleacher-like seats, made of chunks of corrugated cardboard; this seating arrangement was designed by Frank Gehry. On the side of the large white room which faced Market Street, Bob, on the first day of the Symposium, set up large, white cardboard cylinders, floor-to-ceiling; the participants and audience entered from a small doorway in the rear. On the second day, the white cylinders were replaced by a large plastic tarp, letting in light from outside, but not wholly transparent; and on the third day, the entire side of the room facing Market Street was opened up.

A combination of subtle psychological factors were brought to play on the dynamics of the Symposium sheerly by virtue of its environment: for example, the low seats were rather uncomfortable—intentionally so, according to Irwin—making it impossible for the audience to relax physically. Nor was the space insulated from street noise, so it was often difficult to hear what the speakers were saying; again. Bob felt this was a positive factor, forcing concentration on the proceedings.

At the outset of the Symposium, one sensed a definite psychological tension between what Dr. Wortz characterized as the "square" and "hip" participants—this dualism gradually gave way to other factional conflicts, and eventually a whole set of unpredictable positive situations emerged in the dynamics of both the group as a whole and the discussion sub-groups, and in the nature of the information exchanged. Irwin commented later, "I was interested in it as an event. It was a chance to exercise some things I was personally curious about, directly in relationship to the A&T project.... It really worked. What happened with the afternoon discussion groups was fantastic; really heady kinds of information."

It is not possible here to be more explicit about the circumstances and results of this Symposium; however, much of the proceedings were recorded and have been published by the Garrett Corporation, and a Second National Symposium on Habitability is currently being organized.

Simultaneously with their preparations for the Symposium, and since that time, Dr. Wortz and Irwin have continued to work together on various other projects. Wortz has consulted Irwin on several occasions in connection with his researches for Garrett. He spoke to us in September 1970 about Bob's participation in an undertaking contracted by NASA:

> 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.

Wortz spoke about yet another—rather mysterious—project in the works between himself and Irwin:

> There's a thing Bob and I would like to try. Right now it's just an experience, but if It could be made Into a thing it would be nice. If it works it will produce an emotional response which you might be surprised about. It has to do with the technique of producing a loving response in someone.

(Irwin later "demonstrated" the technique to Jane Livingston and Tuchman; it does indeed work and has to do with pulling people or objects into one's immediate circle of psychological perception, in a sense as an extension of oneself.)

Dr. Wortz and Bob Irwin have recently indicated to us their interest in realizing an environmental artwork of the kind originally outlined, combining an anechoic chamber with a Ganz field. Turrell's involvement in such an undertaking is unknown at this point.

Jane Livingston

Rockne Krebs

Rockne Krebs working on *Day Passage* in Osaka, 1970

The Hewlett-Packard Corporation contracted with the Museum as a Sponsor Corporation in August 1968, after a fairly prolonged exchange of correspondence between the Museum and David Packard. Hewlett-Packard had declined to join as Patron Sponsor, and we might not have persisted so long in soliciting their cooperation except that we had toured their Palo Alto facility with Mr. Packard in July and felt strongly that their technological potential for an artist, especially in the area of lasers, was exceptionally important. By joining the program in the Sponsor capacity, Hewlett-Packard ultimately provided valuable resources and went to considerable effort and expense in assisting the artist matched with them—their commitment finally equaled that of most Patron Sponsor corporations.

After Hewlett-Packard had signed a Sponsor Corporation contract, nearly a year passed before they received an artist, though the assignment, when made, was accomplished easily.

In March 1969, Hal Glicksman received a letter from Washington, D.C. artist Rockne Krebs:

> Walter Hopps suggested that I contact you if I was interested in participating in the L.A. County Museum's "Art and Technology" show. I am.
>
> Perhaps Walter mentioned my light structures to you. I would be particularly interested in producing one in collaboration with a corporation which makes lasers. I have been plugging away at these things since the spring of 1967 when I panhandled a laser and set one of the structures up in my apartment. Since then there have been three one-man shows—a fourth coming up at the Corcoran in May [later rescheduled for November]. I have yet to scratch the surface in terms of the possibilities. The inevitable inhibiting factors for me are technical assistance and the equipment necessary to realize the work. Needless to say, your project sounds attractive to me.
>
> I now have eight lights of my own. All but one were purchased from Spectra-Physics, a firm based in Mountain View, California. Their local rep has been reasonably cooperative about lending me equipment when he has it available. I understand that Spectra-Physics is one of the few companies left whose primary product is lasers. I mention this because Spectra-Physics might be limited in how much they could afford

> to subsidize this kind of project as compared to a large corporation for which lasers would be a subsidiary product. I am just speculating, however. Laser applications apparently have not kept up with what was envisioned initially.
>
> If you are interested, I will prepare a detailed proposal for a piece.

We were indeed interested, and on April 11, Rockne sent us a carefully drawn-up proposal. It described two works, one to be set up outdoors and shown at night, the other an indoor piece. He called them *Night Passage* and *Day Passage*. In May, we brought Krebs to California for three days to tour corporations. He visited Hewlett-Packard, and signed an artist contract. It was imme-diately evident that Hewlett-Packard would be well equipped to work with Krebs, and following Krebs' tour, we sent his proposal to Dan Lansdon, Administrative Head of Hewlett-Packard's laboratory, with a letter urging that a collaboration be initiated. On June 6, Lansdon phoned to say that Hewlett-Packard was prepared to work with Krebs: it was agreed that Krebs would begin residence in mid-July. A year later, Rockne wrote about his feelings at that time, just after he had first toured the corporation:

> Initially, from the point of view of realizing a laser piece, I had some misgivings about a collaboration with Hewlett-Packard. They made lasers, but I had no idea if they were the type suited for my work. The security lid was on the project they had going with lasers and they refused to discuss it with me.
>
> I did feel that there were some interesting people there but in terms of Hewlett-Packard's products, I did not immediately see any possibilities for the kind of work that was on my mind when I went to Palo Alto. . . .
>
> To be completely honest about it, at the time I wanted very much to make a piece. This is not the cool, think-tank theme that might be popular to peddle, but several years of ideation and attempts to visualize pieces that were beyond my resources to realize, both technically and financially, had preceded my initial visit.
>
> Maurice Tuchman and Hal Glicksman stressed the importance of the unknown possibilities that this sort of collaboration might point to. Quote Tuchman: "You may not even want to make a laser piece."
>
> Okay. I was skeptical, but I told Tuchman, HG, JL and BA [Maurice Tuchman, Hal Glicksman, Jane Livingston, and Betty Asher that I would be glad to go to Hewlett-Packard and spend time in the labs and see what happened.
>
> Who knows what was on the group mind at the Hewlett-Packard labs? There was an unknown. Titillating.

Krebs was at this time more enthusiastic about doing an outdoor piece (some version of *Night Passage*) than the indoor *Day Passage* and in June sent us an RCA price schedule on laser equipment with hand-written notes on how he might use their argon laser. Model LD 2100, for such a project. He wrote:

> The LD 2100 has an internal cavity prism assembly which permits the selection of a minimum of six individual frequencies—colors.
>
> It should be possible to devise a way to run through its color range continuously which is from green-yellow to blue. Now try to imagine a huge exterior light structure of three of these on different cycles and one stable red 50 mw helium neon zapping between the buildings and finally shooting off over Wilshire into the L.A. atmosphere.
>
> Flowers would grow in the cement out front of the L.A. County Museum the three or four hours a night that it was turned on.
>
> In fact—let this be my proposal to Hewlett-Packard. I recall that they have one argon laser some place. They would begin by making an automatic wavelength selector device that runs on a continuous cycle for their argon laser. (Although I would be interested in how it's done, it is not necessary that I know. Then if I'm allowed out there I could have that to begin experimenting with when I arrive in July. If it does what I think it will, we could then see about renting or borrowing the one or two more lasers necessary to realize the piece.) I would like to be able to control

> the cycle rate—slow or fast, and to be able to stop it on a specific color if I wanted. . . .

By the time Krebs arrived in Palo Alto in July, and the collaboration was underway, it had become fairly certain that some of the A&T projects would go to Expo 70, and we encouraged Krebs and Hewlett-Packard to execute a laser environment that could be displayed in the New Arts area. Thus, the idea of creating an outdoor work was relegated to secondary priority. Krebs and Hewlett-Packard's physicist Laurence Hubby did run some night tests during his stay at Hewlett-Packard involving a laser beam directed into the atmosphere and hand-manipulated mechanically to change color. This peripheral experimentation was actually of key importance to the artist in many respects. He afterward wrote:

> I have a reasonably good science-fiction background. When I arrived at the Hewlett-Packard labs I could turn a laser "on" and "off." I felt that the technology involved was best left to the technicians. Still do with this qualification: I want to know all the capabilities and limitations of the tool. What we were doing wasn't merely collaborating on the execution of a piece for Expo. I was able, with the assistance of Hubby and others, to research in a much broader sense, possibilities for work that had nothing to do with any particular piece. For example: Larry Hubby and I would go back to the labs in the evening (on his time off). We would set up and run the tests for outdoor pieces. With Larry's assistance I was able to determine the power of laser required to do an outdoor piece, and the size of optical telescope necessary to refocus the laser light to get minimal divergence in relation to distance. In other words, what my scale limitations were. I learned that there was a definite relationship between the particle size, the frequency of the light (color), and how well it scattered under normal atmospheric conditions—appeared visible along the path of the beam. I learned that the blues and greens would be scattered better by the incidental matter present in the atmosphere than the longer wavelengths of red.

Throughout Krebs' initial residence at Hewlett-Packard, from July 21 through August, and in the later stages of the project, Dan Lansdon served as his principal contact. Lansdon was extraordinarily helpful in directing the artist to the right personnel for advice and assistance in the various technical aspects of the project; according to Krebs, "Lansdon had the authority, and used it: he knew what people to see and how to approach them." Krebs not only worked with a great number of technicians at Hewlett-Packard but made several connections with laser experts outside their laboratory. The Palo Alto area is probably the world center of laser research, and on five or six occasions, Krebs was led by Hewlett-Packard people to seek information from experts at such nearby organizations as Spectra-Physics, Coherent Radiation Laboratories and Stanford Research Laboratories. He presented a slide lecture to personnel at Spectra-Physics which was received with considerable enthusiasm. Indeed the first two or three weeks of Krebs' stay in Palo Alto were devoted primarily to a process of gathering and exchanging information and simply conversing informally with various laser researchers. Krebs said later that when he arrived at Hewlett-Packard with his project in mind, he "didn't know if the piece was *possible*; I suspected it was, but it was much more complicated than I had envisioned. Technically, it's more complicated than any work I've done."

Rockne also commented that he was intensely affected intellectually by his experience in Palo Alto: "My mind was stimulated," he said, "in a way it never had been before, and probably never would be, particularly by art."

Krebs was extremely gratified to find that he could easily obtain direct and precise answers to questions he had hitherto not been able to resolve. For example, he consulted with a Stanford Research Institute physicist, Dr. Arthur Vassiliadis, on the issue of the precise threshold levels of eye damage by laser light and got exact quantitative information from him, based on recent studies, that probably was not available at that time anywhere else in the world.

One incident occurred, not directly related to his work on the main project, which may have especially significant ramifications for Krebs. He was asked to present a lecture with slides to a group of Hewlett-Packard employees. The talk elicited similar interest to that expressed by the Spectra-Physics audience, and one man, a scientist named Egon Loebner, approached Krebs at the end of the presentation to invite him to lunch. Loebner is an authority on patent procedure (he was teaching a course in invention at Stanford), and he felt that something Rockne had demonstrated might in principle be a patentable technique. He saw in some of Rockne's laser light configurations a potentially utilitarian function as a device showing particular ways of architecturally delineating space, or "light as structure." Loebner and Krebs sought the advice of a patent lawyer whom Loebner knew, and as a result a patent search is presently underway for what is being termed "architectural photon structures." According to Krebs' description of the projected uses for this phenomenon, it would be employed literally as an architectural element. For example, temporary walls, false ceilings, and room dividers might be created with laser light. Such structures could be constructed indoors or outdoors; one advantage, for instance, might apply in a landscape situation, in which one wished to mark out a space without physically disrupting the terrain or flora. Although this potential function for his laser environments had not occurred to Krebs, he quickly saw its rationale, as envisioned by Loebner. Krebs had used light in this way repeatedly but was not particularly aware that it might constitute a patentable invention, or even that he may indeed have been doing it for the first time.

In executing the piece for Expo, Krebs worked perhaps most closely with Hewlett-Packard physicist Laurence Hubby, who designed and put together the optical apparatus, and with optics engineer Bruce Ruff. Of the system designed by Hubby, Krebs was to say later, "The apparatus that controls the argon beam is a work of art in itself. It has been absolutely beautifully designed." Besides the intricate optical system, which incorporated hundreds of parts, the work basically comprised a series of small mirrors to direct the light beams, two helium neon lasers, special mounts for the helium neon lasers, the large argon laser, the fog-producing machine needed to increase the visibility of the beams, and two eight and one-half by fourteen-foot plate glass mirrors which were made in Japan. The Japanese company that provided the mirrors stated that they may be the largest true mirrors ever made. Rockne wrote, elaborating on the system:

> These *small* mirrors were no small design problem. First, they needed to be adjustable through three axes—x, y, and z, with as much adjustment as possible. The latter was necessary to give me flexibility when redirecting the light beam. Second, they had to be stable, so that once a position was determined the mount itself would not slip and cause misalignment. Third, the mount had to be attached to a wall of similar plane. Fourth, I wanted all this to happen in as discreet a piece of apparatus as possible: a small three-inch diameter mirror mount that would protrude little from the wall. (My feeling about these pieces is that the *work of art* is not the apparatus. Rather, it is a score or arrangement [or whatever] determined in relationship to a specific enclosure. Allowing for the obvious contradiction of the necessity for some kind of apparatus [mirror mount] to redirect the light it is important to me that they be as inconspicuous as possible.)
>
> This kind of mirror mount (or Maurice's term, "beam joint") is not stock optical equipment. Dan Lansdon and I spent an amazing number of hours discussing the requirements and attempting to find some kind of existing mount that could be altered—none existed! Although several of Hewlett-Packard's mechanical engineers worked on it at various times, it was Lansdon who resolved and perfected a mirror mount which satisfied my requirements, with the beautiful plus of being relatively inexpensive to produce—about $30 per mount. If I continue to work with lasers, as seems likely at this time, try to imagine how long it would have taken, how much it would have cost, how difficult it would have been for me to locate people capable of and willing to bother designing this one little item. With the prototype which I now have I can have them made myself.

The main aspect of the project accomplished in terms of realizing the piece for Expo during Krebs' initial stay at Hewlett-Packard was the designing of the programmed optical system; this is of course in some ways the crux of what the work is about, but it still remained to actually obtain the large argon laser (a problem which caused difficulties until the last moment) and physically set up the entire structure for final experimentation and perfection. This process had to take place in the installation area at Expo. Fortunately, there was considerable flexibility in the final disposition of the components within a prescribed space.

Hal Glicksman wrote this memo to the staff on August 28, 1969:

> Rockne Krebs has left Palo Alto for Washington,

> D.C. He will return mid- October. [This was eventually postponed.] Hewlett has approved $10,000 worth of mirrors and other devices for the infinity reflector system and other uses which Krebs gets to keep. The Argon laser has *not* been approved. Jelco (Japan Electronics Co.) makes a suitable laser that could be rented in Japan. Lansdon is investigating this and other possibilities.

In September, Krebs met in New York with members of the Expo Exhibition Design Team and us. At that time a tentative location for the work was selected. It seemed then that the major problems were the hazard created by the artificial fog (this actually posed no difficulties) and the rental or purchase of the argon laser. Krebs needed a corridor-like space or spaces with low ambient light; these requirements were easily met, and it was provisionally decided to distribute the bouncing light beams in several sections located at various points in the area, mounted high overhead. Krebs made several drawings showing alternative plans for distributing passages of laser light through the New Arts area.

After this meeting, some radical revisions in the New Arts area were effected. Krebs wrote to Dan Lansdon on October 15:

> …I mentioned when I called last week that the architect of the U.S. Pavilion in Osaka, Ivan Chermayeff, indicated there were going to be some changes in the New Arts Exhibit area. I have just received a revised plan for the area. The space is now divided into rooms rather than having it in one big area. My new space is roughly forty feet by twenty feet. This changes the enclosure to the extent that my piece will have to be reworked. I am concerned now that in a more confined area the intensity of the Argon's green and blue beams will wipe out the lower power [helium neon] red.
>
> The altered space should not change the apparatus we collaborated on this summer except for reducing the number of small mirror mounts required. I think I said twenty versus thirty mounts last week when we talked. Reduce that to fifteen total (or fourteen in addition to the prototype I have), and hold up making the mount for the [helium neon] lasers.…

Hewlett-Packard and the Museum attempted to procure the argon laser as a donation from its manufacturer. Finally, it was purchased by Hewlett-Packard from Coherent Radiation Laboratories, and two helium neon gas lasers, model 251, were lent by University Laboratories.

Once it was determined that the large parallel mirrors would be made in Japan, and the sources of the three lasers and the fog juice were resolved, the question of actually installing the work at Expo was at issue. There was no doubt that Krebs would have to supervise the installation himself, but before his arrival considerable preparation was expected.

Krebs wrote to David Sutton, November 28, 1969:

> Regarding your suggestion in your November 18 letter that the Japanese contractor purchase and install the mirrors—I have three enclosures which should give you the information he would need. I like the idea of having the floor to ceiling wall of mirrors as you suggested over the phone, and I think it could be done. It would make for a better looking installation than what is called for in my enclosures. My reasons for not suggesting this possibility initially were the additional expense of the mirrors and the difficulties encountered in aligning the mirrors in a co-planar relationship. It would be necessary to install the plywood paneling in such a way that you could insure the two walls used with the mirrors be co-planar before any attempt is made to install the mirrors. Then, in installing the mirrors, I would recommend covering the entire surface of the plywood with an even coating of "mirror mastik." This could certainly be done before I arrive in Osaka. (Note: the mirrors to be used are simply standard one-fourth inch thick plate glass. They come in a stock size of eight feet by ten feet in the U.S.) Once I am there and install the lasers and other apparatus, it would be necessary to drill three holes in one mirror. However, I do not think this will pose a problem.

Krebs returned to Hewlett-Packard for a week in January 1970 to finish the work begun the previous summer—the lasers had still to be tested in operation with the small mirrors, and the optical system completed. During this period he worked intensely with Laurence Hubby, and again Lansdon assisted him significantly. Because Krebs was to accomplish the installation himself, without the assistance of the Hewlett-Packard scientists who had developed the work, he had to be taught to assemble and operate the optical system. Krebs wrote:

> John Lazier, the Hewlett-Packard electronic technician who designed the electronic shuttering system and the program which could control the rate of change and configuration and color change, had worked out a number of variable program possibilities. He and I discussed these at length, he trying to visualize what the various program possibilities might look like. I decided for the most apparently random program. The limitations were: three positions, "A," "B," and "C" which could result in three separate light configurations and two basic colors. I wanted the rates, color, and position changes independent of one another. We were told the average viewer would spend roughly three minutes in the space, so the possibility of the piece completing its cycle—running through all three positions and the final 30-second rapid stage—had to be worked out with this three-minute time factor in mind. The more we discussed it, the more I began to see how important the rate of color change and the rate of re-positioning would be to the final piece. And without actually experiencing it in the space I was reluctant to settle for a basic program which I could not alter. John Lazier was sympathetic and spent considerable extra time designing into the system a control mechanism which would allow me to alter the rate of the cycle to fit the situation. Also, to facilitate making the piece, a switch was put in so I could leave it on at any designed point in the cycle.
>
> The last night I was in Palo Alto, Lansdon, Hubby, and I were up into the wee hours setting the argon laser and its optical system up to test it. We actually mounted several small mirror mounts and put up a test configuration. Everything worked beautifully except the collimating telescopes. I felt that visually the beam's intensity was too weak because of the beam diameter. I asked Larry Hubby to redesign the telescope and reduce the beam diameter to one-half inch, which he did.

On January 24, Krebs arrived in Osaka to begin the six-week job of installation. The space in the New Arts area allotted for the work measured twenty-three feet by forty-six feet; it was a parallelogram-shaped room. Beside it there was a separate, walled-off utility room within which the laser apparatus was to be mounted; the large mirrors were placed face to face in the center of the room. Krebs accomplished nearly all of the immensely complicated installation himself. He moved into a schedule whereby he would work at night, alone; it was easier for him to function undisturbed by the workmen in adjacent areas.

The work is difficult to describe, but in assessing the artist's intentions for it and the important issue of its special nature as a collaborative project, some attempt at description is necessary.

Two kinds of laser light were used. The argon laser produced most of the light, and because its powerful light green and blue beams could be controlled by the optical system (in conjunction with the small "beam joint" mirrors, to disperse the beams) to flash on and off or change color, it was used to generate the complicated configurations of continually changing light structures. The red beams emanating from the smaller helium neon lasers formed a *static* configuration seen reflected "to infinity" in the two parallel mirrors.

The argon beams were structured in three basic sections. Originating at each end of the room, and traversing it length-wise, were "fans" of light. At one end, "joints" of light originating from a single beam (sections of beams reflected between small mirrors) traversed the area in a parallelogram which hung horizontally, at a distance of seven and one-half to eight feet above the floor. At the other end, a beam was positioned vertically, up the wall, from eight to twelve feet above floor level. This beam would then fan out in a vertical line and twist into a horizontal configuration. Then this entire system would be reversed, and the same thing would occur at the opposite end of the room. The configurations of light were programmed to run through a repetitive cycle; they would pop back and forth or seem to swing; just as the spectator began to apprehend the pattern from one point of view, it would suddenly begin to enter a "dialogue" phase, popping back and forth across the space. The cycle was determined at seven minutes, based on the anticipated rate of traffic flow through Krebs' room.

The third argon beam was positioned vertically in the center of the space, running down the center of the mirrors. This generated a kind of "wall," but worked into the sweep of the beam activity originating from each end of the room. The center beam worked in various combinations with the peripheral argon structures. Reflected in the infinity reflection system, it moved in and out and changed shape in relation to the "armature" of the red (helium neon) static-beam network.

The apparent depth perceived as one stood between the parallel mirrors was calculated by Krebs to be about ten times that of the actual distance between them (about) eighteen feet). Thus as one walked through the area, he entered a passageway between the mirrors which was actually narrower than the rest of the room but seemed to open out suddenly into a great expanse.

When this description of the work had been written, it was shown to Krebs in the hope that he could add to, or clarify it. Krebs felt that it was not totally accurate and submitted three drawings which he hoped would make the structure more easily visualizable to us.

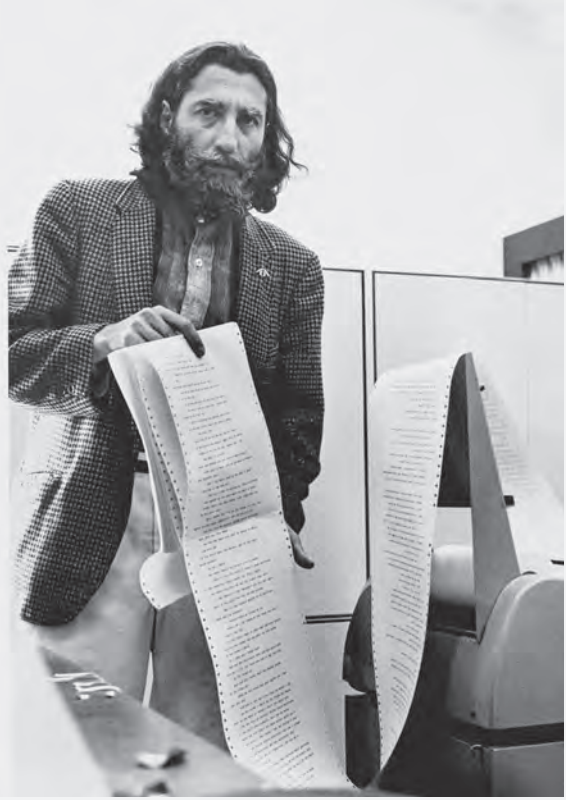
In relation to Krebs' past work with lasers, this piece represents a significant departure chiefly by virtue of the programming system, which he could not have developed without the assistance of specialists. The artist had for some time wanted to find a way to weaken the psychological persistence with which laser beams are perceived as apparently *real matter*. He felt that by making the beams temporarily disappear and then reappear, or by repositioning the light from one source into a series of varying configurations, he might succeed in achieving a sense of the light in its true character—as simply light. The ability of laser light to suggest spatial delineation and to convey both the transiency and relativeness of this process is realized, Krebs found, only when clues are given to counter the strongly illusionistic felt presence of a laser beam projected uninterruptedly. The clues were provided by the programming system. Discussing his intentions for the Expo piece, Krebs wrote:

> The light beam would fill the room with one configuration and then another— versus "to flash on and off"…you just have the sense of something that's in one place and then it's in another. As you noticed, the beams of laser light have visually a tangible presence. But I am not dealing with material in the same manner the sculptor has in the past. Conventionally a sculpture is a configuration of mass that one sees because it is illuminated by some light source. I reversed this proposition. I put incidental matter into the atmosphere (or use what is already present) and project light through it. The path the light beams take as they pass through incidental matter in the atmosphere is the sculpture. It is a piece of sculpture that one could physically move through.
>
> But, it is light (I think Newton called it "a unique form of matter") and it has unique capabilities. In the configuration that resulted from positions "A" or "C" there was never any sense of the structure as a kinetic thing—of the light moving from one point to another. Rather it was simply there in a space that had previously either been empty or occupied by a different structure.
>
> So these are some things that I am able to do with my medium that I could not do with another. There are other possibilities. This piece was not an attempt to demonstrate all the unique properties of light in general or laser light in particular. It was an attempt to realize a particular work of art which did of course use some of these properties.
>
> The visual presence of the laser light can be sufficiently convincing that one forgets with his eyes and ultimately with his mind the reality of what he sees. The idea of reconfiguration is then a self-conscious attempt to tickle both his mind and eyes.

Rockne plans to expand the basis for the Expo piece somewhat in doing a work for the Museum exhibition; there will probably be a greater profusion of light beams from the argon lasers, and possibly the addition of one or two helium neon lasers. We are planning as well to arrange for the artist to set up an outdoor work, using one or more powerful argon lasers, shooting beams out over the city of Los Angeles from the Museum.

Jane Livingston

Jackson Mac Low



Jackson Mac Low with printouts of his PFR-3 poetry

Jackson Mac Low's participation in A&T came about for several unusual reasons. His was from the beginning a special case, since he is not an artist but a poet, and could thus not be expected to have the same kind of relationship to a corporation as other artists contracted with us. Our rationale in approaching Mac Low had in part to do with an intensely frustrating impasse reached with an important corporation: namely, there came a point in our dealings with IBM when it seemed we must either try a totally new approach or simply give it up. Since we had attempted unsuccessfully to obtain IBM's approval for interactions with several artists—Victor Vasarely, Robert Irwin, Eduardo Paolozzi, and Vjenceslav Richter—and since one reason for this failure appeared to be the difficulty for these artists of using computer technology in a way mutually satisfactory to them and IBM, we thought of bringing in a poet, who could use computers as a linguistic medium. The suggestion to include Mac Low was David Antin's.

Mac Low is associated with concrete poetry, an international, heterogeneous school of poetry, which came to prominence in the early fifties. However, unlike many of the younger exponents of this poetic movement who specifically seek a synthesis between traditional poetry and painting, Mac Low has conformed to an older manifestation of this style. In his *Anthology of Concrete Poetry*, Emmett Williams discusses a kind of poetry which best describes Mac Low's own work:

> The visual element in this poetry tended to be structural, a consequence of the poem, a "picture" of the lines of force of the work itself, and not merely textural. It was a poetry far beyond paraphrase, a poetry that often asked to be completed or activated by the reader, a poetry of direct presentation—the *word*, not *words*, *words*, *words*, or expressionistic squiggles—using the semantic, visual, and phonetic elements of language as raw materials in a way seldom used by the poets of the past.

Mac Low studied music from the age of four and began composing music and poetry at fifteen. His educational background includes studies in philosophy, comparative literature, Greek language, and music. In 1954 he published *Five Biblical Poems*, in which he invented a kind of verse using, as the basic unit, the "event" rather than the traditional foot, syllable, stress, or cadence. The poems are based on actual Biblical happenings and the events are either single words or silences, each equal in duration to any word. Integers in the title indicate the verse structure which can be made verbal by musical or other non-verbal sounds produced at the ends of lines and stanzas. *Five Biblical Poems* is also the first work Mac Low composed by chance operations, a method he has developed and extended in his later work. Since 1954, he has written several plays, as well as a book published in 1968 by the Black Sparrow Press, *Twenty-two Light Poems*. Besides writing poetry and plays, he has done a number of paintings, collages, and constructions.

Besides admiring Mac Low's work in general, Antin knew of several performance pieces he had composed involving simultaneous readings of randomly ordered fragments of poetry by several people in concert, following a rhythmic "score," and accompanied by musical sounds. The principle behind this technique, it seemed, could be applied to computer input a nd output, similar perhaps to methods used by John Cage.

In April 1969, Jane Livingston met with Mac Low in New York, where he lives and teaches at NYU. Jackson was immediately enthusiastic about coming to California to work with IBM: in fact, he had even then a definite idea for a project. He talked in terms which seemed impressively knowledgeable: the areas he indicated were of interest had to do with artificial grammars and word-string processing, computer-generated sounds, modification of speech by computer or related methods, and the use of APL consoles and various educational machines. The theme he wished to pursue was "The Conservation of the Earth": he would draw on regional ecological information for the words and images. He wanted, he said, to combine words projected as pictures with sound-recorded words or abstract sounds.

We contacted IBM to describe Mac Low's general intention for collaboration. It was agreed that Mac Low would come to Los Angeles to meet with personnel at IBM's Scientific Research Center in Century City, rather than tour the enormous San Jose facility which had until then been intended as the base for an artist's residence with the corporation. In June 1969, Mac Low arrived with his wife and young children—they came by train, as he avoids flying—and a meeting was held the day of his arrival at Century City with the poet, Jane Livingston, and a number of IBM physicists and mathematicians. It was a two-hour session, and a memorably uncomfortable occasion, at least for Jane Livingston. Mac Low had formulated an immensely ambitious proposal involving an egg-shaped, environmental housing for the work—he had a rough sketch for this structure, which stood on legs and was conceived to be large enough in its interior to accommodate several people—and an elaborate computer system for accepting and feeding out massive amounts of information based on the ecology of the Los Angeles metropolis. It was to be a participatory experience. The viewer should, according to his scheme, be able to request information at will and receive it in one of several forms—flashed onto a screen, orally recorded and emitted through a speaker, etc. As Jackson presented his idea (which was obviously more complex and technical than outlined here), the seven IBM computer scientists attending the meeting listened politely, but with palpable skepticism and even amusement. The contrast between Mac Low's demeanor—he looked, on one hand, like a mad professor, and on the other like a gypsy itinerant—and the cool, groomed appearance of the gentlemen whom he addressed, was extraordinary. After the poet's initial description, the conference developed into a series of patient explanations as to why Jackson's ideas were totally beyond the realm of practicability, both from a financial standpoint and in view of the limitations of computer technology. Gradually, Mac Low altered his requirements to conform to the realities of the situation, and by the end of the meeting it was plain that he would be willing to compromise significantly enough to work within whatever parameters IBM might set for his project. However, it became evident to us later that IBM was not interested in working with Mac Low no matter what his project involved. IBM did, as a sort of consolation gesture, arrange for Mac Low to attend a week-long course in computer programming at IBM's downtown Los Angeles headquarters.

Fortunately another, much smaller, computer company—Information International—had joined A & T as a Sponsor Corporation in December 1968. We had visited the company with Eduardo Paolozzi and Vjenceslav Richter and had discussed with them the possibility of working with Ron Davis, but no match had been effected. The computer system that I. I. [Information International] wished to make available to an artist and demonstrated for each visitor was a graphic display console manufactured by them. It is described in a letter from their Public Relations consultant, Dawn Walker:

> A system made by this firm seems exceptionally suited to your purpose. It is a computer optical system which can be used as an artist's tool to produce graphics. It is capable of generating computer-animated film and other graphics. The machine, valued at half a million dollars, is used for a number of scientific and industrial purposes. However, it becomes a tool for the artist because of its high capability to react to what is desired of it graphically. Because it has the capability to record directly on 35-mm or 70-mm film, it can be used to produce computer-animated movies from digital information. The creation of these movies is controlled by the operator through a number of means, including monitoring of the process via a television-like screen. In essence, film is created via a number of controls, and emerges ready for the camera from the machine.

(A widely-shown animated film made with Information International's system was created by John Whitney and his son, Michael; we had seen this, and the Whitneys were eager to participate in A&T, but we were not especially interested in having another such film done through the program, although such an undertaking by an artist would have exploited the unique capabilities of the machine in a way more advantageous to the corporation for commercial exposure than what was finally done with it by Mac Low.)

On June 19, Mac Low visited Information International and met with Charles Ray, Manager of Applications Development, who demonstrated the graphic display console. (Both Ray and the company's president, Alfred L. Fenaughty, were to be extremely helpful to Mac Low and enduringly cooperative with us in the course of the project.) One of the programs used abstract, linear geometric configurations which appeared on the screen and moved rhythmically through a randomly ordered sequence of alterations, accompanied by music—a Bach fugue in this case. A program accompanied by abstract sounds—*bips* and *bleeps*—synchronized to image fluctuations was also shown. Programs could be called up or altered with the use of a light pen held to certain points on the screen; Mac Low sat at the typewriter console for fifteen or twenty minutes experimenting with this device, which fascinated him.

It was agreed on this day by the company, the poet and us that Mac Low would enter into collaboration with Information International. The poet began work immediately, commuting each day for ten weeks from his rented apartment in Hollywood to the company's facility in Santa Monica. He was at first assisted principally by the Corporation's Director of Programming, John Hanson. The use Mac Low made of the company's PDP-9 Computer (manufactured by DEC) was actually not technically difficult or sophisticated in terms of the programs themselves; according to Charles Ray, the basic programming for Mac Low's poems was accomplished in an eight-hour period early in the collaboration and was later refined. This was done by Hanson. In later stages of the project. Senior Programmer Dean Anschultz was heavily involved in working with Mac Low, refining and extending the program to enable greater sophistication in his word groupings than was initially possible. Mac Low didn't learn to actually program himself (this would have been virtually impossible in the time he had)—in other words, he couldn't instruct the machine—but he did learn to *operate* the equipment, by manipulating the typewriter-console. He was given access to the computer system for four hours a day, from six to ten a.m., five days a week, and working on this basis he composed a significant body of poetry.

Although Mac Low's demands on Information International's programming expertise were relatively modest, he did provide a novel experience for Information International's personnel in that the PFR-3 system (this is the designation for the entire graphic display unit, including the programmable film reader, magnetic tape units, etc.) had not previously been used by them to produce *word* images, but was employed chiefly for graphic patterns. By relying on the computer's ability to propagate words directly onto the screen (as a series of dots, rather than by scanning lines, as in a television screen), Mac Low bypassed the PFR-3's film-reading capacity, which involves photographing images.

Mac Low finally composed nineteen poems. Each one was built differently, and they became progressively more complex as he, John Hanson, and particularly Dean Anschultz elaborated the program. Only one program was made. It initially consisted of forty-eight characters, including spaces, which could be generated by pressing the typewriter keys on the display unit. During the first phase, individual two- or three-letter words could be permuted in various ways. They then devised a linker mechanism, enabling series of words to be always linked together in the same way; thus larger blocks of words could be permuted in various configurations. Finally a carriage return device was added to the program, so that a number of lines of poetry could be made to appear simultaneously on the screen. In the last poem, *THE*, each message was composed of a number of complete sentences, rather than just linked words or phrases. Most of the poems were based on a family of words with related imagery. *SOUTH*, for example, uses words all referring to plants and animals in Latin America and Africa.

Mac Low submitted several of the poems made with Information International to *Stony Brook*, for its no. 3/4 (1969) issue. He included a letter to the Editor, George Quasha, explaining the way in which the poems were composed:

> The poems enclosed are xeroxes of print out realizations of poems I composed last summer (1969) on a PFR-3 programmable film reader at Information International, Inc., in West Los Angeles, for the Art & Technology exhibition of the Los Angeles County Museum of Art, organized by Maurice Tuchman. A PFR-3 programmable film reader is a device, or rather a linked group of devices including a DEC PDP-9 computer, which "reads" film in the sense that it turns the image on the film into digital form and thence projects this image via a computer onto a special type of cathode-ray tube (CRT) in a monitor console. It can modify the image when it is in digital form or analyze it in myriad ways (e.g., it can project the X-ray image of an organ of the body, increase the contrast of its features, trace the contours, and give notice of anomalies, etc.). Its applications range from medical diagnosis to oil prospecting.
>
> In composing nineteen poems this summer on the PFR-3, I didn't make much use of the film-reading potentiality of the device (I did wish to work with photos of handwriting, but my programmers, John Hanson and Dean Anschultz, were too deluged with other work to be able to get to that program before I had to leave L.A.). The program made for me by Hanson and Anschultz began as a simple permutation program: It allowed me to type in (on a teletype) up to one hundred forty eight-character, single-line "messages" as one group or poem. When one was not typing messages in, the computer would pseudo-randomly range over the entire group of messages, settle on one, select one or more or all of the units in the message, and select one permutation of that group of units. This group of units would appear at a pseudo-random position (I say "pseudo-random" because the means used were pseudo-random numbers) on the monitor CRT.
>
> Two special features of the CRT must be noticed: the fact that it propagates its image by a series of dots rather than by line-scanning as in video, and the fact that images fade gradually rather than abruptly from the face of the two, due to the use of long-persistence phosphors. As against the bluish-white first appearances of images, the after-images are chartreuse and black. In addition, the particular PFR-3 monitor console I worked on was wired to an audio amplifier in such a way that every time an image (e.g., a series of words) appeared on the CRT, the same series of impulses from the computer which fired the electron gun to produce the image also went through the audio system to produce a sound. In the case of my word groups, the longer the series of characters was, the deeper in pitch the tone (a sound in the oboe-bassoon family, more or less) and the longer its duration. Thus single words would produce high pitches; several-line groups (which the later forms of the program made possible) had the sound of deep organ pipes.
>
> In addition, if one desired printout, one could push down one of the "program-sense" levers on the console, whereupon the teletype would type out every tenth word group that appeared on the screen. This feature of the program is the source of the present examples. Moreover, in the later forms of the program, I was able to vary the speed of propagation of the word groups by depressing various combinations of the AC levers on the computer itself. A regular feature of the console itself is a group of knobs that enables one to shift the image horizontally or vertically or change its horizontal or vertical size (or any combination of any number of these four possibilities); when one shifts the setting of one or more of these knobs while an image is being propagated, one produces chartreuse tracks!
>
> In the earlier forms of the program, the permutable units were single words and I had no period as a printable character. The program would pull out any of the permutations of any of the combinations of the words of any of the up-to-one hundred messages which constituted a single 'poem' in this

sense. The two-page run beginning "ALWAYS ARE TRANSFORMING ENERGIES ALL PARAMETERS" is the earliest example of this stage. It is printoff from the poem "TRAN," which consists of the single message "ENERGIES ARE TRANSFORMING ALL PARAMETERS ALWAYS" and which I improvised on the PFR-3 teletype the first day I worked on it in the middle of June, 1969. From the same stage is the poem "DANISH" (or "DANSK") which was the first one completed with one hundred full-line messages. (Of this I enclose the first realization drawing on all one hundred messages— the actual printoff beginning with "GRANDFATHERS BENIGNANT".… I also enclose three xeroxed runs of printoff of "DANISH": the single-page beginning "CRUNCHING ARE"; the three-page run beginning "PAVEMENTS CARPETING ARE JACARANDA VIOLET FLOWERS"; and the single-page beginning "TROMBONES LOUD TONES ARE RESONANT SOUNDING LONG."

"DANISH" consists of one hundred complete sentences, some composed by means of systematic chance, some just dreamed up, each of which has its verb in either the present progressive (e.g., "is/are going") or past progressive (e.g., "was/were going") tense and each of which consists of a maximum of forty-eight characters, including spaces. It was composed during most of the last week of June 1969. The use of the *-ing* form of verbs as present participles, gerunds (nouns), adjectivals allows for a maximum of at least fragmentary grammaticalness when these words appear in random groups as in these examples: it is easy for the *-ing* form to shift from one grammatical role to another according to the permutational context. Elements of some of the sentences were drawn by chance from a dictionary and from *Black Elk Speaks* (Neihardt).

In later stages of the program, I had a "linker" by which I could link up any number of words—even whole sentences—and use them as units rather than merely single words. "SOUTH," of which I send you a complete sixteen-page run, is one using this linkage feature. It began as a series of sentences improvised the first time I worked with the PFR-3. Somehow the lack of grammaticalness in the resultant printout of pseudo-random permutations of combinations of the words of the sentences I typed in didn't 'make it' for me, but by scanning through it for actual and suggested sentences, I produced the one hundred messages of the final version of "SOUTH"—each of which consists of one or two whole sentences which are the actual units of the messages since their words always appear in the same succession because of the linkage. The imagery of "SOUTH" is an indiscriminate mixture of flora and fauna from both Central and South America and Africa (possibly also southern Asia).…

A very late feature of the program was a workable "carriage return"—i.e., the possibility of messages having more than one line of forty-eight characters, of propagating on the CRT face multiline groups of units or whole messages, and of printing out such multiline messages and unit groups. This was a terribly complex programming problem (or rather, making these *three* types of carriage return possible and compatible and also making it possible to *edit* such messages—which is another long story)—finally solved by Dean Anschultz, the red-bearded Demon Programmer of Venice on the Pacific.

In the poem "DAVID" (the name refers to Dave Antin, I guess, whom I saw several times in both Los Angeles and in Solana Beach, and who saw and heard the PFR-3 in action—both "playing" some of my poems and having new ones typed into it), all of the one hundred messages are questions or statements about questions involving "DAVID" asking questions, etc. All of the words of each question or statement are permanently linked, and they run from two words in length to three lines. See the page beginning "DAVID ASKED." (By the way, I also got an operational period about the time that I did the final [sentence] version of "SOUTH.") This page is from the middle of a long run of printout-realization of "DAVID."

The last poem I worked on (for two or more weeks, I believe) in August 1969, was "THE"—of which I enclose three short runs of printout. In "THE," each message consists of four to six short sentences, each typed originally on a separate line. These short sentences are the units of the messages of the poem, and their words are permanently linked within each sentence. Thus each word group propagated on the CRT face and/or printed out is a sort of strophe of one to six lines, each line of which is a complete sentence. As is obvious from the printout-realization examples enclosed, each sentence mentions a more or less “universal” phenomenon; each strophe consists of a closely related group of such phenomena. Ex. 1 (“THE SUN SHINES.”) is from an early stage of this poem, in which I had not yet accreted many messages. One may print out at any stage of the game, so that earlier printout draws from small numbers of messages; later printout is drawn from larger numbers of messages— up to one hundred, except for “THE”—which has such long messages that it overran the memory core of the PDP-9 at about the 43rd message: it’s the Saint-Saëns’ 4th—organ pipes and all—of my PFR-3 poems. It reached the limits of the computer’s capacity and had to be trimmed back before the computer stopped, just giving up altogether (as it did every time I passed a certain limit in adding messages to the poem). There were a lot of *human* phenomena that I never got to put into the poem because I put them off to the end of the list of messages, thinking I’d be able to accrete up to one hundred of them despite the extreme lengths of the individual messages. The organ pipes came from the fact that there were so many characters and lines in most of the word groups propagated on the CRT that most of the corresponding audible tones were similar to those of very deep organ pipes—still vaguely “double-beating-read” in timbre, some being chords or tone clusters. (This isn’t the Saint-Saëns’ 4th but the Mahler 9th of the PFR-3 poems.)

Ex. 1 is early since it draws from only a few messages and still has the word “animals” rather than “mammals”—the word used in the later stages of “THE” ’s composition. Ex. 2 (“THE WIND BLOWS”) and Ex. 3 (“THE PEOPLE BUILD METROPOLISES”) are from late stages of “THE”; they are, respectively, complete two and four-page runs of printout.

We seriously considered displaying Mac Low’s computer-generated poetry in the New Arts Exhibition at Expo 70 and even went so far as to have some test film footage made of the PFR-3 screen with the poetry appearing on it. (It was plain that the equipment itself, in operation, could not be seen long enough or closely enough to be understood by crowds of people passing through the exhibition area.) The film as we saw it was not entirely successful, and it would have required an expenditure beyond our means, or the company’s, to produce it in acceptable form.

Jane Livingston

A&T

THE EARTH TURNS.

THE STARS SHINE.
THE EARTH TURNS. THE MOON SHINES.

THE STARS SHINE.

The

THE MOON SHINES.
THE EARTH TURNS. THE SUN SHINES.

THE STREAMS FLOW.
THE RAIN FALLS.
THE OCEANS FALL. THE OCEANS RISE.
THE SNOW FALLS.
THE WIND BLOWS.
THE RIVERS FLOW.

THE PLANETS SHINE.
THE EARTH TURNS.

THE EARTH TURNS. THE MOON SHINES.
THE PLANETS SHINE.

THE PLANETS SHINE.

THE EARTH TURNS. THE STARS SHINE.
THE PLANETS SHINE.

THE OCEANS FALL. THE WIND BLOWS.
THE SNOW FALLS.
THE RAIN FALLS.
THE RIVERS FLOW.

THE WIND BLOWS.
THE OCEANS FALL. THE RIVERS FLOW.
THE SNOW FALLS.
THE STREAMS FLOW.
THE RAIN FALLS.
THE OCEANS RISE.

THE SNOW FALLS.
THE RIVERS FLOW.
THE OCEANS FALL. THE STREAMS FLOW.
THE RAIN FALLS.
THE OCEANS RISE.

Claes Oldenburg

Maurice Tuchman

top
Oldenburg in his workroom at WED Enterprises, 1969

bottom
Oldenburg with *Giant Icebag*, 1970

Walt Disney Productions is a corporation whose participation we hoped from the outset of A&T to enlist because of their enormous production capacity and their sophisticated research into problems of visual illusion. No more strenuous attempt to contract any company was made than our effort with Disney, or its partner firm, WED Enterprises. In January 1968, Missy Chandler made the first of numerous calls to Roy O. Disney, Sr. in an attempt to arrange a meeting with Tuchman and him. Eight months after that initial call, a meeting was finally arranged in Glendale between Tuchman, Missy Chandler, Irena Shapira, and WED's Neal E. McClure, Secretary (Legal Counsellor), and Richard F. Irvine, Executive Vice-President. McClure and Irvine were not terribly interested in A&T, but neither were they eager to offend Mrs. Chandler, and they promised to consider the idea in further meetings with their Head of Design and Mr. Disney. On October 2, McClure wrote:

> My Dear Mrs. Chandler:
> After checking further both here at WED and at the Studio, we must advise you that we are not in a position to participate in your imaginative "Art and Technology" plan.
>
> As discussed with you last Thursday, there are several reasons persuading against our participation, the two most cogent being our extreme work pressure to complete Walt Disney World in Florida, and the highly confidential nature of much of the work performed here at WED.

Despite this letter, Tuchman urged Missy to continue arguing our case, and she succeeded in arranging a second meeting at Disney on October 31 with the company's Head of Design, John Hench and Executive Vice-President, E. Cardon Walker. Tuchman was in New York on A&T business at the time of this meeting and received a phone call from the Museum informing him that WED had committed to the program as a Patron Sponsor. Disney's legal counsellor Neal McClure later requested and obtained an interesting alteration in the contract—one of tenor, rather than substantive legal import—by "reserving the right to the Company to *disapprove* any artist or project."

Tuchman immediately called Claes Oldenburg and went to see him. Oldenburg had been approached by us some time previously but had not responded favorably to our invitation, primarily because there was no contracted corporation relevant to his needs at the time, but also because of doubts he had about working with company people, engineers, and administrators. He was skeptical about the advantages industry could provide in executing his work and about the necessity for his being at a company in person: “As far as I’m concerned,” he said to the *New York Times*, “the Yellow Pages provide enough technology for me.” From our point of view, however, to have an artist of Oldenburg’s importance and prestige working under the project was critical at this early moment in the development of A & T. Such a collaboration as that between Oldenburg and Disney would, we knew, lend concreteness to the public conception of the program, which was at that time rather vague. It would also, we felt, prompt participation by other corporations and strengthen the preliminary interest we were encountering in discussions with other artists. (We made an effort to involve Dubuffet at around this time for similar reasons.) We persuaded Oldenburg to come to Los Angeles and tour Disney’s facilities. He came on November 17, 1968, and was shown various workshops and research areas in Glendale and several rides at Disneyland by John Hench.

Hench and Oldenburg were at first wary of each other, and Tuchman was put in the position of attempting to explain one to the other and somehow alleviate the sense of mutual suspicion. By the time Oldenburg left, he was convinced that Disney *could* be of enormous benefit to him and even displayed a degree of excitement about certain plans he was already envisioning. He said he would draft a schedule for visits to Disney throughout the coming year. Oldenburg remained cautious, however, as he indicated in a letter to Tuchman on December 14, 1968: “John Hench’s quote in the Glueck article certainly makes me pause. I wonder to what extent he will assume the position of spokesman for what might be done. The trouble with WED is that they are ideologically involved as well as technologically, as we know.” Nevertheless, he then sent John Hench and us a proposed schedule:

Set up housing Describe project	March 2–16	2 weeks
Main work on project	May	4½ weeks
Additional work on project	June 29–July 12	2 weeks (if necessary)
Additional work on project	Nov. or Dec. (or Feb. ’70	3 weeks (if necessary)

Disney was still worried. Neal McClure called Betty Asher on January 30, and she reported this conversation in a memo to Tuchman:

> A Mr. McClure called from WED Enterprises. They would like to see a proposal of just what Claes intends doing at Disney. Also, they have not had the opportunity of approving the artist or the project as per the contract. They would like that opportunity.
>
> He would like to have you call Mr. Hench. They are afraid they might get a Kienholz-type product and, after all they are a family directed operation.
>
> I assured him that “set up housing” just meant that Claes was planning on taking some time to find his own digs convenient to their facility. He was afraid that he expected them to provide housing there.

On February 21 Claes wrote John Hench:

> I will be detained on projects in NYC until about the first of May—I hope to spend the whole month of May on the coast. At that time I hope to have obtained residence facilities in the Balboa area, in order to commute to the Disneyland workshops. My preference is to have a basic studio at Disneyland and from there visit, when-ever necessary, the Glendale workshop. At Disneyland, I’ll need an office space to draw in and to make some small models and to write on my typewriter—a place that is relatively private and quiet. It doesn’t have to be large.
>
> After getting settled I would expect to continue exploring the facilities for a few more days and then to retire if that’s the word to formulate a project on the basis of and arising out of what I’ve seen. I want to stress this approach—that I won’t be arriving with a project ready to go under my arm. I will bring a notebook of possibilities and some preconceptions… but I can’t say in advance what area of the many offered

> by…WED workshops will be drawn upon.
>
> If you bear with me, by the end of May, something definite should be in the works. If it is, I'll be returning in the summer and late fall to complete it, and in the meantime maybe can direct it from NYC. Maybe it will go by itself the times I'm not there.

On May 1, Oldenburg settled into a motel near the Disney plant in Glendale. He worked daily throughout the month. This was a productive time, and visitors to his workroom at WED found a fertile body of proposals and models being developed by Oldenburg. One writer was impressed by these plans sufficiently to plan a book on "Oldenburg in Disneyland." As Claes prepared to leave at the end of May he drew up two general projects for consideration by WED, which included many separate sections and models he had been preparing. He referred to one project as a *Theatre of Objects* or *Oldenburg's Ride*. The other was the *Giant Icebag*. He explained:

> The practical way to approach working with any corporation or any material or technique supplier is to see where their services fit in with your needs. And first of all I had to ask myself what is it in my work that requires technological assistance on the scale that this program will give me. Most of the time I don't use technology very much. There was a class of objects that had been contemplated and suggested in '65, and these were all of a kinetic sort—they moved or they broke or they reconstituted themselves, or they peeled themselves—they went through simple motions. And so knowing that I was going to get into a technological program, I went through all my notes and I selected those things which seemed to fit the program, and those are the notes that I brought out with me, such as the one with the jello mold, which dates from 1965. All of those ideas with breaking things and changing things are all of my notebooks from 1965. When I arrived at Disney, I looked around for the service that would fit me, and they were then engaged in preparing the haunted house which opened later. But in the haunted house they had all these effects where things were metamorphosing and they were using mirrors and stuff, so I went to the library and I got books on simple magic and also books on simple mechanics. I tried to fit my thoughts about what I needed in technology into what services they provided at that moment.

Oldenburg's Ride was to be a large series of magical, mechanical sculptures, enclosed in an amphitheater of the artist's design. By May 23, when Tuchman made his last visit to Oldenburg's workroom at Disney, Claes was considering designs of the following component sculptures for the theatre:

> a giant toothpaste tube, which rises and falls, and is raised by the paste
> a colossal rising and falling screw which releases oil at its top
> a large object, as a car or piano, made in soft material, mounted on a machine that would twist, compress, and change its shape (the machine was suggested by Disney's materials-testing device)
> a large undulating green jello mold, with fruits suspended inside
> a bowl of cornflakes and banana slices falling from an inverted disk
> a cup which would break and then reconstitute itself
> a plate, on which eggs are cracked, thrown, scrambled, and then reconstituted
> a pie case, in which pies would gradually disappear as if they were being eaten, and then be reassembled
> a "chocolate earthquake" made of giant chocolate bars, which would shift precariously, crack open, and settle back (suggested by a magazine advertisement and the then current earthquake scare in California)

Several metamorphic pieces, in which metamorphosis would actually occur, including a banana transformed into a fan (Claes labeled it a "fanana": in this connection Oldenburg recalls Jim Dine's painting, *The Plant Becomes a Fan*, of 1961–63).

Common to all these proposals were phenomena of disintegration, transmogrification, and reconstitution. Oldenburg speaks eloquently of these projected works as having to do with "the tragedy of brokenness" and the denial of that tragedy—"As in a dream," he said, "where your teeth fall out, but on awakening you find out they didn't." These works relate strongly to both dream states and to various superstitions ("If you encounter a situation in real life which has occurred to you before, you *do* it"). They also call to mind the curious sense of denial, or temporal negation, suggested by film footage when it is run backward. Oldenburg's illusionist proposals comment serio-comically on American inclinations toward escapism and unfounded optimism—the "happy-ending" syndrome.

These sculpture designs were to be developed, from their state as sketches and collages, into working models by Disney craftsmen and model builders. Oldenburg was encouraged by the company tomake as many proposals as he liked, and he was assured that all his plans for illusionist works in the *Theatre of Objects* were well within the capabilities of Disney's technology.

Oldenburg's other proposed work, the *Giant Icebag*, had been developed to the point where an engineered model could be constructed. He was eager to concentrate on a single work that could be available for Expo 70. Claes drew up the following descriptions for Disney model makers before he left, expecting to return in August:

> ICEBAG—skin
> The "bag" is made up of pleat sections, attached at the bottoms to a circular frame in some way that permits easy removal. It will probably be necessary to reinforce the sections or attach some sort of frame to the collar. Each pleat may be cast separately and joined to the other by very large and concealed zippers for easy transport. In the process of assembly, the pleats would be laid out around the frame and machinery supporting the "cap" like a giant flower, to be brought up and together one by one.
>
> The material may be represented by sewn vinyl in the working model. A pink vinyl which I have purchased is stored at Gemini and can be obtained through Tuchman or the Museum.
>
> In the full-size piece, this material should be fairly thick, so that the pleats maintain their shape and the movement of the material communicates resistance to the turning motion, but it should be capable of developing folds. The folds may be predetermined.
>
> The material should take color, be opaque, be glossy. Most desirable would be if the material contained the color. The color is roughly the salmon-pink indicated on the models.
>
> The material should be as durable as possible, since this is an outdoor piece, but the part construction allows for replacements.
>
> ICEBAG—top of "cap"
> The top of the "cap" is a reflecting disk eight to nine feet in diameter. A night version is conceivable—the surface which reflects the sun and sky by day could be made to show illumination from the interior at night—could it? The sculpture could thus have a day and night phase. A weak illumination, moon-like.
>
> ICEBAG—Mechanical
> This cross-section of the *Icebag* attempts to indicate the type of movement desired.
> The "cap" 1) turns 2) telescopes or spirals up and down 3) tilts. The movement may be compared to that of a searchlight at a Hollywood opening.
>
> As the "cap" moves, it should stretch or create folds in the "bag" which is to be made of flexible material. It will be necessary to separate the "bag" collar from the "cap" to permit rotation continuously in one direction, but if this is unfeasible, the movement could be a "winding" and "unwinding."
>
> The movement should be very slow. A model should provide the means for testing different rates of motion.
>
> It would be desirable for the progress of the project to have a working model of this machine prepared in my absence (I will return in early August). The model should be about eighteen inches high at furthest extension—or whatever scale serves the purpose.

When Oldenburg left Disney, he left behind him scores of drawings and diagrams—and several models along with instructions—in his workroom. He departed feeling pleased with the prospects for his future collaboration, as did we, and as we understood did Disney. Two weeks later John Hench called Tuchman and asked him and Museum Director Kenneth Donahue to visit Disney and deliver an "official" opinion of the work before the company proceeded to construct models for Claes. After this visit took place, Tuchman wrote Hench on June 23:

Following our visit with you last Friday, I want to tell you how extremely delighted we are with the projects Claes Oldenburg has conceived to be carried out with WED. I feel that both the *Icebag* and *Oldenburg's Ride* (the *Theatre of Objects*) will most decidedly be among the lastingly significant works to come out of Art and Technology; certainly Oldenburg himself assumes high priority in our estimation of the program as a whole, and there is no doubt that the ideas inspired by his contact with Disney are potentially some of the most important work of his career.

We shall definitely count on sending the *Giant Icebag* to Expo 70 at Osaka, and I feel more and more strongly that whatever components of the *Theatre of Objects* can be completed in time, such as the *Chocolate Earthquake* or the *Falling Egg*, should also be included in the Osaka exhibition.

May I take this opportunity to congratulate and thank you for your exceptional responsiveness to the artist matched with your corporation. We anticipate that this endeavor will be uniquely momentous and gratifying for all concerned.

On July 2, the following letter from E. Cardon Walker was delivered by messenger to the Museum:

Dear Mr. Donahue:

We have received your letter and Mr. Tuchman's letter, both dated June 23, 1969, and directed to John Hench, Vice-President, wherein you advise us that you are selecting *The Icebag* and *Oldenburg's Ride* as artistic projects for the Art and Technology program.

While we understand your keen interest in the projects submitted by Mr. Oldenburg, we find there are other substantial factors to be considered by us. Therefore, pursuant to Paragraph 6 of the November 25, 1968, agreement between the Museum and the Disney organization, we do hereby advise you of our disapproval of these artistic projects.

Being aware of your expressed delight with the projects proposed by Mr. Oldenburg, we are willing, upon our being relieved of any further responsibility or obligation, to make available all right, title, and interest in the preliminary works developed by Mr. Oldenburg in order that they may be completed by others.

We wish to extend our best wishes for your success in this venture and to thank you for the opportunity of working with you and with such a renowned artist as Mr. Oldenburg.

Tuchman immediately attempted to meet with Messrs. Walker and Hench, who were not eager to do so, but who finally agreed to see him. Tuchman reviewed this meeting in a letter to Walker on July 7:

I am replying to your letter of July 1 to Mr. Donahue. The Director has been out of the country and will not return until later this month. I want to thank you and Mr. Hench for meeting with me on July 3 to discuss the relationship between WED and the Museum in regard to Mr. Oldenburg's project proposals.

Let me review our discussion of July 3. In your July 1 letter, you refer to your "disapproval of Oldenburg's artistic projects" and state that "there are other substantial factors to be considered" which lead you to desire to abandon the collaboration with Mr. Oldenburg and the Museum. You told me that these factors primarily involved time, energy, and money; that the cost to WED to build Oldenburg's *Icebag* would be about $125,000.00, that this was too high a sum to expend, and that WED's personnel could not undertake such an involvement this year. Since Mr. Oldenburg was also proposing a *Theatre of Objects* (also called *Oldenburg's Ride*), which is composed of eight or nine separate parts, all of which are uniquely dependent upon, and were prompted by, WED's imaginative engineering, I asked you to consider discussing with the artist how this project might be accomplished. You agreed to have John Hench discuss this possibility with Mr. Oldenburg next week in New York, when Mr. Hench would be there. I just contacted Mr. Oldenburg, informed him of these sudden developments, and asked him to meet with Mr. Hench along with one of my staff members (since I am leaving for Japan July 7). The artist indicated his willingness to consider the making of several separate works from the

Theatre of Objects proposal, but he was just then leaving for London for ten days and therefore could not meet with Mr. Hench next week. He indicated also that while he is open to and indeed interested in working on several separate components of the *Theatre*, or even a modest size model of the *Theatre*, that it would be unwise to hold discussions without some guideline set down by WED as to feasible costs. If the *Icebag* would cost too much, the question is, then, how large a sum (including staff time) is WED willing to expend. Until this matter of budget is determined by you, it would not be possible to proceed with Mr. Oldenburg. The artist was scheduled to make his third journey to WED on August 1 for two weeks, and if you can provide this financial guideline, he could come out and continue research on the project at that time.

Since you had not been intimately involved with this project over the last few months, I attempted at our July 3 meeting to fill you in more extensively on the WED-Oldenburg relationship, and on other matters pertaining to the entire Art and Technology program. I indicated that the progress between Oldenburg and WED had been extraordinary; and that "Oldenburg in Disneyland" was already a world-famous enterprise, and had prompted excitement on the part of every leading periodical and newspaper informed of the event. Countless stories have been and are now in the works at publications like *Fortune*, *Business Week*, *Time*, and *New York Times*, the *Los Angeles Times* and European television. Recently, the Museum has been invited by the United States Information Agency to prepare the New Arts exhibition for the United States Pavilion at Expo 70, Osaka, Japan. This will be officially announced by President Nixon next month, but a formal contract between the Museum and the USIA has been signed. The Museum has informed the USIA, in a report of June 1, that among our highest hopes for projects to be included in the World's Fair were works of art expected from the Oldenburg/WED collaboration. This would mean that WED and four or five other American corporations would be the sole representatives of the United States to a world audience of an estimated forty million persons. In this context, as I submitted to you two days ago, it seemed to me imperative that every attempt be made to arrive at a satisfying and productive relationship among you, the Museum and this most important and talented artist. With the world's eyes upon us, and with every reason to believe that the benefits to WED—if for no other reason than the truly vast promotional exposure—are so compelling and important, the Museum again asks you to continue working with us to a productive conclusion.

E. Cardon Walker replied on July 16:

Our position in regard to other projects from Claes Oldenburg, as you requested in your July 7, 1969, letter, is that we cannot properly set a limit on staff time for these projects. In fact, the original concept of the agreement was that we would pay the Museum $7,000 and commit to supply materials, working space, and technical assistance for three months or until the completion of the project, whichever period was shorter. Mr. Oldenburg first visited us on November 18, 1968, and by letter of January 23, 1969, request was made for working space in March of 1969. As you know, we have honored our obligation of $7,000, and the three-month period is now long past. Since Mr. Oldenburg was scheduled to return to WED on August 1, we would, of course, consider a proposal developed by him during such a two-week period, but, as indicated above, his proposal would have to reflect the major labor on the project as being performed by himself, leaving our technical staff relatively free. Any costs involved should not be disproportionate to the original $7,000 contribution to the Museum.

We are sorry a mutually agreeable project was not developed, but we must now turn our corporate efforts toward fulfillment of our primary obligations.

None of the points mentioned in this letter conform to the contract signed by Disney and the Museum;

Informed of these developments, Claes Oldenburg was dismayed but set about constructively to realize his plans, or one of them, in other ways. He suggested fabrication of the *Icebag* as an enormous balloon. After study on our part, with technical advice from balloon and rubber companies (for a time it looked as if Goodyear Rubber would take over the project), this was determined to be unfeasible.

In the process of researching balloon companies for the *Icebag*, we had come upon a small firm that seemed promising for Claes's other plans for illu-sion-ist sculptures. To the end of investigating this possibility, Oldenburg returned to Los Angeles on August 1 and toured, with Tuchman and Gail Scott, a firm then called Vee-Line, later Allied Research and Development Corporation, in Fountain Valley. Vee-Line made large inflatable structures for scien-tific and military purposes but mainly for advertising, with items then called "Replic-Air Displays." Claes was amused by a forty-foot potato chip bag balloon that had been made for Laura Scudder. Oldenburg worked at the company for four days with David Tanner, the chief designer-engineer-administrator. He gave Tanner a small model of the *Chocolate Earthquake*, to be made into a three-foot working model. The model was delivered three weeks later and did not perform to the artist's satisfaction. Oldenburg then turned to working on an inflatable banana related to the *Fanana* plan developed at Disney. This sculpture was to be about twelve feet high, mechanized so that four banana peels (held together by a magnetic winch at the base) would unpeel while the banana would slowly disappear (being deflated sectionally) as if it were being eaten. Various models were made by Claes and then by Tanner; the shape, color and texture were approved, and we commissioned the company to produce a half-size model in order to test the working parts and the fabric and to determine the kinetic rhythms of the work. This time, delivery of the model was delayed over a period of months, and when it finally appeared, it too was unsatisfactory to the artist. The project was abandoned.

At this point we turned Oldenburg's designs and models for the *Giant Icebag* over to Ken Tyler at Gemini G.E.L., asking Tyler to investigate produc-tion possibilities. In an interview with Tuchman in October 1970, Tyler recounted his adventures in fabricating this monumental sculpture:

> The things we were concerned with in the beginning were an elephant-like quality in the fabric, the breathing quality and the swiveling movement. We also were originally talking about a thirty-foot diameter bag. And that meant that there was no place I could find—I made a lot of phone calls across the country in those days for you—there was no place I knew that could spread out a circle of fabric thirty feet in diameter and sew it. There's no seamstress outfit that large. We had all these things, and the cap was to be constructed in fiberglass, or wood, or steel. Those were no *real* problems, we knew we could solve them. But we couldn't schedule in such a short period of time because we couldn't locate houses that were capable of manufacturing these large scale items. When it came down to it, we settled for animation houses. So, we went to the same people as Disney would go to, which happened to be Krofft Enterprises, in the final analysis. We started out with General Displays. They built the first two prototypes—a six footer and an eight footer. The eight footer is what we used in the movie, *Sort Of A Commercial For An Icebag*. At that time, meeting with Claes and going back and forth with my private engineers, people that I knew who have helped us on other projects, and with General Displays, we came up with the various movements that we felt could be done hydraulically or by air. We settled for hydraulics because it was a self-contained unit with lasting ability where air had some problems: movement would be too staccato-like and also air cylinders became too complex technically given the time we had to construct the bag....
>
> Then we found out by discussing this over and over again with Claes that the tilt of the cap was an important movement to him, which none of us had ever considered. We always thought that that was a fixed position, and as it rotated the cap created the impression of a wave, of an up and down movement. And then he always talked about the serpentine action of the bag related to a roller-coaster because remember he had been working on the Disney *Oldenburg's Ride*, so all of that was kind of in his head, and it was very difficult to get it out of his head and put it down on a piece of paper and say would you settle for this, would this be a sufficient movement for this piece. And that is all we were involved with in the first four weeks. We were trying to find from Claes one movement at a time. What was our latitude in that movement? Would he settle for six inches or a foot? Did we always have to maintain a thirty foot diameter? Could we shrink it if we had to? How much could we shrink it? We talked about twenty-eight feet. We talked about twenty-two feet. We kept bringing him down in increments then finally got around to

the eighteen foot one. Now how did we get around to that? By just spreading it out on the floor and suddenly he saw that an eighteen foot diameter was pretty large and this defined the scale for him.…

We knew that in order to get the bag absolutely right we would have to go through several prototype bags: how many we didn't know. As it turned out we went through four bags. Two got built, two got destroyed—one ate itself during the filming session. Remember that one when you were there? The fabric got caught in the gears and it ate itself. Then we got into a series of difficulties with the fabricator General Displays, and they turned out to be over-enthusiastic in the sense that they didn't have the means to build something of this scale with precision. There were no electrical provisions in the first prototype. We were purely concerned with mechanics. We were not involved, at that time, with programming the bag. Programming came much later in the history of the bag's construction, when we got eight blowers going. That's when we found out that eight separate blowers inflating at different times would move the bag like a snake, with serpentine movements, or wave movements. Now we got involved with the cam system and here we needed an automation house such as Krofft, even though our people could say yes, you do it with a cam that trips the blower one at a time, so that you have one cam that drives the blowers, and you have one cam that drives the cylinder which goes up and down, and you have one cam which drives the tilt of the cap thirty degrees, and of course you have one cam that shuts the machine off if you want to shut it off. But also at this time we discussed the machine having to run continuously, which set up another kind of problem for us. Studies were made for a heavy duty hydraulic system that could run continuously. This put another burden on us. Then we got caught up with the problem of building a super-structure with the bag light enough to go to Osaka in pieces because you couldn't have an eighteen foot diameter—it wouldn't fit into the airplane or through the existing door openings in the American Pavilion.…

The engineers were being fed information, they would make a drawing and we would change the drawing, we'd get a cap design and we would change that cap design, we'd get a hook-up going and we would decide we couldn't do that because it would be too unrealistic to take that bag apart in so many pieces. So it was decided, really out of desperation, that we had to build what they call a knock-down unit—a unit that anyone could put together anywhere in the world with a manual. We proceeded to make, like a refrigerator or a stove is made, a part and a bunch of other parts to go together with the guidelines of a manual. Everything locks together with bolts and nuts, and there is no one rigid kind of construction. And I think this is when the real form of the bag was established, eighteen feet in diameter, rising to a height of about twelve to sixteen feet, with an established path of travel. By this time adequate testing on vinyls and other fabrics had been made, and Claes, collaborating with Sidney Felsen, made his decision on the pink shade and the type of polyvinyl that we were to use. During this time, Sid spent many days attempting to secure sufficient material to construct the bag without having to order a special mill run which was too costly. We then got to the weight of the fabric, then dressed the weight up with foam inside so the bag would again return to the elephant-like movement.…

Then we couldn't find a stock cylinder to use because Vickers, which manufactures the type of hydraulic cylinders we were looking for, had to ship all they made to Viet Nam, for use in helicopters. We wasted a lot of time on this problem. Stanley Grinstein got on the phone calling all around the country trying to buy cylinders that we could adapt to drive the bag up and down and couldn't find one. Finally Krofft found Conquip, in Upland, California, and Conquip said, I understand your plight, and they had a fairly good idea of what we wanted, and by that time we had some pretty good models constructed at Krofft. So they came in and said, We think we can make you cylinders within six to nine weeks, which wasn't good enough. We had to have cylinders before that. By this time we were still working with your deadline of September which we couldn't make, and then you gave us I think another thirty days which made it October or November; I am not sure of those dates. Finally we got to December and shipped in January. So as it turns out, if there wasn't this company in the valley that was manufacturing pistons of the size we were looking for, we wouldn't have completed and shipped the bag.…

With most projects, the aerospace or military requirements screw up somebody's delivery. The one manufacturer we were dealing with to sew the bag was busy building tents and we couldn't get his time. Then we found Featherlike Products Company. This company was really the secret to the *Icebag* at the last minute. They said, "Yes, we can sew it," and with that we were able to pursue the course with the engineers, hydraulic people, design people, and Krofft.…So then the bag went ahead. We almost lost the project when it got to the point where they wanted three months to run and test the bag and we couldn't give it to them because the bag had to be shipped by boat on a certain date.

Featherlike was my buffer. I went back to Krofft and said look I have got somebody that can sew our bag and you won't have to take your costume people off the filming of *PufnStuf* to sew this fabric and they have a big room over there where they can sew a balloon thirty feet in diameter. But in fabric construction a pattern can be off by as much as fifty percent of the material, depending on how you pleat it, how you sew it, how you cut it and the whole bit. So Sid got this fabric—which took another solid week of phone calls all the way around the country calling every manufacturer of polyvinyl material. The seamstresses were almost going to kill themselves trying to sew this. They were very heroic in this effort. These women just couldn't handle that kind of weight so additional help was required. Just to drape several hundred pounds of material and sew it was quite an awesome job.…

When we got into the movement of the bag, once we resolved the sixteen foot height, we got the general perspective of the bag, up and down motion and so on. Then we were able to come up with some general concepts of moving the fabric up and down. One idea was a roller-coaster concept which would be a trough that ran around the outside of the bag shaped like a roller-coaster. It would have an undulated quality to it. There would be a big ball on an arm, and it would roll around this roller-coaster and therefore move the fabric. This idea I came up with seemed very reasonable at the time, but it turned out to be so bizarre that even Jules Verne would have rejected it.…

In collaboration you have to be careful not to give the artist one hundred choices because then it is going to take him six months to decide which choice he is going to like best. So we were trying to keep Claes in the position of informing us rather than our informing him. In other words, we would present something to Claes and then watch him closely and if he reacted very, very favorably, we would pursue it for another couple of days and then try it out. We just didn't know. No one had built anything of this size before, nor had anything been built with the durability aspects that we were trying for, because most outdoor displays don't last. Most Fairs are built only for a Fair's time. Things are not built to last five, ten, fifteen, twenty-five years so that was the obstacle course we were running. Also we were simultaneously trying to come up with a design and double-checking everyone's ideas. Will that motor last, how long; has it got hermetic seal bearings; can we install a larger motor so it will last longer; will we have enough power in the U.S. Pavilion in Osaka. We couldn't obtain enough power there, I learned, so we changed the voltage for the bag, reducing every motor down in amperage. It scared the daylights out of me because each time you would give me a phone call it would just throw everything in a state of chaos with the changes. None of us ever knew what was feasible in this collaboration.…

When my partners Sidney Felsen and Stanley Grinstein finally negotiated the contract with Krofft there were two things we asked for. One, we asked for total participation by all of Krofft's members. In other words, we wanted to have the ability to go from the sewing department to the animated department to the woodworking department to the electric department to executive offices if we had to. But we also asked if we could bring anybody we wanted into their shop at any time we wanted to inspect what they were doing, and if necessary even take part of their shop and have it analyzed because we were under a tremendous obligation with no time and virtually no money. They were able to see this because Hollywood operates under very strange circumstances. They are not like most manufacturing outfits. So I used the people who built my press to study the hydraulic system and tell me it was all right. I used Featherlike to tell me if the bag was sewn properly. We used our wood model makers to tell us if what they were putting on was wrong and therefore changed it. Krofft controlled most of the testing, and we had them build a machine to test the stretchability of a polyvinyl. Even though manufacturers gave us these test results we didn't believe them. Every step required some form of checking. . . .

We had to go to theatrical people, we couldn't go to aerospace people or to other engineering people who are used to six and seven months lead time, or engineers who are used to taking a problem home and making teeny models and looking at it for a week before they even dare make a step to produce something larger. We had to go to people like Sid and Marty Krofft, who had guts and who were able to say fantastic, we believe in you, go ahead and do the project. You don't make great movies without doing this or great puppets or great sculpture. They thought of the *Icebag* as another character in one of their movies. It was very funny to hear them talk about all the characters that they have built. They talk about these time schedules where a guy says on Friday afternoon, and the board meeting is a week away, "I don't like the look of that dog. I surely don't want that on television next week with that stupid dog in it." That gives them seven days to change the dog, so no one goes home. They just keep working until the dog is changed. Well, we really came in with the same kind of concept. We don't like what we have as a schedule for you, we said. We don't like what we are presenting in drawings because they are not very accurate. But you are professional people in a theatre and you are used to working all hours. So you have to write a contract with us which says I stay up twenty-four hours a day, you stay up twenty-four hours a day. Whether the artist is there or not, you work any schedule I want you to work until the bag is completed. So we exclusively would have X amount of people from start to finish. That's it. It has to be on that schedule or we will never make it and therefore it is silly to sign a contract with you because you will only be late. If we are late, the Museum will be cheated out of their piece, and they have an agreement with the government, etc., etc. Krofft signed the contract. It was easy to drive that bargain with them because they were theatrical people. You can't do this with other kinds of businesses. They work under regular union shop hours. The union says you don't work unless you get double time, triple time. And you can't even work around the clock, it is against the law. But with these kind of people, who are all skilled artists, they work as long as they have to work to get something done. So they were really very much like artists. An artist doesn't stop painting when he wants to continue, he just keeps going until he falls down. Maurice, we had a very sick looking group at the end of the project. In fact, four of them didn't go to bed for three days. That's what it took to get the *Icebag* to the opening, and we didn't know if we had to stay up for three more days to change the cams and this was very shaky stuff. Now the only confidence that I gave you was the confidence I had in that agreement. This was the reason why I was able to be grandiose about it all and say don't worry Maurice, we'll get it to you, and that date is all right. And we would say to Claes don't worry Claes, by the time you come back out to L.A. it will be running or the blower will be working, or the fabric will be sewn. We just knocked ourselves out until it happened. Every day I would drive out to Krofft and we would get a schedule. We would spec it; we would go over certain things. I would drive back home and get to work in the shop. This thing kept up for about three months. It was living hell but the kind of hell you would go through when you do set designing or when you're working with a little theatre or a professional theatre. That's the sort of spirit that went through the creation of the *Icebag*. To me it is the piece, Maurice, it really is the piece that did it. . . .

I think that all of us got involved in this project, you, Gemini, Claes, basically because we were all very convinced that something like this should be done and the time was right. It was right for the artist, it was right for you, and it was right for us. We weren't prepared maybe in the best of ways, but we certainly didn't baby ourselves in the situation and we certainly didn't have a lot of buffers to protect us. I think because you had a limited budget and you had limited time and you passed that on to us and the artist together we were all able to work together in this triangle association. We were proceeding on the course that Billy Klüver and E.A.T. thought about for years but never were really able to pull off. So the missing link in Art and Technology has to be timing, and it is something very few people are willing to talk about because they just don't think about it. I think if you would bring to us today the *Icebag* knowing what we know today, we would not commit to three months, we just wouldn't. We are too knowledgeable now. We would say eight months and we probably wouldn't do a better bag. I believe that the shortness of the schedule, the pressures that were brought upon everyone, the messed up situation in Osaka, were all extremely beneficial. …

There are few artists other than Claes who could have done this, with such precision and logic. I am sure it took its toll. I saw it on Claes, who was very tired after this. This took a tremendous amount out of Claes the artist, but he had the foresight in the very beginning to know that he was going to have to operate within a very large arena of people and he set up certain kinds of responsibilities that he was willing to give to people who were operating in various capacities. This is very unusual stuff. Generally the artist is not capable of doing that. …

Art and technology rarely works, I think, and it has to do with the element of time, the surprise situation when timing becomes absolutely the most important thing. I think today if you would ask yourself this question, could I go out now and duplicate this or that project and improve it?—that is the key question—I think you would in most cases have to come up with the answer no. I don't think that Claes will ever do a collaboration like this again. He has learned too much from it, and everyone around him has learned too much from it. That in no way takes away from the project, but I think in this whole enterprise—the surprise of the short budget, of the fanatic spirit that one gets into when all these obstacle courses are thrown at you, and the kind of tenacity that you exercise in situations like this as a creative person—that we are really talking about theatre. I think maybe this is the theatre—putting together all these families of people and their interaction. This really is the living theatre. It's not on Broadway any more, but this certainly is it. For me the technicians are the stage designers, the set builders, the choreographers, and our guys like Claes are the actors. We may be the producers or directors, or writers, or what have you, that are involved in this complex of work. But we are really performing in the greatest tradition of theatre, no time, no money, all impossible deeds, but somehow it gets across and some accomplishment comes from it.

The *Icebag* was completed in early January and was shown in a preview at Krofft before it was shipped to the U.S. Pavilion at Expo. Oldenburg, Tyler, and a crew of Japanese workmen installed it in one week's time. It was placed at the entrance to the New Arts exhibition.

Oldenburg has speculated on the *Giant Icebag* and A&T at length, in taped interviews with Eric Saarinen, with Jane Livingston and with Tuchman. The following excerpts come from these various conversations, made in March, July, and September 1970:

Getting involved with Art and Technology, I had to ask myself first of all what particular problem was it that I couldn't solve myself in my own studio and I needed help with; and I thought the most difficult thing was really to find some soft material which could be used in a quantity and also be durable enough to serve outdoors as a public sculpture. And this I hadn't solved, and I hoped perhaps that Art and Technology could provide me with the resources for, oh, some kind of material—rubber or something stronger and thicker than the kind of vinyl that I had been using. The other thing that I needed was, of course, machinery which could create a slight movement of the object itself. Up to this point I had relied on the suggestion of movement or on the spectator, say, who would own a piece and would move the piece around himself. But it was now interesting to me to see if I could discover a way to make the piece itself move in a very slight way and change its aspect. So these two things I really couldn't solve in my studio because I knew very little about mechanics and

I had no workshop. And I had been using vinyl, but I hoped that through Art and Technology I could discover something stronger, thicker. As it turned out in the final result, what was used for the *Icebag* was vinyl again and not much different from the sort of vinyl that I had been using all along, so that there wasn't any advance on that front, but there was an advance on the front of mechanics—that is, a structure was built with a gear system and hydraulic system, which all cost quite a bit of money and took a lot of expert help, and this motor enabled the sculpture to move. So I had what I wanted, which was a sculpture that moved or an object that moved by itself. The *Icebag* as it operates in Osaka, is doing pretty much what I wanted it to do, but one finds that—or I found that there were always compromises. The whole problem with technology is that you can't achieve the directness that your fingers can make when you alter something the way you want it in the studio. I mean if you have clay or if you have cloth or if you have some simple material that's non-technical and doesn't involve a lot of other people's help, you can very easily alter it and make it look exactly the way you want it to. But this is not possible in working with technicians—it becomes a very indirect process, so that you have to give an order or command perhaps long distance and wait for several weeks before it's achieved, and then it's not achieved quite the way you want it—but it's pretty close to it. But it becomes so difficult just to make a slight little movement to make is exactly the way you want it, and so it becomes finally a kind of—well, finally the technicians say we've reached the limit and you decide that perhaps they have reached the limit, and one has to settle for just a little bit less of what one wants. Sometimes one's lucky. But it's these little, tiny, final adjustments that I miss perhaps in the *Icebag*—there might have been a few things that I would have thought of right at the end which would have brought the piece into a much more personal solution or context, which I could not do simply because technology had determined a certain direction and it was too expensive and the time didn't allow for these final adjustments and changes. But that's all right because I consider the whole thing rather experimental, anyway. It certainly is the most complex piece I've ever done, and the first of what I hope to be more complex pieces. . . .

Technology is an available material, which is very different from certain conventional ideas of artistic activity in that it involves a lot of other people, and it involves using skills that the artist or the originator of the event or action doesn't necessarily possess. I don't know anything about mechanics, and yet I'm creating something, or I'm imagining something which involves mechanics and I'm asking someone else to do it for me. The question is, can anyone else do it for me, or could I allow other people to do things that I don't know anything about, and what kind of controls and what kind of respect can I create in them for my intention if I don't really know what they're doing. So there are very special problems involved in technology. There's also a kind of a rush towards completion on the one hand—you start something going and you invest a certain amount of money in a kind of machine, and you get a result, which is very limited—because in technology everything is highly limited. You get a limited result, and you don't like the result and it becomes difficult then to throw away the whole machine and start over again. So that technology is very deterministic—the activity in the studio is so much more fun because you can change things constantly. In technology you just—you have to be very sure what you're doing before you give the orders to go ahead, so it's an activity which in every way denies the freedom and the pleasure of being an artist. And yet it's a challenging thing—I think of it as kind of a defensive activity on the part of the artist; if he can't handle this material which is so very much present in all his surroundings, then, you know, he'll sort of lose face—John Marin used to feel very put down by taxi cabs—he saw a taxi cab especially in the old days when taxi cabs were very clean and very beautifully colored, and he said to himself what is my painting worth next to a taxi cab?—a taxi cab is so much more powerful and beautiful and so much more expressive of the present time. That used to depress him. And I feel sometimes the same way about machinery—when I see it. In my happening in '63 in Los Angeles, I used automobiles, and one of the best pieces in the happening was a concrete mixer—a brand new concrete mixer that I had gotten from the construction company just by asking them if they'd send it over. It had never been used before, and I used it in the performance—I just moved it very slightly. It was this heavy, powerful object, and it was sort of completely at my disposal, and what I chose to do with it was just to move it inches this way and that way, and this way and that way, just to see how well such a huge mechanical object could perform for me without doing what it was made to do, without functioning. It's almost like lion taming, you know, dealing with technology this way. I suppose it would be very difficult to feel like a modern artist if you weren't in some way coping with the presence of things that you do not understand. There's so much surrounding you, so much specialization that you don't comprehend. And the artist is supposed to be the person who can unify or make a whole out of diverse things, to give direction and order and he has to contend with technology and specialization. And if he doesn't do that, he limits himself. So I think it's kind of a necessity forced on the artist by the times. . . .

I think perhaps my approach to technology is to remove the difficulty of technology, as to take something which is formidable in its complexity, and make it do some very foolish thing—and I sort of like the idea that all this time and effort was spent on the *Icebag*. I'm creating something which really doesn't do very much. It just does something very simple; and it doesn't do anything more really than a leaf does in the wind. I don't want to get into complex motions. I would never make the subject of the work the fantastic complexity that technology could achieve—like a Swiss watch, for example. I mean that's very interesting to watch, but that's not my aim. I think I would go in just the opposite direction. I would take all this complexity that technology can provide and direct it towards a simple solution that equates it more with nature, or gets it, you know, out of the mechanical realm and back into nature. So I'm very concerned that the *Icebag*, after all its machinery action, looks like it was alive. It's the philosophy of the automaton and it was what Walt Disney dreamed about, which was the great irony—that he had spent millions to create technology that would give him the effect of life. His dream was to strap these recording apparatuses on an acting company and do all the plays of Shakespeare so that he could then reconstruct the plays with automatons—in other words to get back to nature, but to make nature yourself—in other words to give, I guess to give birth to nature yourself through the machine. But I wouldn't try to take on anything that complex—I mean the *Icebag* has a very simple life—it's a very simple organism, it's something like a starfish, a very low level of organism. And I would like to keep it that way. I wouldn't want it to walk around and behave like a robot. I would just like it to kind of crawl around—I'm very fond of snails and I have a zoo of snails in the back— and it's that kind of activity that I like. . . .

There are some things that I played around with before which probably relate to the *Icebag*—once I had a big fried egg about fourteen feet across, which was used in a performance at Stockholm in '66. There were people under the egg which animated the egg—the fried egg—it looked very much like an icebag. Bob Breer did some things with a self-moving object and a few years ago he put a cloth and some silver foil over some of his moving objects, and it produced a material that looked as if you had dropped a cloth on the floor and the material itself had come to life and began to move—but you couldn't see the motors underneath. So at that time I proposed combining the two agents—the motors that Bob developed with the fried egg that I had developed—so what we would have would be kind of a crawling, moving fried egg, a flexing fried egg. So things like that had been in my head for some years before I had the opportunity to play with that in *Art and Technology*. The *Icebag* is chosen as an object because it has a lot of rather flaccid material tied together under a hard shape, so that you have a contrast between the flaccidity of the material which is always changing and the hardness of the top or the cap which holds it, which binds it. That way you have limits to how much the material can behave, which it didn't have in these earlier experiments—the fried egg of course was all soft, but if you take a fried egg and put, say, maybe the yellow part, a mirror or a hard surface, you'd have you'd be on your way to achieving an icebag, an icebag effect. So it's perhaps even suggested by handling a bag or handling any kind of material which you would bunch up and say hold in your fist in order to manage it somewhat and then watch the movements that you would create in it by bumping or pushing it against other surfaces. And what the cap does, it sort of organizes the material in a way that gives it some kind of form. I mean I desired the movement of material, and the point of the object is just to organize this sort of thing in some way so that it can be presented.

The first configuration in Oldenburg's art to anticipate the *Giant Icebag* is a remarkable watercolor of 1963, *Frankfurters and Mustard Cup*. A costume design of the artist conceived in 1965 also suggests the monumental sculpture. The *Icebag* became perhaps the most complex synthesis of associative forms Oldenburg has made to date. In addition to the "fourteen-foot fried egg" Oldenburg referred to above, he has mentioned the following images as relating to the final shape of the *Icebag*:

the human head (hard like the
fiberglass cap) and body (soft as the foam
and vinyl)
the Museum's enormous vacuum cleaner
(used to clean the concrete plaza)
Mount Fuji
an inkwell bottle
the planned centerpiece of Walt Disney World
in Florida (a ride that "looks like a white icebag")
a sandbagged ashtray
the artist's cap
domes, particularly the cupola of the Capitol
building in Washington, D.C.
moon craters
Hollywood premiere searchlights
tomatoes
breasts
the "universal concept of the sun"
the atomic bomb
"The Sponge, Upper Geyser Basin, Yellowstone
National Park"

As seen from above, the *Icebag* was further suggested to Claes by:

the poster for Expo 70
a doughnut
a clock
the moon's relationship to earth as photographed by astronauts
a Chinese cookie

In October 1970, as this report goes to press, Oldenburg spoke with Tuchman about his changed feelings in regard to the problems posed by Art and Technology. Art, he said, was basically a "matter of childhood," while "technology concerns adulthood." His original reluctance to interact with corporations had to do, he now believes, with the fears that attend responsibility. Oldenburg now affirms the necessity to take such responsibility. He feels that only in this way can a primary dilemma of our time be faced: the imperative to "achieve harmony between the two natures—that of the machine and true organic nature." He drew up a chart for us to indicate the transformations an artist must undergo in order to deal successfully in the corporation-technology arena:

Artist in Studio	**Artist in Collaborative Situation**
1. intolerant	**tolerant**
2. impatient	**patient**
3. static	**mobile**
4. rigid	**flexible**
5. inward-looking	**outward-looking**
6. uncooperative	**cooperative**
7. stingy	**giving**
8. violent	**restrained**
9. impulsive	**deliberate**
10. vindictive-paranoid	**forgiving**
11. proud	**self-effacing**
12. destructive (especially self)	**constructive**
13. compulsive	**non-compulsive**
14. unpredictable	**foresighted**
15. drunk or high (looking for sublimity) (custodian of the sublime)	**sober** (indifferent to the sublime, like airplane pilots)
16. caprice	**perseverance**
17. feverish	**calm**
18. magic applied without reservations	**magic circumspectly applied**
19. alienation	**participation**
20. image of self	**image of *more than self***
21. ease	**difficulty**
22. God (identification with nature)	**more difficult to be God** (apartness from nature)
23. control	**leave be** (do not interfere)
24. obsessive (primitive mind)	**scientific**

Maurice Tuchman

Robert Rauschenberg

top
Rauschenberg (second from right) with Teledyne engineers and curators Maurice Tuchman and Gail Scott (third and fourth from left), testing a prototype for *Mud Muse*, 1970

middle
Opening night of the *Art and Technology* exhibition at LACMA, 1971

bottom
Mud Muse (detail), 1971

Bob Rauschenberg's collaboration with Teledyne began in September 1968, after a tour of the company in Los Angeles, has continued over a two-year period, and is at present still in the final stages of completion. It has perhaps been longer in process than any other project in the A&T program and has been characterized by brief moments of intense interaction between Bob and Teledyne personnel (principally Frank LaHaye, Vice President, and Lewis Ellmore, Director of Special Programs) and long intermittent periods of inactivity or company fabrication in the artist's absence. There was never an extended residence period by the artist. The reason for this slow evolution was not, however, due to lack of enthusiasm by anyone involved. From the start Teledyne was eager to accommodate Rauschenberg and his project proposals; for his part, Bob was always willing to make himself available when some aspect of the project required his attention.

In a series of meetings during Rauschenberg's initial visit in September 1968, the artist was introduced to several key executives at Teledyne's head office in Century City: George Roberts, President, and Vice Presidents Frank LaHaye and Berkeley Baker, all of whom were acquainted with Bob's work. At this time the company agreed to accept the artist in residence, and additional meetings were held with Lewis Ellmore, who was asked to assist in the collaboration. Ellmore later recounted this first interview with Bob in a letter to us dated November 12, 1970:

> We had an absolutely fascinating discussion over lunch, and both Bob and I became entranced with the possibilities available. We really had not the slightest idea as to what form the project should take, but Bob's thesis was that, after all, art is creative manipulation of materials and processes, and there appeared to be a great many new developments in technology to be exploited. All this sounded quite good; the difficulty seemed to lie in the fact that the typical artist had neither access to, nor full understanding of advanced technology and the artistic ability of the average technician or scientist is vanishingly small. Thus, the combination of Bob and me with the resources of Teledyne.
>
> At that first luncheon it became obvious that Bob was certainly not a typical artist, and I grew

> increasingly enthusiastic; more, I suspect, about the prospect of working with Bob than about the project in general, since it seemed to me that any contribution I could make would be insignificant compared to the artistic creativity injected by Bob. It also appeared that we could work together easily since we shared a…sincere belief that although life was pretty grim, it was possible to improve it. So, amidst a pledge of assistance and dedication of resources from Teledyne, we parted, the first step to be the exchange of letters between Bob and me, each expressing an initial viewpoint.

In December, LaHaye and Ellmore met again with Bob in his New York studio, visited the Museum of Modern Art to see Rauschenberg's piece *Soundings* currently on exhibition there, and resumed their discussion on the project. In the same letter cited above Ellmore recapitulated this and subsequent meetings:

> The meetings we had were refreshingly informal and a genuine pleasure. Bob's goal was to create a dynamic work, which not only would stimulate more than just the visual senses, but would in fact interact with the observer. He had pioneered in this field and was at that time exhibiting his *Soundings* at the New York Museum of Modern Art. He felt that that represented a direction to be further pursued, and we, over the next several months, exchanged many thoughts and ideas.
>
> Fundamentally, Bob wanted to escape from the limitations of two dimensions and to couple the work, in a way yet to be defined, to the observer. My role in all this was really as technical censor, if you will, serving only to comment on the technical feasibility of what Bob wanted to do.…
>
> We considered many types of three-dimensional displays ranging from mixing air currents made visible by thermal differentials, to closed loop machining systems where the output of the machine was subsequently modified and fed back into the input. We considered fluids of various types flowing, mixing, and in general doing all sorts of things. We considered different geometries, materials, methods of manipulation and alteration, and, overall, just about everything one can conceive of. We thought about the types and forms of energy, which could be sensed and used to activate and regulate the dynamics of the work. Again, everything from deliberate and direct observer control to purely random processes. We included sound, light, motion, odor, etc., etc. At one time we looked into actually being able to sense the mental state of the observer, but while theoretically possible, it seemed to be a bit advanced in terms of actually implementing it.
>
> We went on to explore ways of stimulating the observer, not only visually, but with both audible and non-audible sounds, pressure differentials and so on. Finally, we looked into means of selectively creating emotional responses in an observer and, in fact, of using these emotions to further modify the art.
>
> We had, by this time, started to vaguely define the limits within which we would operate, and started to formulate ideas in terms of the materials and technologies needed. In recalling this phase, it was certainly one of the most stimulating of my experience. We literally were unfettered conceptually, limited only by Bob's imagination, which appears to be boundless.

Sometime during the course of this series of interchanges, which extended through the Spring of 1969—at exactly what point it is not altogether certain—it became clear to Rauschenberg what the piece should actually be. According to the artist's own account, he was lying on the beach when it occurred to him spontaneously to use mud and to reproduce the bubbling activity of the "paint pots" at Yellowstone National Park; sound stimuli would be channeled to directly generate the mud movement. He conveyed this notion to Ellmore and other engineers at Teledyne who began to investigate the feasibility of activating mud by sound waves. It was quickly determined that the level of sound required to cause by itself any movement or bubbling effect in an expanse of viscous material would deafen the human ear. Again, Ellmore summarized for us this stage of research:

> The visual mechanism chosen by Bob was to be a large tank of viscous liquid through which a less viscous liquid or a gas would be released; the control of such release to be governed by the sensing and processing of selected elements

> of the environment. Simultaneously this was to be accompanied by a similarly processed acoustic display.
>
> We found rather rapidly that the constraints of reality were upon us. For example, following a meeting with one of the Teledyne Companies engaged in the manufacture of viscous liquid, Bob, after due experimentation, discovered the combination of chemicals, which would yield the desired effect. Alas, the cost [would have been] monumental and it was some time before it was realized that simple drilling mud was actually superior. Similarly we decided on injecting air into the mud and planned on using a valve which would release air in direct proportion to the applied electrical signal. It required some experimentation before we found that controlling the duration of one of three constant pressure sources gave nearly equivalent results at a cost reduction of about 99%. There were many many such examples, stemming, I suspect, largely from the space age environment within which the various contributing companies were accustomed to operating. In short, there was no incentive to do other than pursue the most technically convenient path.…

In the fall of 1969 we considered the possibility of including Rauschenberg's piece, tentatively titled *Mud-Muse*, in the Expo show. After informing Teledyne of this, they agreed to build a small model to test the system. Work on a square eighteen-inch prototype tank began immediately at Teledyne's Torrance division, Sprague Engineering, supervised by George Carr. The model was finished in January 1970 and functioned satisfactorily. However, because of delays in obtaining the necessary fabrication materials for the full-scale version, the Expo deadline could not be met.

The pressure to finish *Mud-Muse* for the Expo show and the construction of the prototype served to bring into focus several problems of mechanical design which were then resolved. The piece would be a nine-by-twelve-foot tank. Bob had originally conceived of it as measuring sixteen by twenty-one feet, but the scale was reduced in accordance with the maximum size capacity of an airplane, in anticipation of shipping the piece at the last possible moment to Japan. The tank would appear to be free-standing, being elevated three inches off the ground, and would have a two-foot aluminum skirt to hide the electrical and pneumatic mechanisms. Above the metal base would be thirty-inch high plexiglass sides; the tank would have no cover, so that the mud would be exposed to top view. (For structural reasons glass was later substituted for plexiglass.) The tank would contain a high viscosity, high density (100 pounds per cubic foot) derivative of driller's mud, light brown in color and extremely soft to the touch. This material was acquired from Teledyne Movible Offshore in Lafayette, Louisiana. At a later stage of its design Frank LaHaye wrote a description of the piece which states in part:

> In the bottom and hidden sides of the tank there are located approximately thirty-six compressed air inlets. Each inlet is connected to three manifolds by low pressure tubing. The manifolds are maintained at three different pressures (2-6-12 PSI). Each line of tubing contains an electronically operated "on-off" valve.
>
> In operation, the effect is a continuous and random boiling eruption of different intensity at different locations. Selection of location and intensity will be done electronically using three or four microphones dispersed at random, either near the piece or at a random location. If located near the piece, the microphones would have to be hung from the ceiling or from a side wall.
>
> It is also planned, though the details have not been resolved, to have a number of special sound tracks playing from under the piece. Selection of one or more of the sound tracks would tie in with the electronic selector system controlling the pneumatic valves. Typical sounds might include the surf, an owl, the wind, musical notes, etc.

By June 1970, the design of the electronic and pneumatic systems had been resolved, and fabrication began in earnest at Teledyne's Aero-Cal division near San Diego where Jim Wilkinson, Chief Engineer, supervised the operation, and Carl Adams coordinated the actual construction.

By October construction of the tank was sufficiently completed to allow preliminary testing of the mud movement through mechanical means; the sound system was still unfinished. Rauschenberg, Tuchman and Livingston were present at Aero-Cal for this long-awaited event. Twenty 50-gallon drums of mud were poured by hand into the tank, and it heaved and bubbled impressively. Bob was delighted. The final stages of the project will take place in December 1970 when the valves will be fully operable and the electronic system installed. By that time, Rauschenberg will have recorded the soundtrack he wants—a combination of jumbled, incoherent, or semi-coherent manmade noises, and sounds from nature. These will be incorporated into the system to interact with the random action of the mud controlled by sounds from microphones located in diverse parts of the exhibition area or Museum proper.

In an interview with Tuchman and Scott in October 1970, Rauschenberg commented on *Mud-Muse* and reflected upon his experience in the A&T program, on the general phenomenon of art and technology, and on the differences between A&T and E.A.T. [Experiments in Art and Technology], which he helped found:

> My piece is not the work of a magician. It only exists in sensation and it is exactly what I thought was missing from the phenomenon of art and technology, because usually whatever the artist does in relationship to technology tends most often to look like exploitation of technology, or what he does is so primitive and simple in depth [compared] to the profound qualities of technology. Like most technological art, this [program] is a beginning, and you can't expect one of the most sophisticated forms to be able to actually emerge overnight. But one of the big problems is the whole social problem, sociological problem—the wooing of industry to even care. Then again, most often the artist himself is so seduced by the simple marvels of science that are really just utilitarian for the scientists and for the industrial world, that the art concept doesn't match, it doesn't even compare to it because the artist usually incorporates the phenomenon. He is seeing a *fact* as a romantic phenomenon, as filled with beauty, and if he touches it and says that's it, then that's his work. Whereas what you really have is a bunch of very old hydraulic ideas, things that we didn't probably pay much attention to when we were going to school, as a thing of beauty. So either it should be just that and left, or you have to take it for granted and move from there and not have the art part of it being a kind of cosmetic for technology because it doesn't need rouging up. Technology has not been unsuccessful.… The temptation for industry is to take the artist in superficially as the artist is appearing to them. If they can get just a little company color out of the collaboration, that is all they want *really* in most cases. They would do it rather than recognize this [broader] collaboration that Frank La Haye has talked about, where it is essential that humanities are considered in industry.
>
> The thrill of making another dollar has carried us so far out of our lives and any real sense of what technology is about and what it does mean to us; what its influences are. We are so busy progressing that we have absolutely lost any realistic sense or even need for it. You can't trust that to a few Ford Foundation grants, for some people who go off and make a bunch of surveys and come back with some figures. It's got to be something really in practice. You were talking about the fact that industry needs a conscience, and it seems to me that the artist is the only person to hire because nearly every other phase of the professional world is already caught up in it, and the artist is the last, freelance professional person. The reason he is not involved, hasn't been involved, is because of the sense of dealing with the totality instead of a specialization. He is dealing with an intangible. With even the most successful artists, it would cost you more to keep him from doing what he wants to do next, if he wants to do it, than it would for you to support him. Now that's sure unique.… We are suffering a really serious hangover with technology. Taken abstractly, you can be anything but extremely proud of its accomplishments. I think we are still medieval about our uses of it. Applying technology is on the sunny side of witchcraft. It's all tricks, and so therefore we have an extremely serious waste. Technology isn't going to suffer, because technology doesn't have to have a heart or anything. Technology will probably work just as well in polluted air as not. In fact, there could be new developments where polluted air would be more advantageous to certain technological things; but not to people.… I think you immediately get involved with *Mud-Muse* on a really physical, basic, sensual level as opposed to its illustrating an interesting idea, either successfully or unsuccessfully, because the level of the piece, on the grounds of an idea,

is pretty low.… There is no lesson there.… It was to exhibit the fact that technology is not for learning lessons but is to be experienced. I've done technical pieces before and there is a much more self-conscious use of technology.… In *Soundings* I tried to start that out by just using the single image of the chair. And I took all the photographs myself and kept turning the chair, so there was no entertainment, supposedly. It's an entertaining piece, but there again I was working to *not* educate anyone. I wanted them to have the sense that they were half of the piece and so there was a one-to-one response. If you walked in the room silently, soundlessly, then nothing would happen, you wouldn't see anything except your own reflection. That's already a kind of idea. But *Mud-Muse* doesn't have an idea like that because *Soundings* already had a lesson and this is a very difficult area: it is hard not to try to build in a lesson for me because I really care so much about this whole area. We're really going to be lost if we don't come to terms. The statistics on how many years we have to live are frightening; they are being printed every day, and we are learning. That information is so much more available than it was, even a year ago, but our rate of doing anything about it is so much slower. This has absolutely to do with our relationship to technology—our idea about the world as being this great big apple or something which is put here for us and if we get in trouble God is going to take care of all that. God's not going to let anything happen to his world because after all, he made us. That's a lot of bull.… But there's not that moral content in *Mud-Muse*.… Pure waste, sensualism, utilizing a pretty sophisticated technology.… I did earth paintings [1953 or 1954] before the peak of abstract expressionism. Bill de Kooning still wasn't selling anything; he was showing in one of the only five galleries in New York City that would show modern Americans, and I went into these earth things. There again, I didn't want to make a big thing about that, but those paintings were about looking and caring. If somebody had a painting they would have to take care of it. It is just as simple as that. I don't care what the motivation is, selfishly, unselfishly, if they're taking care of it because they're thinking more about the other person or they're taking care of it only because they're thinking about themselves, the result is the same, that they're taking care of it. And those were pieces that would literally die if you didn't water them. They were growing art pieces on the wall, not on the ground, and I said this is art, too.…

I don't see that A&T and E.A.T. are in competition, so comparison doesn't say anything interesting except on any level other than trying another way to arouse people's sensibilities about the problem that is all too obvious, only to people who know about it, who unfortunately have to be in the minority.… I think that what you are doing here is interesting in the respect that E.A.T. has to play from guts. The mere fact that E.A.T. has survived this long with so many people still involved in it, means that it is a success. It was an idea before its time, even though it was a little late. It still didn't come from any vogue. You started from the idea of art, and the fact that you were proposing it, guaranteed a level of encounter that E.A.T. isn't interested in because we had to do just the opposite and say that we are not involved in esthetics. We are not censors, we are not talent scouts. Anyone who needs help, technological help, ought to have it available for them, and we are catalysts who not only provide that help but excite other people, and an organization could get to them where an individual couldn't. We have really been criticized. Our biggest enemy are people who say, "Now what is wrong with a Rembrandt?" You started from the other end, and because of your endorsement and the fact that you provided the possibility of a guarantee of a showing, it meant that if they committed themselves, then they would have to do it well, which we couldn't do. All of our things begin at one end and either die before they get to the other end or the work is finished. You started at the art end and drew all of these things to that, using the fact and your influence that the end result would be art. In E.A.T. we say, we can get something started but we can't promise you anything. You can only do what you did, by setting those limitations, saying that there is going to be an exhibition; the work will be shown and by such and such a time. But we couldn't do that sort of thing and just go on year after year changing.… I don't think your problems, though, have been any different from ours in spite of the different approach because we ran into the same thing—skepticism, patronizing. Then it is about the middle-management guy who is afraid even though the boss has told him that we are doing this. He can't believe the boss will admit it when he sees it.... The research people are at the bottom of all industry. The research people immediately get interested. Those guys were able to watch air passing through mud and were involved. There was no esthetic judgment there about whether somebody ought to be doing this or not be doing this—with those people that you really rely on to do the work, and so does the company. The top guy is always just a little bit interested. If he is interested at all, he is excited by the prospect that there is going to be this collaboration which is unique, but the problem is the middleman. When he gets home his wife is going to say, "what did you do today, dear," and he will lose face unless he says, "there's this funny-looking guy who came in today, God knows where from, and he talked strange, had some funny ideas, and asked me to do some strange things!" That does nothing for his status.

Mud-Muse starts from sound: An impulse is turned into electrical signal and then spreads out into three other breakdowns, depending on its dynamics. Then each one of those splits off in three ways. I don't want it to have a one-to-one relationship to the spectator. It *is* primitive but I hope in being primitive that it can be simple and the intent be legible. It is an existing fact that the world is interdependent. The idea of art very often tends to illustrate some solitary independent concern recognized as isolation. It celebrates most often a kind of withdrawal or self-concern; and it's unrealistic. Even works that are about the other thing usually have a short life because they too get included in this other very precious work.

Gail R. Scott

Richard Serra

By June, 1969 we had taken six artists to Kaiser Steel Corporation (Len Lye, François Dallegret, Philip King, Jules Olitski, Robert Smithson, and Mark di Suvero) without effecting a match. James Monte, who had by this time moved to New York, urged us to invite Richard Serra to visit Kaiser's Fontana division. On June 10, Hal Glicksman and Serra toured the facility, and the artist was enthusiastic about what he saw. Shortly thereafter, he submitted the following proposal:

> PROPOSAL FOR LOS ANGELES COUNTY MUSEUM IN CONJUNCTION WITH KAISER STEEL
>
> The work will be related to both the physical properties of the site (Kaiser Steel) and the characteristics of the materials and processes concomitant to it. The work falls into three basic categories:
> A. Casting in location
> B. Overlaying processes
> C. Constructions
>
> A. Casting: The molten metal for casting is to be brought directly from the furnaces by turret car to the yard. Sand casting molds are to be used to control the pouring flow in location.
> 1. Slabs are to be embedded and supported in place in the molds.
> 2. Shapes are to be derived from direct pouring.
>
> B. Overlaying processes: Specific diverse processes are to be superimposed in final states. The juxtaposition is to point to the specific characteristics contained in each step and method of processing. Work will assume a holistic striated form. Stacking will be the control.
> Example: poured form overlaid by in crops, hot rolled slab, galvanized sheet, cold rolled, discarded gangue, etc.
>
> C. Constructions: Work is to be erected in place. Slabs, hot rolled (ploom [*sic*?]), to be used. Principle of work is to rely on physical tension, balance, and gravity.
> Example: Stonehenge type construction.

We invited Serra to take up residence at Kaiser, and on July 21 he commenced work. After negotiations with Kaiser management and supervisory staff, it was agreed that the artist would work, at certain

top
Richard Serra with a temporary sculpture at Kaiser Steel, 1969

bottom
Richard Serra (right) installing *Five Plates, Two Poles* at LACMA, 1971

specified times, in the “skullcracker” yard. (Here various scrap materials are broken down so as to be reprocessed.) To do this Kaiser provided the artist with an H-shaped overhead magnetic crane, an experienced crane operator and several construction assistants. Bill Brinkman, foundry foreman, was assigned to oversee the collaboration; he became an Invaluable assistant to the artist. For the next four weeks Serra worked closely with this crew of assistants, often during the night shift, when the crane was available. He usually positioned himself on the ^ ground near the location on which the piece was to be built, signaling directions to the crane operator standing at the controls in an overhead tower.

In his work of the past two years, Serra’s primary structural method has been that of propping, leaning, and stacking various types of massive materials—lead sheets, rolled lead columns, steel, and giant logs. His basic approach to these methods Is empirical, combined with an Intuitive understanding of the physical properties of gravity, tension, and balance.In all these works, among which *One Ton Prop (House of Cards)* and *Sign Board Prop*, both of 1969, are notable examples, the notion of process Is inherent to the sculpture and as Important as the final construction resulting from the accumulation of individual components. The artist best explains his approach at Kaiser in the following statement written after his period of collaboration at the plant:

> Skullcracker Stacking Series (name of yard)
> Work at Kaiser Steel (Fontana, California) was erected with an overhead magnetic crane.
> The structures were not conceived in advance.
> A hand language was learned. (Collaboration existed between the operator and myself.)
> Material primarily utilized: crop, the waste product of the hot roll mill. These large chunks of steel cut from the ends of slabs provided a variety of nonfixed relational possibilities.
>
> The scale 15 to 30 feet in height and weighing 100–250 tons was related directly to the potential of the place. The problem: to avoid architectonic structure, i.e. to allow the work to be both dense, loose, and balanced without relying on previous forms or given methods.
>
> The series involved the possibilities of constructing with weight, i.e. gravitational balanced weight overhead as support. This series was further abstracted with the resultant lead structures made in New York In the fall.
>
> Direct engagement with the materials (crop, plate, slab, billets, stools, etc.) that is, the elements involved, enabled concrete identification with each step in the process. Paradoxically the solutions to the problems of construction (stacking) appear rational, although the process of finding these solutions was not. The apparent potential for disorder for movement endowed the structures with a quality outside of their physical or relational definition. Complete disorientation occurred daily. Work that both tended upward and collapsed downward toward the ground simultaneously was OK. In all twenty structures were erected in eight weeks—the pieces were put together and taken apart.
>
> Technology is a form of tool making (body extensions). Technology is not art—not invention. It is a simultaneous hope and hoax. It does not concern itself with the undefined, the inexplicable: it deals with the affirmation of its own making. Technology is what we do to the Black Panthers and the Vietnamese under the guise of advancement in a materialistic theology.

It was in the context of this past body of work and with the above stated attitude that Serra directed his efforts at Kaiser. He proceeded by trial and error, and, after establishing a rapport with his crew and experimenting with the equipment, he executed about twelve constructions in a period of two weeks of intense activity. The procedure would be to erect a piece, and, if he considered it successful, to have it recorded photographically when possible. The structure was then dismantled. These were process experiments which would l ater be evaluated by Serra.

The first piece Serra executed involved piling sixteen stools in a cantilevered stack. Each stool weighs approximately six tons, and the piece as a whole weighed close to one hundred tons.[1] This massive amount of material, compacted into dense rectangular forms and erected on a tilt, produces a powerful sense of precarious balance.

From this method of stacking the elements according to a regular pattern, Serra progressed into more experimental stacking processes, following a loosely organized distributional procedure and using varied steel materials. He arranged crops, or fishtails,[2] in a loose pile, low to the ground; over this he laid large steel slabs or sheet plate at an angle from the ground forming an incline. As he worked along this line, he exerted increasing control over the stacking method, allowing more and more complexity in the structural format. He would pile together a loose arrangement of the fish tails against which a twenty foot steel slab was propped, one end on the ground; on the lower end the mass would be counterbalanced. This method of organization was continued until an acceptable structure was produced. Some of these pieces reached to a height of twenty-five feet. Six works of this type were executed, some of which included counterbalanced plates of steel thrust out laterally. The works in this group are anti-architectonic; the massive steel components are disposed so that their relational quality defies structural logic. Instead, the works evince the process by which they were built.

After one month Serra left for New York with the intention of returning in a few months to continue working. He was not able to travel west again until January 1970, and then spent only a few days in Fontana. He searched around the Kaiser plant for a new type of steel material and eventually located a vast yard of "slag," which is an impure oxide residue from smelting and takes the form of giant boulders. These he had taken to the skullcracker yard and with them executed three works, again using methods of propping and leaning. However, the work bogged down, apparently due to the lack of proper assistance.

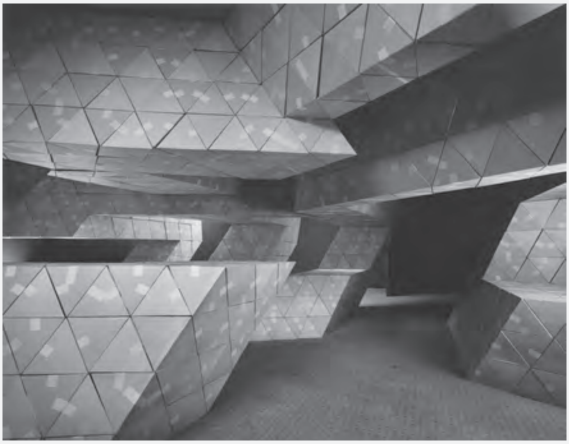
It was agreed that Serra would return to Los Angeles early in the Spring of 1971, when he would execute a sculpture, or a series of works for the Museum exhibition, with the help of Kaiser's equipment, men, and resources. In September 1970, Serra indicated that in addition to erecting one of the works from the "skullcracker" series, he would also like to do a piece relating to his more recent thinking; the idea derived directly from what he had learned about steel at Kaiser. It is to be installed on a selected incline of the Museum park grounds. The place selected for the work will be measured; this variable will determine the shape and length of the work. Once the land is measured, a plate is set into the ground so that it is diagonally bisected, revealing the elevational fall (i.e., the height and length) between two predetermined points. (At zero elevation the work negates itself; at a 45-degree slope the shape is a square.) Once the piece is installed, it is cut along its bisecting contour, flush to the ground, and allowed to fall. The resulting shape reveals on one edge the contour line of the ground.

Gail R. Scott

1 A stool is a rectangular block of cast iron used in the steelmaking process to close off the bottom of the mold into which molten iron is poured.

2 In the steelmaking process, the blocks of steel are cropped and squared at either end before being sent to the rolling mills; the cutoff ends, irregular in shape, are called crops or fishtails.

Tony Smith



top
Tony Smith (left) with model and plans for his installation, 1969

bottom
Smith's installation at LACMA, 1971

Jane Livingston met with Tony Smith in New York in April 1969 and suggested to him the notion of doing a work for A&T. Smith talked about executing a "soft" suspended sculpture (he used the term *pneumatic* in describing his intention), using perhaps some sort of inflatable vinyl or plastic in biomorphic configurations. Smith later discussed this idea:

> I had wanted to do a project that was technical in nature in that I wanted to make a certain type of structure in which all of the compressive elements would be made of air or gas in compression, and therefore all the materials would be in tension—that is, whatever contained the air would be in tension, and then there would also be some lineal elements, also in tension.

Since none of the corporations contracted to A&T were equipped with the kind of technology or materials appropriate for the kind of structure Smith described to her, Jane Livingston encouraged him to consider working with Container Corporation of America. Tony seemed interested in this possibility and mentioned in particular his long-standing interest in doing an architectural-sculptural work using fourteen-sided modules. It occurred to him that this might well be executed in paperboard.

Smith went to Aruba for several weeks, and then to the University of Hawaii in June. In the meantime, Hal Glicksman investigated the possibility of soliciting a corporation that could execute an inflatable or pneumatic sculpture, but we finally abandoned the pursuit.

At the same time, we talked to Anthony Marcin, Public Relations Manager of Container Corporation in Chicago, about collaborating with Smith. Marcin discussed this with his colleagues and indicated that they were enthusiastic. (Several artists had previously expressed interest in CCA—specifically Öyvind Fahlström, François Dallegret, and Les Levine—but their proposals never developed sufficiently.) Marcin was to be unusually cooperative throughout the collaboration and seems to have been directly responsible for many of the important decisions which enabled the project to come to fruition.

Smith stopped in Los Angeles en route to Hawaii; he discussed the work in some detail with us, still with an idea of using the fourteen-sided module. Then in a letter from Hawaii of June 23, 1969, he said:

> My reason for temporarily abandoning [the

> 14-sided solid] as the module for a piece is that it would become too much of an engineering feat. I would prefer to achieve esthetic and psychological effects. The ingenuity of the Corporation's engineering and technical resources would be called upon to help me achieve such results. As I once said, in speaking *of Amaryllis*, I wanted to make a cave. Since I have all the maquette components from which I intended to develop the piece for the [Hawaii] campus, and for which I now have no immediate use, I'll start to work with them today on your project.…

The maquette modules referred to were of two geometric configurations—the tetrahedron and the octahedron; this combination was to become the basis for the artist's final conception of the piece. In speaking further about the history of his interest in making a cave-like work. Smith said:

> I've always had a certain interest in caves, and one of the reasons that it was particularly important in this case was that I had started a series of pieces which ended with the making of a piece called *Gracehoper* which is in Bennington, Vermont. This piece has certain inner forms that struck me as not necessarily cave-like in themselves, but they suggested the idea of making a further piece in the series which would literally have more of the sense of a cave. Around that time I saw a photograph of an eroded part of the desert in Arizona or somewhere in the West and it gave me something of the sense of the way in which I wanted to develop the piece. Now, it would have required so many components that I wanted to use the same parts that I had used in the previous piece, but the model was kept by the people who built *Gracehoper* and I realized that I didn't have the energy to start making the great number of components that would be necessary to start a new model, so I always felt somewhat frustrated in that. . . . *Gracehoper* was probably done in 1962, and I would have made the following piece, which I had thought of as more cave-like, at that time had I had the components, but it's very boring to make those little parts and so I never did make that piece. So it's just something that had been in my mind for a long time and immediately before going to Los Angeles to discuss this project with Jane Livingston, I had been in Aruba and had visited some bat caves there.[1] I think that when we spoke of the possibility of doing something for the Container Corporation, I recalled the previous intention of making a cave and then coupled that with the very recent experience I had in caves in Aruba, so it seemed natural that these two thoughts should revive an interest in caves.… You know, if I'd had to make all those small components myself, I wouldn't have done it—there are thousands of pieces in that form and unless the pieces were stamped out, as they were by the Container Corporation, I would certainly never have done it on my own.

Over the July 4 weekend, Pete Clarke, a structural engineer for CCA in Los Angeles, and Jane Livingston went to Hawaii to see Tony Smith. Smith had several partial models, formed with tetrahedra and octahedra, which served to demonstrate the fundamental principle of the structure. Clarke indicated that these units could be easily die-cut in flat corrugated board and then assembled individually and built with no lock joints or tabs (Tony was adamant about avoiding the use of lock joints) by gluing the units together. Tony stressed that the feeling he wanted in the cave was of softness—he often made the analogy to the texture and color of a wasp's nest (and indeed presented Jane Livingston with a gift of one months later). He felt strongly that the natural brown color of the board should remain untreated, and that the surfaces should retain the quality of slight rippling imparted by the subsurface corrugation. Smith later described, from a technical point of view, his original intentions for the Container Corporation project:

> In my work I use small cardboard maquettes, actual little tetrahedra and octahedra, and I paste them together with tape in order to arrive at the forms of the work.… When I had worked on a small scale in the past, [the original model] would be made into a model with smooth sides from which the steel fabricator works; that way individual components are actually absorbed in the final work. But it seemed that in making something with actual cardboard boxes, I was doing exactly what I do on the small scale and I felt it might be interesting to get the effect of a soft sculpture—that is, soft in the sense of using a material that isn't durable or which is relatively weightless.
>
> Space frames of the sort that I use have been used

> in architectural structures. It's just that they've been fabricated by using struts which are joined at the corners—at the meeting of the edges of the elements. My intention was to use the complete component and simply glue it—glue the surfaces in the way that I had been in the habit of doing with my [maquette] units. This actually is a different type of structure than a structure which is based on lineal elements or struts which are fastened at the joints. In other words, *there isn't any structure except the components from which the form has been made*.

During the Hawaiian visit, Tony talked of introducing light, in shafts, into the cave, and gradually came to emphasize the importance of special illumination in the work. He characterized the effect he visualized by drawing an analogy to nineteenth-century stage lighting:

> Sometimes one sees an effect in caves, actually, if there's a crevice between rocks and light comes in—of the light entering in the form of a sheet rather than as a beam. It's broad.… Sometimes [this effect] is used in the stage. There was a great stage designer at the end of the nineteenth century by the name of Adolphe Appia who did some sets for Wagner. He used some sets which were made up almost entirely of light—that is, there were no other elements used very much, and his lighting had somewhat the effect of sheets of light. I've seen it on the German stage also— they'll block out a certain part of the stage by a kind of curtain of light.… [This technique] usually has been used in order to create space—create planes of space, receding planes of space.

Smith at one point had thought of introducing sound into the work but said in later conversation that he was not concerned with sound or tones *per se*, but with the sensations of hearing produced by vibrations in the air. He was interested in the phenomenon encountered in bat caves, when a person's entrance can prompt mysterious sonic waves and fleeting air displacements as the bats are disturbed. Smith investigated the state of scientific knowledge regarding this phenomenon and located an expert in La Jolla, California.

It was agreed in Honolulu that Pete Clarke would have some small, die-cut units made (four inches on a side) of thin, white paperboard for Tony to use in constructing a mock-up in Los Angeles. We were at this point thinking definitely of the work for display at Expo, and on July 17 sent Tony plans of the New Arts Section of the U.S. Pavilion.

Smith in the meantime sent us some rather obscure Polaroid shots of details of modules fitted together, to show us in a general way what he was after. These snapshots proved to be very revealing of Smith's primary intention for the sense of the work.

In a letter dated August 11, from Tokyo, Smith said:

> This is about the polaroid photographs. What is shown is not intended as the piece. It is what a piece of it might be like. It is made up of about 120 modular units in the ratio of about three tetrahedra to two octahedra. I think the final sculpture should have more than four times that number of units—at least 500 in all. [The Expo sculpture finally comprised 2500 units.]
>
> …The girl who made the components also took the pictures, and, although she has no idea of what the piece is about, she insisted upon including several photographs which she thought were good. She thought she had failed completely in the close-ups taken the next day, but they are very close to what I really want.…
>
> A funny thing happened. While my assistant was making the [small modules], I decided that it might be better to use an altogether different modular unit—that of *New Piece* (shown at Philadelphia in 1966 and 1967). I thought that this might be an opportunity to try out, on a large scale, a system which has intrigued me for many years.… Then I showed the drawing for the [U.S.] pavilion and the photograph of the model to an architect in Honolulu who had worked for Wright just after I did. He remarked on how fortunate it was that the pavilion had been designed on my own triangular module. This made me realize that the other scheme [the 14-sided design] would have been impossible!

In August 1969, the artist toured the Container Corporation corrugated plant in Los Angeles. CCA had made for him two full-size corrugated mock-ups of single units—one tetra and one octahedron, two feet on a side, with no lock joints, which Smith felt were precisely right. Container Corporation agreed to produce about 500 full-scale units at their Los Angeles corrugated plant for Tony to use in making a model, as well as make several hundred four-inch, carton-material modules. The former commitment was never fulfilled, and thus Smith never actually worked with the full-sized units. Moreover, when the corrugated modules were made en masse, they had lock joints. This was in violation of the understanding reached between Smith and Pete Clarke in Honolulu and displeased the artist considerably.

Tony remained in Los Angeles for about three weeks to make a small-scale maquette for the work. This was erected on a ping-pong table he set up in his suite at the Chateau Marmont. Several local kids were pressed into service folding modules and taping them together. Somehow there were never enough modules. Two rush deliveries were made during the course of Tony's stay here, as he used up cardboard units—they were rapidly swallowed up into the model and a temporary dead-end would be reached—but the five by seven foot model was finally completed and brought to the Museum.

Tony returned to New York in September to resume teaching at Hunter College; he had missed several classes on our account.

In September 1969, Smith, Jane Livingston and Maurice Tuchman met for most of one day with the Expo designers at their New York headquarters. We were able at length to decide on a space for the work after several alternative plans were considered and abandoned, and it became clear that a new model would have to be made. It also transpired that the ceiling height was considerably lower than we and the artist had thought—thirteen rather than sixteen feet.

During our session at the Design Team Headquarters in New York, Tony was adamant in characterizing the work as sculpture, as opposed to architecture. It was clear at this point that he had resolved in his own mind the essential nature of the work though it still existed only conceptually. We were all extremely concerned about the problem of handling the enormous traffic flow through the U.S. Pavilion, but Tony seemed to feel he could design the work to accommodate the expected 10,000 visitors per hour. However, he did have to make important sacrifices. He was to say later:

> My intention was to make a piece of sculpture which emphasized the negative space rather than the positive form. The other pieces I've done have been placed usually out of doors or even if they're indoors, they tend to be compact: I think that even though the negative space has been used in some of them, the main effect is one of massiveness.
> I have always been interested in the volumes made by the pieces, and I felt that in this case it would give me an opportunity to deal with these negative spaces as the main element of the sculpture itself. So I set out to do a piece where I was defining the negative spaces as much as possible. Of course, when I began, I didn't realize that such crowds would be involved, and so in the end I wound up getting a space that's much more architectural than what I had hoped for. I had hoped to mold much more sculptural space than has actually resulted; but when I began to learn about some of the problems of just moving the people through the pavilion, I had to open the space so as to make what is almost a passageway now—which wasn't my intention in the first place. I had intended to do something much more labyrinthine, something which would have many choices of movement rather than a guided movement. So I think the piece probably loses a good deal because it had to be smoothed out to such an extent—I couldn't have any projections or indentations on the lower part of the space, because people could fall or be pushed into places, and then the actual ceiling height of the pavilion was lower than we had originally hoped, and again we lost some of the possibility of molding the space above peoples' heads simply because the ceiling wasn't tall enough to allow for it. So in that sense, I think that the space is closer to the space of buildings, perhaps than was my intention originally.

In November 1969, Tony received the modules necessary to build his second, incredibly complex model for Expo. By the end of the month he began work on the model, accomplishing it in a matter of days At this point, through the offices of Marcin in Chicago, William Lloyd, Chicago-based manager of design for Container Corporation of America, was brought into the project. Lloyd visited Tony at his home for one day just before the model was crated for shipment to Expo, and on the basis of that meeting he was able to direct the immensely laborious construction of the work at Expo 70. Lloyd and Smith seem to have quickly established a sense of mutual trust, and Lloyd thus made a series of decisions later for which the final work owed its existence.

The shipment of components to Expo consisted of the model, several palletized flats of precut cardboard and three fifty-gallon drums of glue. Part of the cardboard units were made in Los Angeles—amounting to 3000 tetrahedra and 1500 octahedra; the rest—another 100 cubic feet and some 3000 pounds of cardboard—were made at the last minute in Container Corporation of America's Cincinnati plant and shipped from there to Expo.

Bill Lloyd and his wife arrived in Osaka February 16 to begin the five-week process of constructing the work. (We had originally allowed two to three weeks for this task.) Several days and scores of laborers were required simply to fold and secure each module before the units could be taped together and mounted. The work was half completed by the first week in March, but it had become increasingly apparent that the effect was not at all satisfactory. The interior surfaces were uneven at best, and the overall structure was precarious. It was decided to tear it down and begin again, using an improvised system whereby the previously insoluble engineering difficulties were overcome. Smith feels that many of the problems resulted from the way in which the modules were made to fit together. He said:

> …When the [Container Corporation] engineer came from Los Angeles to Honolulu last summer, we established in about five minutes that the pieces were going to be glued, not put together with lock joints, and when he showed me the mock-ups in Los Angeles later, they were as we had decided to do them— they were glued. And even the shop drawings which they gave me were made in order to be assembled by gluing; but when Bill Lloyd went there to put the piece together, they were made with lock joints rather than glued. That's why they had to tape them.… I feel that [the lock joints] mar the piece, because you see the spaces where the lock joints occur, and in the end they had to put tape over those joints too. So I think the whole piece loses a good deal by being put together that way.… I think the reason that the structure actually sagged or collapsed, whatever happened to it in the course of making it, was because…the components weren't made as they were intended to be made.

The lighting of the piece was achieved under the supervision of Lloyd and the USIA's lighting contractor, with a view to approximating Smith's stated effects as closely as possible. It was not totally successful. Smith stated, "I think I wasn't able to convey to the engineer [Bill Lloyd] the type of lighting I wanted. I wanted a rather sheetlike light, whereas from the photographs [of the Expo work], it seemed as though they used… two spots, just two rather conical shaped lights." (Actually, there were four spots used.) When the lighting had been completed, it began to appear that the cardboard surface was simply too vulnerable, in the sense that one was psychologically drawn to touch the walls as one walked through; obviously, under the circumstances, the work could not long withstand such handling. It was one of the Design Team members' suggestions to paint the entire interior of the cave with red or blue phosphorescent pigments and introduce ultraviolet light in place of incandescent light, with the notion that the spectators would then focus on the effects of illumination as such, rather than on the raw cardboard surfaces. A call was made from Bill Lloyd in Osaka to Smith in New Jersey to consult with him on this possibility, and—rather to everyone's surprise—Smith was agreeable. We felt that this alternative might well be esthetically calamitous, suggesting as it could have the multi-media, electric-circus ambience rampant at Expo 70. The work remained unpainted, though in the course of the Fair its interior was to become densely covered with multicolored international graffiti. The artist was so delighted with this fact that he requested that all of the graffiti-embellished modules that could be retrieved be returned to him after the closing of Expo.

Whether the completed Expo work truly represented the intentions the artist originally had in mind is necessarily questionable, since Smith did not supervise its construction or even see it in Japan. In rebuilding the structure, Smith's design was altered somewhat to strengthen certain spans which had previously sagged and to create broader passageways. Nevertheless, despite these changes and despite the impossibility, for reasons of safety, of darkening the interior as much as the artist might have liked, the fundamental feeling of the piece remained remarkably close to that conveyed in the early Polaroid detail photos Smith had sent us—and to the look and feel of both maquettes.

Bill Lloyd, when asked to comment later about the construction of the work at Expo, said to Jane Livingston:

> The structure Smith had conceived was extremely challenging. His model was architecturally sound; it fit the space perfectly. And it would have been stronger than the Pavilion building had we used

cement rather than glue to build it.

> Tony was right about the disadvantages of the lock joints. I have no explanation for the fact that the components were made that way....

> The changes we made were necessary because of the problems of traffic. I would say the original model was revised about thirty percent. The entryway was all but eliminated, there were structural changes at the exit, and the passageways were widened. It was difficult.... To make one little change, you had to alter as many as thirty pieces. Each piece acts as a keystone. To widen one passageway took three or four hours of mathematical figuring—it had to support an overhead beam, etc.

Despite the artist's reservations about the lighting of the work, based on photographs he saw of it, Lloyd felt it worked quite well. He said:

> I think the work did finally accomplish what Smith wanted it to. This was really due to the lighting. Originally, we had one bank of light—that wasn't good. We tore it out and re-lit it, with shafts. Tony's plan for lighting would have been too dim. People would have barged into walls. Sure, we made compromises, but it worked.

The primary discrepancy which Smith felt existed between his initial conception of the work and its manifestation at Expo is expressed, aptly, in his words:

> I feel that it's a weakness in the piece that it appears so much like a building. I would rather have had...a greater diversity of spaces within, than the place actually has; and in that sense [more like] the way we think of a cave as hollowed out rather than something constructed as we would construct something with stones or other masonry elements. I don't think of it as masonry, although I know that most people do associate it with masonry.

In planning for the Los Angeles exhibition of the Expo works, we decided in April 1970 to give over an entire plaza-level gallery of the Special Exhibitions area for Smith's work. This comprises a larger area than allotted for any other work. Jane Livingston met with Smith, Lloyd, and Marcin in New York in April 1970 to discuss the sculpture for the Museum exhibition. It was understood by all of us that the work would be substantially different from the Expo structure. Tony was pleased at the prospect of having an extended space within which to work, chiefly because he wanted to design the structure as a freestanding entity, with several points of access. To demonstrate the kind of configuration the overall sculpture would have, he formed his hand Into a crabbed, or grappling position, fingers down and bent, wrist high. He commented that given a larger, freer space, he could accomplish a piece that would be much closer to his original cave idea than what was done at Expo. Smith and Bill Lloyd discussed the desirability of using a lighter and firmer material than corrugated cardboard, probably solid fiberboard, and avoiding lock joints. Thus it was agreed that both Tony and CCA would virtually begin again in designing and fabricating the piece for Los Angeles. We requested that Lloyd supervise the work's construction. As we prepare the catalog for press, Smith is working on his new model.

Jane Livingston

1 At one time. Smith considered titling the piece *Guadirikiri*, the name of a specific bat cave in Aruba. The work was never, however, definitively titled.

Victor Vasarely

Before going to Europe in the fall of 1968, Tuchman wrote to Victor Vasarely in Paris to inform him of the A&T project, mentioning specifically IBM, and to arrange an appointment to see the artist in his studio. By the time Tuchman met with the artist in October, Vasarely had written up a proposal for an artwork involving computer technology. The statement he formulated for us is as follows:

> From my youth, impregnated with the teachings of Bauhaus, I have felt a strong attraction for the linear and corpuscular structures. My past studies, namely *Tigres*, *Zebras*, *Martiens*, and *Echiquiers* bear witness.
>
> In 1953 begins my Kinetic period in black and white where the structures are freely developed. At this time, my thoughts are taken up with the idea of a binary plastic language which could be introduced into an electronic circuit.
>
> Towards 1960, my method of plastic units exists in its final form, a method I have developed in numerous works and writings. The application of this binary black and white, positive-negative system to the wider field of color and monochromic games revealed a mine of riches hitherto unsuspected. The Folklore Planetaire (1962), Permutational (1965) series and also the more recent 1966 structures based on the perspectivist and axonometric hexagon are representative of this.
>
> I now have in my possession a matchless primer for combining plastic units and I become more and more involved in my studies in cybernetics. In fact, as of this period all my works are programmated; colors, tones and forms all being reduced to a simple code.
>
> My attention is drawn to the possibility of creating an electronic machine working in collaboration with persons specialized in this field. What a formidable and costly enterprise! My first contacts are encouraging but it is difficult to get assistance and the delays are long.
>
> But what exactly is this proposed device? It is a large lumino-cybernetic screen that can send out millions of different color combinations. Practically speaking, in my mind I see a metallic

box about 312.5 cm × 312.5 cm with a depth of 10 to 20 cm varying according to necessity.

This box is subdivided into a network of 625 compartments each measuring 12.5 × 12.5 cm and each containing a circle 10 cm in diameter. This structure of squares as well as the individual circles therein should be made of thin solid metallic strips about 1/2 a millimeter thick. This infrastructure contains the multicolored electric device which functions by electronics and a complementary rheostat.

Start with six basic colors, RED, BLUE, GREEN, MAUVE, YELLOW and GREY. Each color is subdivided into 12 tones which makes 72 color variations. Each individual compartment must be able to put out alternatively the 72 color variations. It is the perfect isolation of the compartments (and of course the circles in them) and the opaque screen that renders the tones clearly and makes them visible. Taking as a base any one of my programmations, we are now able to recreate the work and a countless number of other compositions the machine proposes. In this way, the limitations due to the artist's method of working in a studio would be overcome.

There are enormous possibilities. Firstly, by filming the pictures projected on the screen, we can compile a repertory of composition references which is inexhaustible. The artist chooses among the best of the compositions the machine has proposed and then recreates the work in the form of a painting, a tapestry, a serigraph, a fresco, a stage setting, a setting for a film or television.

Without a doubt the most important of the possibilities the machine offers is that involving architectonic experimentations. The requirements are immense for the integration of plastic beauty in future constructions be it a question of urban or rural habitat or public monuments. Based on the Informatic and the Prospective, the prefabrication of polychrome elements for architecture cannot be decided without bringing in cybernetics. This will interest many technical branches such as construction, chemical dyes, synthetics without mentioning traditional materials such as metals, glass, cement or ceramics.

Lastly, thanks to our machine, we will be able to conduct human experiences of the highest importance in the domain of Experimental Psychology. In offering this spectacle to the masses and in asking them to express their preferences, we will obtain statistic truth of esthetic values of an entire population. From this time on, art can freely enter the general circuit of production-consumption.

Tuchman returned to Los Angeles at the end of October, and immediately contacted Dave Heggie, our contact man at IBM, about Vasarely's proposal. IBM's initial response to the Vasarely idea was to convey definite interest; we hoped they would send an engineer to Paris to talk directly with the artist, but they elected first to study the written statement in terms of a cost estimate for its realization before involving themselves more deeply. The figure they arrived at was about $2,000,000; this was regarded as prohibitively high, and they declined to pursue it further.

We then submitted the Vasarely proposal to RCA and Teledyne for study. RCA kept the matter pending for months without making a definite statement as to their possible willingness to execute such a work, and finally replied negatively, again on the basis of the expense represented. Teledyne analyzed the proposal carefully, and even suggested a way of executing the work which might be within reasonable technical means to pursue, but by the time this developed, that company was already in collaboration with Robert Rauschenberg.

By the fall of 1969, a year after our original connection had been made with Vasarely, we wrote to inform him finally that we were unable to elicit a commitment to fabricate his proposed work under A&T.

Andy Warhol

Rain Machine in Osaka, 1970

By the end of 1968 several of the corporations contracted to A&T produced or used laser equipment and thus had the capability of making holograms. We had received several proposals from younger artists wanting to work with holography, but these struck us as being potentially uninteresting, too-literal approaches to a technique which, by its very novelty and exoticism, presented pitfalls. Maurice Tuchman had for some time thought of this medium in connection with Andy Warhol. In February 1969, Warhol visited Los Angeles for several days and met with us to investigate corporations. We mentioned to him the notion of working with lasers to make 3D images, and Warhol was distinctly intrigued. At that time, there was an exhibition of self-portrait holograms by Bruce Nauman at the Nicholas Wilder Gallery which Warhol saw with us; Warhol seemed quite taken with Nauman's images, and this served for us as a reference point in visualizing the kind of effect he might pursue.

We arranged for Warhol to visit RCA's Burbank division. This proved rather unfruitful in terms of concrete media that might be explored. Just before Warhol returned to New York, he and his entourage toured Ampex's Redwood City facility accompanied by Dr. Charles Spitzer. The examples of holography available there were not particularly striking, especially in terms of scale. The most interesting aspect of that visit was a demonstration videotape recently produced by Ampex which showed various special effects in video cutting, etc.

On Warhol's return to New York, we sent him some literature on holography and annual reports from Ampex and Hewlett-Packard, which he read. Andy then had constructed, at his expense, a series of mock-ups with which some sort of 3D image might be combined. We had only a remote conception of what these were about until some weeks later when, in April 1969, Jane Livingston went to New York and saw the three mock-ups at Warhol's studio. In one of them, small polyethylene particles were agitated in a circular motion by air blowers to simulate whirling snowflakes; this was encased between two glass faces embedded in an approximately six-by-eight-foot rectangular wood frame. There was also a rain machine of similar size, but not enclosed by glass; it consisted of a simple pump system through which water circulated, falling in strands from apertures in a top section of pipe into a trough concealed beneath an artificial grass bed. The rain was side-lighted to create an effect of sparkling beads. There was also a wind machine, simply a wooden box encasing an air blower. Each of these was intended to work in conjunction with a 3D image; behind the rain, for example, would be a hologram or video screen; the snow machine would incorporate a holographic image in the center, through and around which the plastic flakes would circulate; the wind machine would vibrate and a 3D holographic sphere would vibrate as well. At this point Warhol had no set conviction about what the images might represent, and when pressed spoke vaguely about simple geometric shapes such as a sphere or cube.

By the time Warhol was really committed to the project, the only contracted corporation able or pre–pared to execute an elaborate holographic display—Hewlett-Packard—was already engaged in collaboration with Rockne Krebs. Even Hewlett-Packard could perhaps not have produced holograms in large enough scale for Andy's requirements. Thus we turned to investigate a medium recently seen on postcards—plastic 3D printing—with a view to substituting this kind of image for holography in Warhol's project.

In June 1969, Hal Glicksman, at the request of Maurice Tuchman, made a study of various 3D printing techniques. According to Hal's report, dated June 17, 1969:

> The first commercial process for 3D printing was developed by a Los Angeles inventor named Sam Leach who worked with Eastman Kodak and Hallmark cards. The first process was called PID—Printing in Dimension. Hallmark now holds the patents for the process and grants licenses under the name Visual Impact. In this process the image is printed on the back of lenticular plastic. The lenticular plastic is made by Rowland Products, Inc. Rowland also makes patterned plastic with the appearance of depth called Rowlux. They do not do any 3D printing themselves. Large, back-lit 3D pictures are made by several manufacturers under license from Visual Impact. They require a very thick lens and are very expensive. The image is usually a transparency on film, not printed. These are made by Three Dimensionals Inc., 3764 Beverly Blvd., L.A. 90004, Harvey Prever. (Mostly religious subjects sold door to door for $1.00 each.) This process is suited to unique items and large sizes. Prever claims to have worked three by six feet; also Victoria Productions, Veraview, New York.
>
> The Cowles Communications process is called Visual Panagraphics. Their representative is Stan Harper, presently in Boulder, Colorado, but will be at 5670 Wilshire Boulevard, California, after July 10. Harper also knows a great deal about the other processes and people in 3D. The Cowles process utilizes a similar camera, lenses, etc. to original Visual Impact process, but Cowles' process prints the picture directly on the magazine stock and then coats the image with plastic and embosses the lenticular screen on instead of a thick pasted on addition. It is also much cheaper in the million plus range of magazine printing. Stan Harper claims the next issue of *Venture* will be much higher quality because of new lenses and new 300 line screen. Harper will send samples and investigate the cost and feasibility of larger images. Cowles might be willing to sponsor us.… There are several Japanese 3D processes—all are variations of the Visual Impact (Hallmark) process. The Japanese cannot photograph in the U.S. because of U.S. Patents, but they can ship finished pictures to the U.S.…

In late June 1969, we made contact with Allen F. Hurlburt, Director of Design for Cowles Communications in New York; Hurlburt had worked with Warhol in the past and was in principle enthusiastic about joining with A&T to collaborate with Warhol. From the beginning of our contact with Hurlburt it was understood that the project would be considered for display at Expo. Warhol, for his part, was definitely interested in the 3D printing process, though it is of course entirely different from holography and required a rethinking of his work. Cowles joined A&T as a Sponsor Corporation in July.

Allen Hurlburt wrote to Andy Warhol on July 3, 1969:

> I have talked to Maurice Tuchman and he tells me that you are interested in working with us on the Art and Technology project.
>
> You have had a brief look at our Xograph facilities and whenever you are ready to make use of this equipment, I would like to work closely with you so that we can produce the effects you want. Cowles is also prepared to assist you in the construction and fabrication you may need to complete the art.

If it would be helpful for me to come to your studio and go over the material at any time, I would happy to do so.

On July 15, Hurlburt wrote to Maurice Tuchman:

Here's the signed contract for our involvement with you and Andy Warhol on Art and Technology.

I have seen Andy's construction (the rain machine) and both he and Harold Glicksman have had a look at our facilities here. We are interested and anxious to use these facilities in any way we can.

I am only concerned about one thing—the nature of Andy's project does involve outside construction which cannot be controlled by us. I would hope that we would only be required to spend a reasonable amount (a few thousand dollars) in this area. I don't wish to place any limitation on the potential of this work of art but I do hope there is a way of keeping this under control.

I am very excited about the possibilities of this collaboration and we will make every effort to bring it to a successful conclusion.

By August, when the collaboration had been officially underway for about a month, Warhol and Hurlburt had still not decided upon what kind of image should be depicted. Andy asked us to suggest ideas for images to him. The notion of using a flower, or flowers, to be photographed and repeated serially, was presented to Andy and Hurlburt. Andy liked the idea and decided to follow it through. Cowles then photographed a number of colored, plastic flowers against beds of artificial grass and plastic foliage, in various formats measuring about four by six inches. In September 1969, a meeting was held at the Cowles New York office with Hurlburt, Warhol, David Sutton (representing the USIA Expo Design Team) and us. The 3D flower photos made by Cowles for Andy to compare were shown, and one of them—four daisies against green foliage—was selected more or less on the basis of communal preference, with Warhol's agreement.

The following memo was sent September 19 from Allen Hurlburt to Messrs. Andy Warhol, Maurice Tuchman, Jack Masey, Ivan Chermayeff, Don Dorming, Ron Glazer, David Sutton:

Subject: Art and Technology Meeting

Held Sept. 18, 1969 at Cowles Communications, Inc.

This meeting was held to review the progress on the A&T project, and to determine future plans in assisting Andy Warhol in the development of an art work for the Los Angeles County Museum of Art program, and the exhibition to take place at Expo 70 in Osaka, Japan.

Several photos taken in the 3D process were exhibited and one showing a group of four daisies was selected. It was agreed that this image would be reproduced in quantity.

It was generally agreed that the images should be mounted on a curved panel behind the curtain of rain provided by the rain machine. There was some discussion about three options for the construction of final work of art. These were:
1 . Construction of a mock-up In New York to be later duplicated in Osaka.
2. Determination of a plan by experimentation here but without a mock-up.
3. The development of a total construction in New York that would be transportable to Osaka and wherever else the art work might be exhibited.

There was general agreement that the third alternative was best if problems such as costs, construction and mobility could be solved.
It was agreed that Mr. Masey and Mr. Sutton would pursue the feasibility of this approach and procure estimates of its cost.

In the meantime, Cowles Communications, Inc. has agreed to cover the cost and assume the risk of 3D reproductions. We must receive and approve an estimated cost of construction.

The rain machine through which the panels of 3D images would be viewed, it was then agreed, would be contracted to the New York firm Today's Displays to be designed and built; Today's Displays would also design the panels themselves and secure the Cowles images to them.

This letter was sent from Joe Grunwald of Today's Displays to Maurice Tuchman, Sept. 26, 1969:

As explained to me by Mr. Warhol and Mr. Sutton, there are three possible interpretations of the

> basic idea, the most economical of which would be a straight wall approximately 12' high × approx. 18' long, covered with three-dimensional photos provided to us.
>
> For this wall we have budgeted the amount of \$2,000 to \$3,000.
>
> The next possibility would be a curved wall, approx. 12' high and approx. 25' long. Again this wall would be covered with three-dimensional photographs provided to us. The budget for this would be \$3,000 to \$4,000.
>
> The deluxe possibility would be to cover both walls of the 21' triangle or a total of 42', again 12' high, with zigzags of approx. 11˝ depth. These zigzags to be covered with three-dimensional photos provided to us. The budget for this would be \$7,000 to \$8,000.
>
> In addition to the above, is the "rain machine" which would cover the 21' front of the area. Again there are various possibilities of realizing the basic idea. A minimum budget for this would be approx. \$5,000.
>
> However, due to complexities of possible requirements in water pressure, use of one, two or three possible rows of jets and quantity of water involved, this item could go as high as \$8,000–10,000.

At various stages in the development of Warhol's project with Cowles, Andy prompted Hurlburt, Grunwald and us to develop alternative possibilities for the work. In each case—in the development of the photographic images, the rain machine, and the constructed environment for these—Andy would view the alternatives and choose among them. Andy continually placed us in the position of weighing the merits and disadvantages of numerous possibilities. Sometimes he would discard altogether our proposal—as for example, in the case of the rain machine, which we visualized as an enclosed and sophisticated mechanism, and which he decided should be presented crudely.

In November 1969, Maurice Tuchman met in New York at the St. Moritz with Warhol and Joe Grunwald. It was decided not to adopt any of the three proposals outlined in Grunwald's September 26 letter regarding the shape and size of the rear panel, but instead to build five separate panels, each four by eight feet. The key question was how to dispose the panels when the work was installed. Warhol was encouraged to make a series of drawings showing several possible arrangements of the panels, but he resisted having to work that way. He finally said to Tuchman that he would prefer having the five units placed in a *random* arrangement, or, failing that, in simply a flat plane, abutting each other. It was agreed that Tuchman would use his own discretion at installation time in placing the panels. The other important factor discussed in that meeting involved the rain machine. Warhol favored the idea of producing two parallel layers of water, and having the water move in a swishing manner, side to side, as opposed to creating a single screen of water pouring from a row of evenly spaced nozzles. Grunwald planned accordingly to execute the more elaborate, two-layered system.

It occurred to Warhol at this time that he liked the idea of simply displaying the rain-producing mechanism forthrightly, rather than encasing the pipes and trough in a wooden structure, as he had in his earlier small model.

One of the artist's reasons for this decision had to do with his attitude about the 3D printed images as such. He had said to Tuchman, "You know, this 3D process isn't all that glamorous or new or exciting." He wanted, therefore, to present the images in conjunction with a naked, unembellished, and inelegant structure so that they would *reveal themselves*—maybe perversely—in their rather vulgar and certainly imperfect quality. His original idea for the holograms, to be seen hazily through water, or snowflakes, or vibrating and out of focus, held over in his approach to the 3D printed images: he had wanted, in his word, a "ghostly" effect. However, the reality of the situation by the time the daisy pictures and rain machine were visualized together, fell short of this vision of ghostliness. Warhol thus adapted his approach to a changed esthetic.

Based on these decisions Today's Displays began work on the project. We felt it would have been helpful for them to build a mock-up for Andy's approval before constructing the final mechanism, but there was no time to do this and meet the Expo deadline.

Perhaps the most important decisions determining the work's final appearance in the U.S. Pavilion at Expo were made not by Warhol but by Tuchman, the

Expo Design Team members, and some of the other artists in the show. The entire installation operation was characterized by a sense of crisis, and there were moments when the piece seemed simply destined to ignominious failure. In the end, somehow, it worked: many people, and particularly the artists who were there installing their own pieces, felt the Warhol to be one of the most compelling works in the exhibition because of its strangely tough and eccentric quality. Robert Whitman commented that "of course Andy's forcing everyone into the act"; the work itself, when completed, made that conspicuously evident, and yet it was unmistakably Warhol. When it was rumored at one point just before the opening of Expo that the work might be taken out of the show, as was suggested by several of the Expo Designers and by a visiting critic who was conversant with Warhol's oeuvre, the American artists who by this time knew the piece intimately objected strenuously.

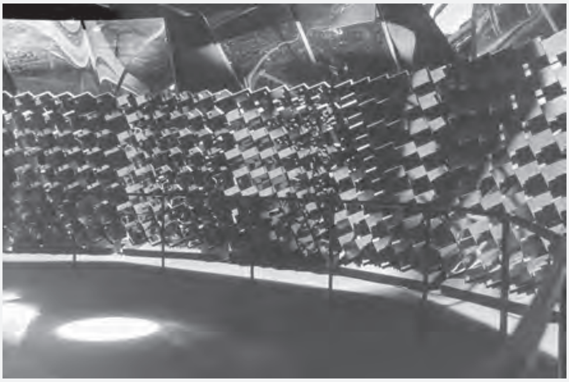
Virtually every stage in the assembling of the work was problematic. The question of how best to distribute the five image-faced panels presented major difficulties. A "random" placement was tried and failed totally. At one point, they were to be arranged horizontally, one atop the other, in a single, flat plane; only four could be accommodated in the space, but this was judged to be the unavoidable solution, since the purpose was to de-emphasize a certain unevenness in the rows of images caused by faulty gluing. However, something seemed profoundly amiss, and was. The effect of three-dimensionality would have been completely lost, since the parallel, raised striations in the plastic segments, which create the visual illusion of depth, cease to function optically when turned 90 degrees. Other alternatives were tried, and finally the panels were placed vertically, side by side, in a flat plane. The entire unit of adjacent panels was raised off the ground, at Tuchman's suggestion, to create the effect of a hovering field of flowers.

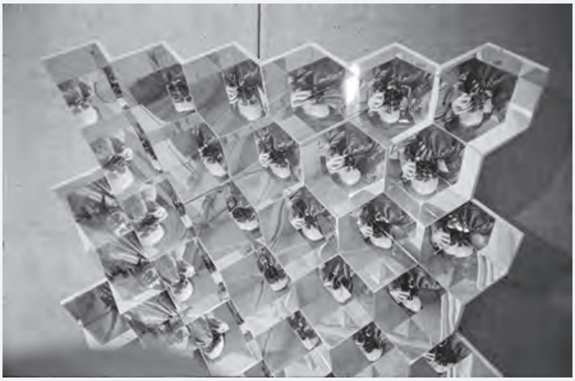
The lighting of the work was extremely difficult. In order to disguise the disturbing unevenness caused by the slight pulling away from the panel surface of the edge of each segment, light could not fall directly on the panels. To illuminate the falling water ideally, the lights should have been mounted in two rows facing each other on either side of the sheets of rain, but this had to be avoided to prohibit an overflow of light from interfering disastrously with Lichtenstein's screens in the adjacent area. Finally the rain was illuminated from the top. The water thus could not be made to sparkle as intensely as might have been intended by the artist, based, at least, on his original rain model.

It was not realized until the time of installation at Expo that the illusion of depth in the photographic images was apparent only at a distance no greater than from eight to ten feet. This understandably detracted from the impact of the work. An even more significant problem, however, was the scale of the images. This was never resolved satisfactorily, and it was determined that in reconstructing the work for the Museum exhibition, each identical image would depict not four but one greatly enlarged flower. Moreover, in developing new images for the second work, Cowles recommended that the 3D effect be technically improved to allow the illusion to be discerned from a much greater distance—from eight to about twenty feet away.

Jane Livingston

Robert Whitman





top
John Forkner and Robert Whitman (right) examining mirror effects, 1969

middle
Installation at Expo 70, Osaka

bottom
Sample construction of corner cube reflectors, 1969

In October 1968, after Philco-Ford had signed a Sponsor contract (they later became a Patron Sponsor with a $7000 grant from the Ford Foundation), we visited their Aeronutronics Division at Newport Beach. Hugh Jessup and Dick Dickson of the Public Affairs Office described the defense research in radar, sensors and image processing carried on at the Newport facilities. We toured chemistry, electro-optics and biophysics laboratories and met two physicists, John Forkner and Michael Doyle, who were enthusiastic about the A&T program and eager to work with an artist on a collaborative venture.

They were helpful in suggesting areas and materials for potential use in an esthetic context: Doyle showed us several laser displays and liquid crystals, a heat-sensitive, viscous material which reacts to temperature change by shifting from reddish pearlescent hues to deep blues and greens; Forkner told us of several optical coating machines available in his section.

During the next few months we considered a number of possible artists for Philco-Ford: John McCracken (who toured the facility), Robert Morris and Bruce Nauman. In February, we invited Robert Whitman to visit the Aeronutronics Division at Newport Beach.

This visit is summarized in the following memo written from Gail Scott to Maurice Tuchman on February 11, 1969:

> Gail Scott went with Robert Whitman to Philco-Ford. Met with Dick Dickson, Mike Doyle, and Eli Reisman (another engineer).
>
> Bob has had experience with E.A.T. [Experiments in Art and Technology] and is looking for a collaborative situation in which he would have extensive technical assistance and the "TA" with whom he works would do all the engineering, programming etc. He has no preconceived idea for a project but wants to work *with* someone who is mutually stimulating. In other words he's looking for the *right people* with whom he could work, rather than (as with Bob Morris) wanting certain facilities for a specific problem. Whitman was, of course, interested in their facilities and equipment, etc., but the contact people seem to be crucial for him.
>
> Mike Doyle was (as usual) responsive and seemed interested in Whitman's description of *Pond* (at the

> Jewish Museum), Bob might want to use liquid crystals in some sort of environment which would also include mylar, mirrors, sound etc.

John Forkner, the other physicist with whom we had talked on our first visit, was not available that day to meet Whitman, but we had advised Bob of Forkner's expressed interest in the program. Largely on the basis of his interview with Mike Doyle, Whitman decided that he would like to pursue the possibility of a collaborative effort at Philco-Ford. Although he had no specific project in mind, we felt confident, given his past work and experience with E.A.T. and considering the scientists we had already met at the Newport division, that it would be a productive match. The company accepted him in residence without insisting on a project proposal in advance. In March he signed the contract and on April 21 arrived in Los Angeles; he promptly located a house for himself and his family in Balboa and went to work.

In an interview recorded some months after his residence at Aeronutronics, Whitman recalled his first weeks there:

> I went out to Philco-Ford and after talking to them briefly, they introduced me to all the guys with beards. John Forkner was one of them; he had the longest beard.... So we talked. I had been interested in optical types of situations before, and so we had some basic community of interest to get started with.

Before meeting Forkner, Whitman had not been especially interested in executing another project in optics, following his recently completed *Pond*, which incorporated pulsating mirrors. Whitman later remarked, "Both of us wanted to escalate out of something we had already done but we naturally drifted back into optics." As they talked, they became engrossed in certain optical problems which are described by Forkner in an article on his project with Whitman, written for the *Journal of Applied Optics*:

> The following fragmentary ideas he [Whitman] was playing with at that time indicated some of the directions in which he was searching: a method of focusing ultrasonic waves on a special wall so that an audible sound would seem to emanate from a localized area: a room environment programmed to react to the presence of people and to respond in a feedback manner; ways of using real optical images to lead the viewer to re-examine familiar objects such as his own face. The ideas had some interesting repercussions. Commenting on the feedback room environment, one of our scientists remarked somewhat caustically that it would make the viewer nothing but a robot. Being immersed in the idea. Bob hadn't seen the function of the room from this very human point of view, and was delighted to have a criticism of this depth. As a result, he re-directed his thinking about the whole problem. The real image ideas fell into my area of knowledge, as optical engineer, and I recall being puzzled by Bob's fascination with this seemingly trivial phenomenon.

Whitman later explained this fascination with such effects:

> I've always been interested in ghosts and spirits and weird things. I've been trying to do that for a long time—ethereal images. The whole thing about ethereal images and real images is that they are natural, and it's only just recently that the kind of technologies have been available that could do that. Before, I was doing films which had something to do with that. Then I got into the laser thing from doing movies, and I found by using a laser I could do it much better and easier than I could with movies. Then I found what I could do with optics—just another step along the line.

Forkner proceeded to experiment along the lines of Whitman's thinking. His article continues:

> One day, having found a large spherical mirror of fair quality, I set this up on my desk and reached my hand toward the center of curvature of the mirror. The very realistic, *three-dimensional* image of my hand that seemed to come out of the mirror was so startling that I immediately showed this incredible effect to my colleagues who were equally amazed. In retrospect, what is surprising is my surprise. Real images as a phenomena are so venerable that the most ancient physics texts (natural Philosophy) show experiments to demonstrate the effect— including the famous 'rose in a vase' exhibit seen in many science museums. The difference, I think, results from my hand being a moving rather than a

> stationary object and the fact that it was my hand (the effect of touching the image of your forefinger without receiving a touch sensation comes as a complete surprise). This little experiment proved to be crucial from my point of view, because, for the first time, I began to understand what the artist was trying to do. This turned out to be the actual beginning of the collaboration, because Bob was also now able to formulate technical questions resulting from evolving artistic ideas. One weekend, shortly after that, his thinking had crystallized sufficiently so that he could state a definite problem. In an effort to restructure space in a visually exciting way Bob wanted an optical system that would image objects as though they were turned inside out—pseudoscopic imagery. He was especially intrigued by the possibility of seeing your face inside-out. Never having worked on this problem before, I wasn't sure that it could be done, but I remembered the pseudoscopic property of certain holographic images and realized there was at least some basis for the idea.

Despite his doubts, Forkner continued to investigate the phenomenon of pseudoscopic imagery. While driving home from work one day he was struck by a possible method of creating the effect he envisioned. Noticing the red reflectors on the back of a car, he reasoned that he might be able to produce a pseudoscopic image using a series of small corner-shaped reflectors (similar in principle to those on automobile taillights) with a beam-splitting mirror to extract the desired image. In an attempt to make such a corner-reflector device, and incidentally to call attention to the scientific uses which might arise from the project, Forkner sent the following memo to his Philco-Ford supervisor:

> If the concept proves feasible it might be constructed on a larger scale as a room with one wall covered with molded, plastic, corner-reflector, mirror tiles and a large Mylar film, beam splitting mirror stretched diagonally across the room. Someone standing at one door of the room would see a real image of a person standing at a door in the adjacent wall, and the image would appear to be only a few feet from him and turned inside out! It should be a really startling illusion, and would be especially interesting technically due to the relation to current work in holography.
>
> To construct a small scale version of the device in order to check feasibility, and to investigate this illusion—which I suspect has never been observed before with real physical objects (holograms are only static, photographic images)—it is proposed to make a special, accurate mold from which a number of plastic corner reflector plates can be generated. I have done some initial design investigation including ray tracing and estimating resolution (diffraction effects, tolerances) and from this arrived at the tool design shown in the attached sketch. This tool can be made in the research model shop, preferably by one of the better model makers because of the accuracy required. The plastics lab could then use the tool to emboss plexiglass or similar acrylic sheet into the desired reflector plates.

The results of his first attempts to construct this device were unsatisfactory, and Forkner decided instead to try to locate a commercially made product. After considerable scouting and detective work, he found a reflecting device (manufactured by the Stimsonite Division of the Elastic Stop Nut Company) which, unlike most similar devices, had small enough corner cubes for his purposes, with the required accuracy of reflection. As Forkner's account explains:

> Samples were quickly procured and after experimenting with methods of scanning to suppress the cellular pattern of the array (using a rotating turntable), we actually were able to see live pseudoscopic images. Using even smaller corner cubes (about .060 inch), the resolution improved to the point where cups could be turned inside-out and a spherical ball appeared as a concave hollow space. We were shocked, however to find that very familiar objects suchas a hand, would not invert—except occasionally in an ambiguous way. With the hand oriented so that your thumb was aligned in front of the gap between two fingers, the top part of the thumb often appeared to be *behind* the fingers and looked as though it were no longer connected to the lower part. This strange result had also been observed by Wheatstone, we later found out, and is evidently intimately connected with the psychology of visual perception and pattern recognition by which the mind reconstructs the object, despite what the eye actually sees. Thus the hope of seeing depth-inverted faces seemed remote.

> This rather fundamental difficulty as well as the potential cost of constructing a wall size pseudoscopic mirror, led us to temporarily set aside this idea in order to concentrate on the possibilities of real images, which we had played with earlier.

In experimenting with the real image effect, Forkner set up a somewhat primitive arrangement consisting of a flat short-focus mirror and a long-focus spherical mirror to observe the real image of one's face in side view. The experiment proved startling; to see the reflection of one's own face, viewed from the side and appearing to float in space as a solid image, is a most disconcerting phenomenon. Extending the principle of this effect, Whitman reasoned that to present familiar inanimate objects in this extraordinary optical context would be equally disorienting and compelling. He and Forkner also discovered that heat radiated by an electric heater could be focused to coincide with the precise location of the optical image, so that the "ghost" image of the heater, hovering in space, would actually be hot to the touch.

During the first three weeks of June, while Forkner proceeded with his experiments, Whitman designed the room in which the optical effects would be experienced. The environment was to consist of a spiral shaped, enclosed space twenty-five by thirty feet in dimension. As Forkner says in his article:

> Within this space he would encounter ten real-image displays as follows: The electric-range heater we experimented with earlier, as well as the ice cube display; an image of a microphone, the counterpart of which would be electrically connected through sound-modifying circuitry to a transistor radio, which in turn would be optically imaged at another part of the room (thus exploiting the sound-focusing properties of curved mirrors); a rag; a continuously flowing column of water, viewed from below; a face mask; and, finally, a pair of locations utilizing the mutual imaging of two viewers' faces through the medium of the pseudoscopic, corner-reflector array mechanism—ten display situations in all. To further complicate matters, Bob wanted most of the displays to have a zoom feature in which the real images would appear initially to be remote from the viewer and then rather quickly to rush forward and appear to pass through him. In this, Bob hoped to use the idea of the varifocal mirror employed in an earlier work, *Pond*, in which he collaborated with Eric Rawson of Bell Telephone Laboratories. He wanted these real-image displays to appear in the space above a special wall consisting of an array of six inch corner cube reflectors extending from the floor of the room to about six feet above this level. The viewer would see himself in these corner reflectors illuminated under chance circumstances by one of a number of parallel columns of light emanating from large, Fresnel lenses in the ceiling of the room. He would see literally thousands of images of his face (the size of the reflectors and the viewing distance being such as to so limit his view), inverted and extending horizontally over the entire extent of his field of vision.

By the end of June the design for an optical environment was completed and drawn up in blueprint. It was immensely ambitious and would be costly to construct and install. However, we felt that the project was formidably impressive and were most anxious to see it realized.

To the end of encouraging Philco-Ford to carry out its construction, on June 25 Maurice Tuchman, Gail Scott, and Dr. Richard Feynman went to Newport to meet with John Lawson, President of the Philco-Ford Aeronutronics Division. Forkner and Whitman attended the meeting to present and explain the designs they had drawn. Tuchman stressed the technical and esthetic breakthroughs already achieved by the project; Dr. Feynman commented favorably on certain of its technical aspects and expressed interest in the visual phenomenon. Despite our efforts, Lawson declined to commit additional Philco-Ford funds to build the room. His decision was final and did not allow for negotiation. Needless to say, we were intensely disappointed. Four days later Whitman returned to New York, but before he left we agreed to seek technical and financial support elsewhere, primarily from funds provided by our Benefactor corporations.

We were seriously considering the work for the Expo show. After several discussions with USIA designers the plans were extensively revised. The spiral-shaped room which accommodated only one entrance-exit opening was not practical for the Fair situation with its massive crowds. Forkner and Whitman agreed on an alternative design for a more open, semi-circular layout with six (later reduced to five) large mirrors and faced with 1,000 corner reflectors running along the lower wall surface.

Over the summer Forkner continued to study the concept of the large *spherical* mirrors, attempting to find a method of achieving the desired optical effect without resorting to expensive polished glass processing. He worked with reflective Mylar, stretched over a circular frame and drawn into a concave shape with a partial vacuum; this method at first produced excessive distortions in the reflected image, "due partially to non-uniform tensioning of the Mylar during mounting and also due to more fundamental non-linear stress distributions inherent in the geometry." Abandoning the use of spherical mirrors, Forkner experimented instead with a pair of cylindrical mirrors to generate the same focusing effect as a sphere. Forkner explains:

> I reasoned that since two cylindrical lenses can be crossed to approximate a spherically symmetrical lens, an analogous arrangement of mirrors should be possible. The usual problem, of course, is that mirrors tend to get in the way of each other. I tried several configurations to get around this, and the best seemed to be two circular cylindrical mirrors. The focal length for this arrangement is the same in both planes, and aberrations are minimized. In fact, when I subsequently ray-traced the system, the results indicated that the size of the image of a point source was limited only by the "spherical aberration" of the upper mirror in the horizontal plane, while the "cross-talk" aberration in the vertical plane was quite small, even for large apertures. I was surprised that this system could theoretically perform this well—it would be more than adequate for our purpose.

After much trial and error experimentation, Forkner evolved a means for constructing the cylindrical frames and a method for applying the reflective Mylar. The two sections of mirror frames (each measuring about five by seven feet) would consist of curved plywood ribs over which a plywood sheet would be glued. The surface would be sanded with a specially made fitted tool to achieve a perfectly smooth surface. Over this, one-eighth-inch metalized acrylic sheets would be fastened with double-faced masking tape. Forkner made a working model for this plan.

In October, after searching for a means to construct the cylinder and corner-reflector mirrors, a member of the USIA's design team recommended that we approach a New York-based company called Today's Displays, an installation and display company in New York. The firm's president Joseph Grunwald visited the Philco-Ford plant to see Forkner's model and agreed to undertake the project, following the above-described procedure. Today's Displays was contracted to build the corner mirrors and the large curved mirrors, while Forkner continued to develop and construct the varifocal mirrors, control units, and vacuum pumps. This equipment was to be placed out of sight above a false ceiling in the installation. The varifocal mirrors served as an intermediary directing device between each object and the large cylindrical mirrors. Without them the real objects could not have been hidden from view. Philco-Ford now limited its support to allowing Forkner the time and materials needed to complete this part of the project.

Because of limited available funds, it was decided to abandon temporarily the one mirror which would produce the pseudoscopic device; we hoped to find some means to include it in the exhibition at the Museum. At this point, it seems likely that we will be able to do so.

As reports came in from Today's Displays, Forkner expressed concern that the mirrors would not be satisfactory and stressed the need for precision in building the structure support. He had already made several trips East to consult with Whitman on various developments in the project, and in November he went to New York to inspect the work in progress at Today's Displays. As he had feared, the support structures were inadequate—the reflected image was not nearly precise enough. Forkner telephoned Maurice Tuchman to say that the optical effect simply would not work and that Today's Displays should cease working on the units.

This was again a disheartening setback, and we felt we had reached an impasse. But with characteristic persistence and ingenuity, Forkner proceeded to develop yet another construction method. He wrote:

> When I settled down from the shock of this new failure, I realized that my own assessment of the required accuracy of the mirrors was too optimistic.... I reasoned that at a point when you examine a real image, you are actually looking at two spots on the mirror (whether spherical or cylindrical), and these spots have a diameter

> and a separation determined by eye separation and pupil diameter and the ratio of observer to image and observer to mirror distances. The diameter of the instantaneous spot actually used on the mirror is small enough (less than 1˝) so that accuracy of curvature is fairly easy to hold in this case. The really difficult problem comes from the need to hold accuracy over the much larger eye separation distance (about 10˝ at the mirror, typically). Errors in this instance cause distortions in the apparent depth dimension of the image. The distortions in the image shape which these large scale errors also cause are even more serious since they appear so obvious when you look at the images. To get a feeling for the magnitude involved, I considered an object whose largest dimension is about 10˝ and which is imaged at unity magnification. I assumed that a bulge of about one-fourth over a three inch portion of this image might be acceptable. Assuming an eleven foot effective radius of curvature of the mirror, this corresponds to an angular error of about 1.8 milliradions. The three inches in the image dimension corresponds to a ten inch span on the mirror and over this span the assumed angular error is equivalent to a deviation from a true circular curve of about .002 inches. The way I interpreted this result was that if you use a three-leg spherometer with a span of ten inches to measure surface errors, the maximum allowable deviation as shown by the dial indicator should be no more than double the calculated deviation of .004 inches. Notice that this is a smoothness requirement and does not imply that the radius of curvature of the mirrors need be held to tolerances of this magnitude—which would have made the project nearly impossible. With this new insight into the tolerances needed for an acceptable image, I began to understand the difficulty we were having in construction.

In order for Forkner to achieve the degree of precision described above, he decided to substitute masonite for the plywood surface. (The softer material could be ground much more smoothly than wood.) This was done on the four foot model and the results were encouraging. He invited us to view a test set-up. Because of USIA deadlines, we had been waiting anxiously for some breakthrough, and as a result of the successful test situation, we were now optimistic that the project could progress. Building the model had demonstrated that the construction theory would work; however, only one month remained in which to build five double sets of huge mirrors before all materials had to be shipped to Japan.

To accomplish this immense task Forkner enlisted the help of his church group, the Laguna Beach Unitarian Fellowship. They borrowed building space in an empty Laguna Beach grocery store and began work under his direction, with the technical help of George Quinn, a man of great professional versatility who supervised the operation. The Fellowship members were assisted by various friends and whoever else wandered into the store out of curiosity and was willing to help. The history of what transpired in that Laguna Beach store between January 2 and February 9 constitutes an important part of the Whitman-Forkner saga. It was a Herculean undertaking, as is indicated in John Forkner's detailed account which follows this discussion.[1]

After witnessing this extraordinary cooperative endeavor, we agreed to recompense George Quinn for his supervisory assistance, to defray the cost of certain carpentry work that had to be subcontracted, and to pay a rental fee for the building space.

The mirror frames, the internal mechanism (vacuum pumps, varifocal mirrors, and special lights), and the corner mirrors from Today's Displays were shipped to Osaka in early February. Philco-Ford authorized a leave of absence for Forkner to supervise installation at Expo. The installation of the environment was a tedious process. It would have been impossible to accomplish without Forkner's thorough knowledge of every stage in the operation. Whitman was involved in E.A.T.'s construction of the Pepsi Cola Pavilion at Expo and depended completely on Forkner to execute his A&T piece.

The Expo spectator, upon entering Whitman's darkened environment and standing under one of twenty-four ceiling light fixtures (each a 100-watt, incandescent lamp located at the focus of a ten-inch diameter plastic Fresnel lens), saw one thousand images of his own face reflected in the corner mirrors. Looking up, he saw, as he moved across the area, five successive pairs of images projected by each of the hidden cylinder mirror systems. In other words, the "ghost" image of each object would suddenly appear in space as one of the miniature spotlights in the ceiling switched on; the image (unlike an ordinary mirror reflection) was seemingly detached from any reflecting surface, and as the mirrors began to pulsate, would advance toward the viewer, then disappear as the light shut off.

The items selected by Whitman were all familiar, common objects—an assortment of organic and man-made things: a clock, an artificial fern, a pear, a cabbage, an electric drill, a brick, a knife, a wad of crumpled paper, and a tank of live goldfish. The experience resulting from this unique combination of optical phenomena is one of mysterious visual disorientation. This sensation is mainly owing to the incongruity between the type of images used—the intimacy of one's own reflection or the utter familiarness of the objects—and the feeling of unreality occurring in the observed situation. To see one thousand images of one's own face, discrete and isolated from the surrounding persons, is in itself startling; but coupled with the evanescent appearance and disappearance of strangely hovering objects, the experience becomes even more extraordinary.

At the time of this writing, plans are underway to develop the environment for exhibition at the Museum through structural and technical modifications. The pseudoscopic device will probably be included as one of the five or six types of image projections. In addition Whitman and Forkner are re-designing the room itself so that the lower section (the corner-reflector mirrors) and upper area (the object projecting mirrors) will combine to effect a more unified visual experience. One way to accomplish an increased coherence will be the transformation of each object into a second form; for example, a cabbage could appear and seem to move toward the viewer; as it disappeared it would gradually change into the shape of an electric drill.

Gail R. Scott

1 See *A Report on the Art and Technology Program of the Los Angeles County Museum of Art 1967–1971* (Los Angeles County Museum of Art, 1971), 353–58.

Participating Corporations, 1967–71

American Cement Corporation
American Standard
Ampex Corporation
Bank of America
Container Corporation of America
Cowles Communications, Inc. Cummins Engine Company, Inc.
Dart Industries
Eldon Industries, Inc.
The Garrett Corporation, Life Sciences Dept.
Gemini G.E.L.
General Electric
Hall Inc. Surgical Systems
Heath and Company
Hewlett-Packard Company
Hudson Institute
Information International
International Business Machines Corporation
International Chemical & Nuclear Corporation
Jet Propulsion Laboratory
Kaiser Steel Corporation
Kleiner-Bell Foundation
Lear Siegler, Inc.
Litton Industries, Inc.
Lockheed Aircraft Corporation
Mifran-Bowman Corporation
Norris Industries
North American Rockwell Corporation
Pan American World Airways
Philco-Ford Corporation
The RAND Corporation
RCA
Teledyne, Inc.
Times Mirror Foundation
TRW Systems Group of TRW, Inc.
Twentieth Century-Fox Film Corporation
Universal City Studios, Inc.
Universal Television Company
WED Enterprises, Inc.
Wyle Laboratories

AGREEMENT

IT IS HEREBY AGREED by and between ______________________________________
(hereinafter Patron Sponsor) and MUSEUM ASSOCIATES, INC. (hereinafter Museum), as follows:

1. Museum operates the Los Angeles County Museum of Art. Museum is presently planning an exhibition tentatively entitled "Art and Technology" to be held at the Los Angeles County Museum of Art in the spring of 1970.

2. Patron Sponsor desires to participate in and assist Museum in the development of said exhibition.

3. Museum has advised Patron Sponsor that Museum will proceed with the development of said exhibition if it obtains agreements, comparable to this agreement, with no less than ten Patron Sponsors (or with other types of sponsors representing the monetary and resource equivalent thereof).

4. Museum has advised Patron Sponsor (a) that any work of art created in the development of said exhibition may, in the sole discretion of Museum, be deemed inappropriate for inclusion in said exhibition, and (b) that Museum may, in its sole discretion, conclude that the totality of works created in the development of said exhibition make it inappropriate to hold said exhibition. Patron Sponsor is aware that in the event of either of these alternatives, or if for any other reason except for failure to obtain ten Patron Sponsors (or the equivalent) the exhibition is not held, or work undertaken or produced at Patron Sponsor's facility is not completed or exhibited, Patron Sponsor is not entitled to a refund of any money or services or other things of value which it has expended in connection with said exhibition.

5. Patron Sponsor agrees to contribute $7,000, of which one-half will be paid at the time of execution of this Agreement but no later than __________.

1.

The remaining one-half will be due on or before ____________. In addition, Patron Sponsor agrees to commit sufficient materials, working space and technical assistance for a three-month period or until completion of the artistic project (as hereinafter defined), whichever is shorter, at a time to be specified by Museum. Said commitment of materials, working space and technical assistance, together with the precise time, will be subject to mutual agreement between Museum and Patron Sponsor, but each agrees to use its best efforts to reach such agreement.

6. Museum, in its sole discretion, will select an artist and an artistic project for development and execution at the facility of and in cooperation with Patron Sponsor.

7. Museum, in its sole discretion, may select and exhibit at the Los Angeles County Museum of Art any or all works of art created at Patron Sponsor's facility as a result of said artistic project. Said exhibition may be scheduled at any time during the year 1970. In addition, Museum may arrange for the exhibition of any of said works of art at other museums or public exhibitions in the United States or abroad at any time until December 31, 1972. Patron Sponsor will cooperate with Museum in any such exhibition or exhibitions and will not display any of said works of art before December 31, 1972 without the prior written consent of Museum.

8. The principal work of art created as a consequence of any artistic project at the facility of Patron Sponsor will, at the option of Patron Sponsor and without further payment, become the property of Patron Sponsor at the conclusion of the exhibition at the Los Angeles County Museum of Art (or at the time of notification to Patron Sponsor that said work will not be exhibited). In the event Patron Sponsor does not choose so to acquire any such work, then it will become the property of the artist creating it. If either Patron Sponsor or the artist wishes to make a gift of said work to Museum, Museum may, in its sole discretion, elect to accept or reject said gift.

2.

9. In the event of a gift to Museum of any work of art, Museum will retain the option to donate or lend said work to any other museum or public institution, or, after a five-year interval, to sell or otherwise dispose of said work to anyone. Museum will further retain the right to exhibit or not exhibit any such gift.

10. If an artist creates additional works of art (beyond the "principal work" described in paragraph 8), the artist will retain ownership of any such additional works unless they are preparatory to or an integral part of said principal work, in which case their ownership will be subject to the provisions of paragraph 8.

11. Museum will carry liability insurance on artists during the period that they are working at the facility of Patron Sponsor. During such time, they will be regarded as "consultants" to Museum.

12. Museum will not insure any works of art produced in connection with any artistic project, except liability insurance for injury or damage caused by said works of art while they are in transit to or on display at the Los Angeles County Museum of Art.

13. All arrangements and charges for the moving of objects from Patron Sponsor's facility to the Los Angeles County Museum of Art (or to other museums or exhibitions) and return to point of origin shall be the responsibility of Museum. Any moving anywhere else shall be the responsibility of the person requesting said movement. Patron Sponsor agrees to store any works created in connection with said artistic project at its sole expense, until Museum requests that said works be moved to the Los Angeles County Museum of Art. In the event Museum makes no such request on or before the opening date of the exhibition, Patron Sponsor may make its own arrangements for disposition of said remaining works at its own expense. If an artist becomes the owner of any works, shipment from Patron Sponsor's facility or from the Los Angeles County Museum of Art is the

artist's obligation and must be accomplished promptly upon conclusion of said exhibition or the artist will have no further rights to any such work and neither Patron Sponsor nor Museum will have any obligation to return or account for any such work to the artist.

14. Patron Sponsor agrees that any works in the process of creation or created at its facility, together with said facility, may be photographed and reproduced in a catalog, press releases, slides or other photographic materials, and that all such photographic materials will be the property of Museum. Patron Sponsor further agrees that all matters relating to publicity for said exhibition, said artistic project, or the artist involved will be under the control of Museum, and that any publicity to be released by Patron Sponsor must be approved in advance by Museum. Museum will, in its sole discretion, give Patron Sponsor appropriate credit and recognition in any exhibition display, catalog or publicity.

15. All notices and other instruments which may be or are required to be given or made by Patron Sponsor or Museum to each other shall be in writing. All notices and other instruments by Patron Sponsor to Museum shall be sent by registered mail, postage prepaid, addressed as follows:

Kenneth Donahue, Director
Los Angeles County Museum of Art
5905 Wilshire Boulevard
Los Angeles, California 90036

or to such other addressee and to such other place as Museum shall from time to time designate in a written notice to Patron Sponsor.

16. All notices and other instruments by Museum to Patron Sponsor shall be sent by registered mail, postage prepaid, addressed as follows:

.
.
.
.

4.

or to such other addressee and such other place as Patron Sponsor may from time to time designate in a written notice to Museum.

17. No rights under this Agreement may be assigned by Patron Sponsor or Museum without the prior written consent of the other (except that Museum shall have full discretion, pursuant to paragraph 7, in arranging for exhibitions and, pursuant to paragraph 9, in dealing with any works of art that it accepts by way of gift). Subject to the foregoing, the covenants and agreements contained herein shall be binding upon and shall inure to the benefit of Patron Sponsor and Museum and their respective successors and assigns.

18. In the event that Museum does not obtain comparable agreements from ten Patron Sponsors (or the equivalent) on or before June 30, 1968, Museum will refund to Patron Sponsor the unexpended portion of its initial $3,500 payment, this Agreement shall be of no further force or effect, and the parties shall be released from all obligations to each other.

19. This Agreement embodies the entire understanding between the parties hereto, and no change, alteration or modification hereof may be made except in writing signed by the party to be charged thereunder.

IN WITNESS WHEREOF, the parties hereto have executed and delivered this Agreement this __________ day of ______________________, 1968.

____
Patron Sponsor

By____________________________

MUSEUM ASSOCIATES, INC.

By____________________________
Kenneth Donahue

AGREEMENT

IT IS HEREBY AGREED by and between ______________________________ (hereinafter Artist) and MUSEUM ASSOCIATES, INC. (hereinafter Museum) as follows:

1. Museum operates the Los Angeles County Museum of Art. Museum is presently planning an exhibition tentatively entitled "Art and Technology" to be held at the Los Angeles County Museum of Art in 1970 or 1971.

2. Artist desires to participate in and assist Museum in the development of said exhibition.

3. Museum has advised Artist (a) that any work of art created in the development of said exhibition may, in the sole discretion of Museum, be deemed inappropriate for inclusion in said exhibition, and (b) that Museum may, in its sole discretion, conclude that the totality of works created in the development of said exhibition make it inappropriate to hold said exhibition. Museum agrees not to exhibit any work the artist deems incomplete or not a work of art.

4. Museum and artist have agreed upon an artistic project, which if acceptable to a Patron Sponsor or Sponsor, will be developed and executed at the facility of said Patron Sponsor or Sponsor. Said artistic project is set forth in Exhibit A to this Agreement and is incorporated herein by reference. Artist agrees to work diligently on said artistic project during the time specified for a consecutive or non-consecutive period of up to three months if necessary for completion.

Museum will provide artist (a) one roundtrip economy class air ticket from his residence to Los Angeles; (b) for Artists who are not residents of Los Angeles, reimbursement for all other travel expenses incurred by the Artist in connection with this project, so long as any such travel arrangements have been made by the

1.

Museum and approved in advance in writing; (c) for Artists who are not residents of Los Angeles, a per diem of $20, to be paid in installments of $140 at the beginning of each week of actual work in Los Angeles; (d) a $250 honorarium for each week's actual work on the project, to be paid in installments of $500 at the end of each two weeks of work. The total sums payable by the Museum to the Artist under items (b), (c) and (d) shall not exceed $4,800.

The foregoing is the only financial obligation of Museum to Artist. Artist acknowledges that Museum is under no other or further obligation to Artist for any debts or obligations incurred by Artist, and that Artist is an independent contractor, not an employee or agent of Museum.

5. Museum, in its sole discretion, may select and exhibit at the Los Angeles County Museum of Art any or all works of art created by Artist as a result of said artistic project. Said exhibition may be scheduled at any time during the year 1970. In addition, Museum may arrange for the exhibition of any said works of art at other museums or public exhibitions in the United States or abroad at any time until December 31, 1972. Artist will cooperate with Museum in any such exhibition or exhibitions and will not display any of said works of art before December 31, 1972 without the prior written consent of Museum, but this restriction shall not apply to any works of the Artist which are not selected for exhibition in the Museum's "Art and Technology" exhibition.

The installation of the work and supporting technological equipment at all of such exhibitions shall be the sole responsibility of the Museum. The Artist will assist in the installation of the work at the initial exhibition, but he shall not be obliged to do so at any subsequent exhibitions.

6. The principal work of art created as a consequence of the artistic project will, at the option of Patron Sponsor and without further payment, become the property of Patron Sponsor at the conclusion of the exhibition at the Los Angeles

County Museum of Art (or at the time of notification to Patron Sponsor that said work will not be exhibited). In the event Patron Sponsor does not choose so to acquire any such work, then it will become the property of Artist. If either Patron Sponsor or Artist wishes to make a gift of said work to Museum, Museum may, in its sole discretion, elect to accept or reject said gift.

7. In the event of a gift to Museum of any work of art, Museum will retain the option to donate or lend said work to any other museum or public institution, or, after a twenty-five year interval, to sell or otherwise dispose of said work to anyone. Museum will further retain the right to exhibit or not exhibit any such gift.

8. If Artist creates additional works of art (beyond the "principal work" described in paragraph 6), Artist will retain ownership of any such additional works unless they are an integral part of said principal work, in which case their ownership will be subject to the provisions of paragraph 6.

9. Museum will carry liability insurance on Artist during the period that Artist is working at the facility of Patron Sponsor or Sponsor. During such time Artist will be regarded as a "consultant" to Museum.

10. Museum will not insure any works of art produced in connection with the artistic project, except liability insurance for injury or damage caused by said works of art while they are in transit to or on display at the Los Angeles County Museum of Art. Museum will repair any damage to said works of art while on Museum premises which does not result from their normal functioning or ordinary wear and tear.

11. All arrangements and charges for the moving of objects from Patron Sponsor's or Sponsor's facility to the Los Angeles County Museum of Art (or to other museums or exhibitions) and return to point of origin shall be the responsibility of Museum. Any moving anywhere else shall be the responsibility of the person

3.

requesting said movement. If Artist becomes the owner of any works, shipment from Patron Sponsor's or Sponsor's facility or from the Los Angeles County Museum of Art is the Artist's obligation and must be accomplished promptly upon conclusion of said exhibition (or within 30 days of the opening date of the exhibition as to any work Museum does not include in the exhibition) or Artist will have no further rights to any such work and neither Patron Sponsor or Sponsor nor Museum will have any obligation to return or account for any such work to Artist. Museum agrees to give Artist 30 days advance notice of his obligation to remove any art work to which he has received ownership.

12. Artist agrees that any works in the process of creation or created in connection with the artistic project may be photographed and reproduced in a catalog, press releases, slides or other photographic materials, and that all such photographic materials will be the property of Museum. Copies of the foregoing shall be given to the Artist. Artist further agrees that all matters relating to publicity for said exhibition, said artistic project, or Artist's involvement therewith will be under the control of Museum, and that any publicity to be released by Artist must be approved in advance by Museum. Museum will give Artist appropriate credit and recognition in any exhibition display, catalog or publicity.

13. If Artist resides outside the United States, Artist agrees to obtain, before coming to Los Angeles and at his sole expense, a temporary visa and work permit as well as legal liability insurance classifying artist as a "Consultant".

14. All notices and other instruments which may be or are required to be given or made by Artist or Museum to each other shall be in writing. All notices and other instruments by Artist to Museum shall be sent by registered mail, postage prepaid, addressed as follows:

Kenneth Donahue, Director
Los Angeles County Museum of Art
5905 Wilshire Boulevard
Los Angeles, California 90036

4.

or to such other addressee and to such other place as Museum shall from time to time designate in a written notice to Artist.

15. All notices and other instruments by Museum to Artist shall be sent by registered mail, postage prepaid, addressed as follows:

.
.
.
.

or to such other addressee and such other place as Artist may from time to time designate in a written notice to Museum.

16. No rights under this Agreement may be assigned by Artist or Museum without the prior written consent of the other (except that Museum shall have full discretion, pursuant to paragraph 5, in arranging for exhibitions and, pursuant to paragraph 7, in dealing with any works of art that it accepts by way of gift). Subject to the foregoing, the covenants and agreements contained herein shall be binding upon and shall inure to the benefit of Artist and Museum and their respective successors and assigns.

17. This Agreement embodies the entire understanding between the parties hereto, and no change, alteration or modification hereof may be made except in writing signed by the party to be charged thereunder.

IN WITNESS WHEREOF, the parties hereto have executed and delivered this Agreement this ______ day of ____________________, 1969.

____
Artist

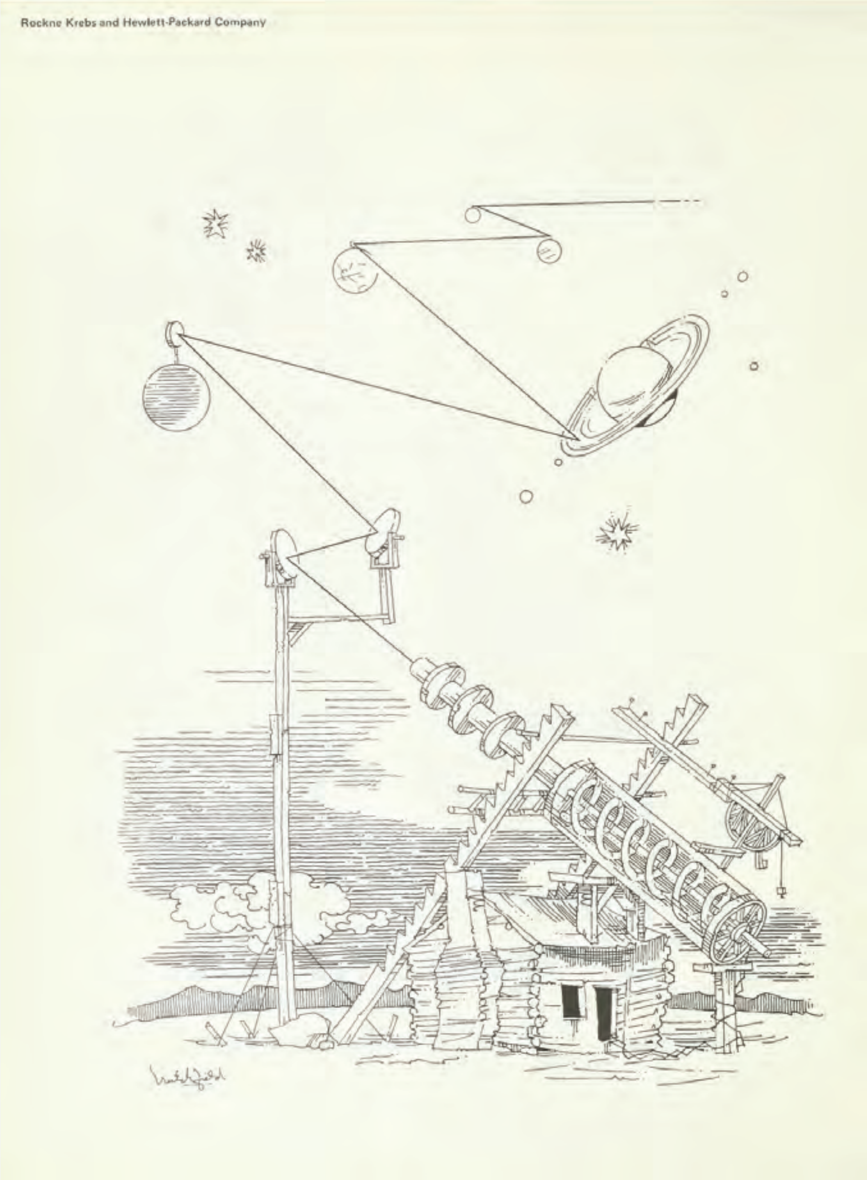
By____________________________
MUSEUM ASSOCIATES, INC.

By____________________________
Kenneth Donahue

5.

The Networked Catalogue

David Karwan



William Crutchfield's illustration from *A Report on the Art and Technology Program of the Los Angeles County Museum of Art, 1967–1971*, interpreting Rockne Krebs's project with the Hewlett-Packard Company.

p. 371
William Crutchfield's illustration from *A Report on the Art and Technology Program of the Los Angeles County Museum of Art, 1967–1971*, interpreting Tony Smith's project with the Container Corporation of America.

Lionized for its radical transparency, the publication documenting the four-year Art & Technology program at LACMA has proved its enduring value. Even though the 1971 exhibition presented only eighteen works, the book, *A Report on the Art and Technology Program of the Los Angeles County Museum of Art, 1967–1971,* serves up comprehensive documentation of the experiences of all participating artists' collaborations with their corporate counterparts. *Time* magazine observed, "the catalogue compiled by Maurice Tuchman in which all the ambitions, negotiations, blocks, and frustrations involved in the immense project are set down, without fear or favor."[1] The volume compiles project descriptions, correspondence with artists, technical diagrams, process photos, sketches, notes, anecdotes about artists working in corporate environments, details of the Pavilion at Expo '70 in Osaka, Japan, and even the contracts between sponsors, artists, and the museum. This visual evidence is why *Report* was revered as "the most revealing document yet published on the art and technology symbiosis"[2] and why it has continued to be a cult find for in-the-know designers and technologists alike. Tuchman says that he based the book's design and candor on a government-published report on sexual practices in the United States, believing that "if the U.S. government can be this frank, so can we." Lou Danziger, who designed the near-400-page catalogue, has no recollection of that government report.[3]

The book itself is magnificently funky, resembling something between an avant-garde telephone book and a floppy financial audit. Danziger's deftly executed two-column page structure balances A & T's sardonic and serious moments. His orderly sans serif typography is juxtaposed against a rich variety of visual materials resulting in a dynamic page by page scavenger hunt. More than 300 pages of *Report* are devoted to the participating artists' projects—indexed in alphabetical order to create a lively, nonlinear reading experience. Unrealized projects such as James Turrell and Robert Irwin's work with the Garrett Corporation are as interesting to learn about as fully executed projects such as R. B. Kitaj's artist book, *Wings (Recent Sculptures and Buildings)*.

Amplifying the catalogue's personality are the often-overlooked illustrations by William Crutchfield depicting various artists' proposals. Tuchman's introduction, along with fellow curator Jane Livingston's contemplative essay, "Thoughts on Art and Technology," are punctuated with ten of the imaginative—at times satirical—drawings. Crutchfield's playfulness radiates from many of the depictions. One can't help but see a larger metaphor in his representation of Claes Oldenburg's kinetic *Giant Ice Bag*. The base of the bag, manifested as a temple, awaits its crowning plug, which is being dragged up an incline by scores of horses. As in this visual analogy to the construction of the pyramids, many of Crutchfield's drawings offer graphic witticisms about time and technology, borrowing from the aesthetics of the early 20th century—focused lines, repeated horizontal or vertical directions, negative space, and heavy inking—to speculate on technology of the late 20th century.

The design of the cover spotlights the largest criticism of the A & T program: its lack of diversity. The paperback edition's cover employs the structure of a checkerboard grid populated by alternating headshots of artists and businessmen; it intended to represent the blurring of lines between art and commerce. Unfortunately, the attempt is overshadowed by the lack of representation of women or people of color. Two women, Aleksandra Kasuba and Channa David (now Channa Horwitz), eventually had their proposals reproduced in the book, but the dearth of women in the A & T program prompted protests against the show.

The book is also a noteworthy graphic and social artifact from the early 1970s. While the A & T program or exhibition wouldn't exactly be classified as part of a countercultural movement, the book promotes many basic values of 70s counterculture: collaboration, access to tools, and the idea that "information wants to be free." There's no doubt that the Art and Technology publication shares the lineage of things like Stuart Brand's *Whole Earth Catalog* (first published in 1968) and the leaked *Pentagon Papers* (1971).

Report also owes something to the Museum of Modern Art's publication for the *Information* exhibition—the first major museum exhibition of conceptual art, which opened in the summer of 1970, a year before the A & T exhibition.

In the preface to *Information*, curator Kynaston McShine states that MoMA wanted this exhibition to be "an international report" on the state of art at that time, while Tuchman titled his catalogue *A Report on the Art and Technology Program of the Los Angeles County Museum of Art, 1967–1971*. McShine notes in the publication's lead essay that "this book is essentially an anthology and considered a necessary adjunct to the exhibition."[4] Tuchman's *Report* is a compendium that is an adjunct to the entire A & T program and exhibition. McShine's and Tuchman's books are not precious objects; indeed, the materials used for both include inexpensive newsprint-like paper, black-and-white printing, and straightforward reproductions of typewritten documents. These production elements—while fashionable for many countercultural publications of the day—could still be seen as inappropriate for an "art catalogue." Hilton Kramer, then the chief art critic for the *New York Times*, described the *Information* publication as a "souvenir album which McShine has put together *in lieu of* a catalogue for the exhibition."

We can extract important questions from Kramer's snide remark: How should an exhibition catalogue function? What is its ultimate purpose? Both McShine's and Tuchman's publications share a sense of era, methodology, and production. They may also be connected to larger aspects of time, place, and cultural attitudes. In thinking about the connection between these two publications, I'm reminded of the playful catalogue for the seminal 1956 *This Is Tomorrow* group exhibition at the Whitechapel Art Gallery.

A multidisciplinary exploration of collaboration, *This Is Tomorrow* brought together thirty-six architects, painters, sculptors, and other artists—including twelve members of the Independent Group. The exhibition presented twelve exhibits by twelve groups and attempted to challenge visitors' conventional notions about art and design by presenting chaotic environments. The catalogue is an experience in itself. The 6.5 × 6.5–inch, spiral-bound book, designed by Edward Wright, echos the graphic cacophony of the show. The catalogue features essays by Reyner Banham and Lawrence Alloway. Each group submitted the floorplan for their environment, a statement, and self-portrait. The book's preface contains this relevant rumination on the role of the exhibition catalogue:

> Exhibitions can offer rare glimpses of both an aesthetic and social milieu. The trappings of the exhibition—invitation cards, leaflets, and—most critically—catalogues embody an invaluable archival resource. They tell us not only about the scope of works on show, but who showed with whom, the graphic style of the day, and styles of writing."[5]

A Report on the Art and Technology Program of the Los Angeles County Museum of Art, 1967–1971 is unconventional, but vital for understanding the A & T program in its totality. The book's organization is an epic achievement for LACMA, and for Maurice Tuchman and his collaborators Hal Glicksman, Jane Livingston, and Gail R. Scott. It documents a significant moment in the LACMA's history, offers a matrix of important artists' projects, and shares insight into the creative process of artists and technologists. It's a surviving monument from a time and place worth reading about.

David Karwan is a graphic designer, educator, and the creative director at LACMA.

A version of this text, "Networked Catalogue," originally apppeared on LACMA's blog, *Unframed*, in July 2015.

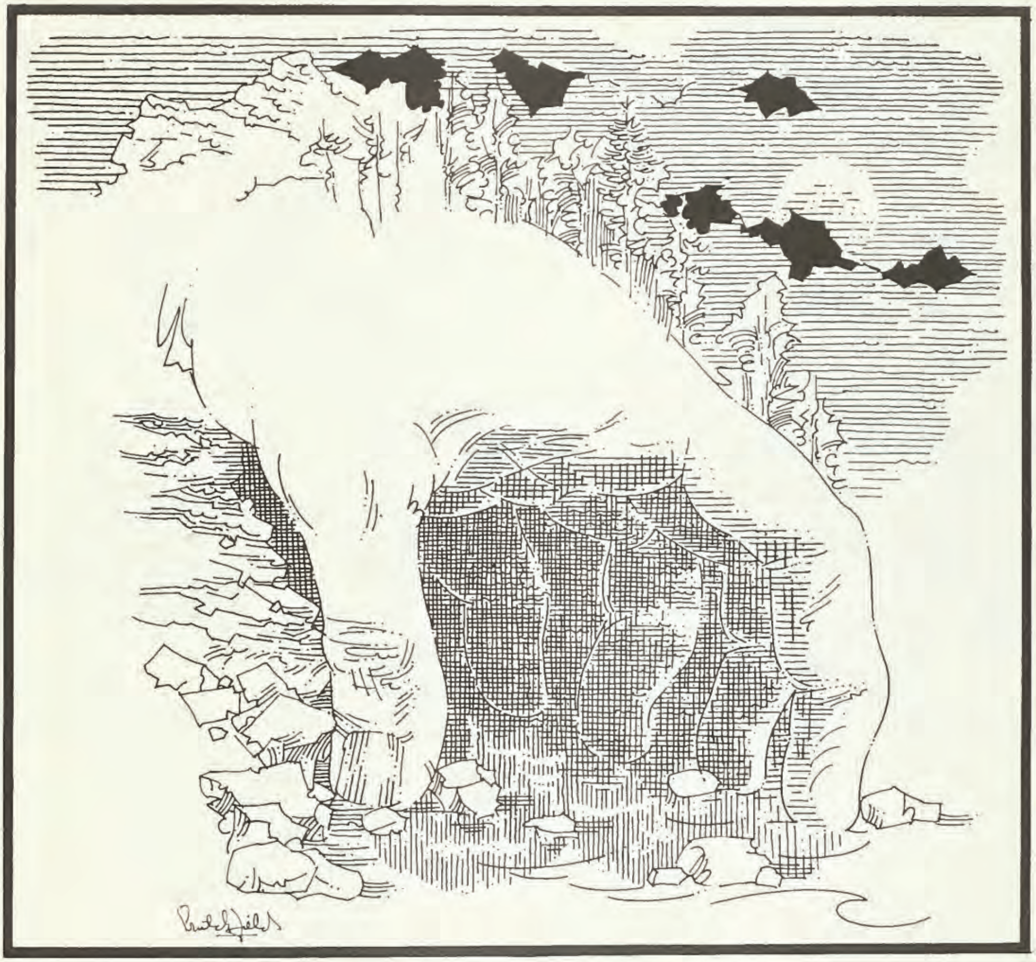
1 *Time*, "Art: Man and Machine," *Time*, June 28, 1971

2 Jack Burnham, "Corporate Art," *Artforum* 10, no. 2 (October 1971): 66.

3 Lynn Zelevansky, *The Broad Contemporary Art Museum at the Los Angeles County Museum of Art* (Los Angeles County Museum of Art, 2008), 139.

4 Kynaston McShine, introduction to *Information* (Museum of Modern Art, 1970), 138.

5 Nayia Yiakoumaki and Iwona Blazwick, "Preface," in *This Is Tomorrow* (Whitechapel Gallery, 2010), 1.



Acknowledgments

First and foremost, I would like to thank CEO and Wallis Annenberg Director Michael Govan for his stalwart support of such an intrepid endeavor. I am grateful to Art + Technology Lab founder and former director Amy Heibel, the Lab's courageous visionary, who remains a lasting source of inspiration for the program to this day. I join Michael in thanking Hyundai Motor Company, whose long-term support has provided the Lab with the stability that many of our artist projects required. I would especially like to acknowledge the Hyundai Artlab team.

At LACMA, the program would have been impossible without the support of Rita Gonzalez, Diana Nawi, Dhyandra Lawson, Aurora van Zoelen Cortés, Caitlin Spencer, and, formerly, Franklin Sirmans, José Luis Blondet, Christine Y. Kim, Jennie King, and Jill Marriage in Contemporary Art. I thank Britt Salvesen and Rebecca Morse in the Wallis Annenberg Photography Department; Bobbye Tigerman and Staci Steinberger in Decorative Arts and Design; Leslie Jones, formerly in Prints and Drawings; Sharon Takeda in Costume and Textiles; Stephen Little and Susanna Ferrell in Chinese and Korean Art; Deliasofia Zacarias in the Director's Office; Diana Magaloni, Senior Deputy Director for Conservation, Curatorial, and Exhibitions; Nancy Thomas, Senior Deputy Director for Art Administration & Collections; and Fiona Ragheb, formerly Deputy Director of Curatorial and Exhibitions. These curatorial colleagues offered invaluable expertise, thoughtful suggestions, and generous collaboration.

For their research and advice in support of our artist projects, I thank Alexis Curry, Douglas Cordell, Kristi Yuzuki, Pauline Wolstencroft, and, formerly, Jessica Gambling in LACMA's Research Library; John Hirx in Conservation; Amanda Dearolph, Joey Heinen, and Russell Zych in Collections Information and Digital Assets; Claudia Gutierrez, Heather Lui, and, formerly, Jeffery Blair, Amanda Williams, Fred Goldstein, and Pamela Kohanchi in the Counsel's Office; Erika Franek, Linda Leckart, and Emmeline Yen in Registration and Collections; Maia November in Risk Management; and Piper Severance in Rights and Reproductions.

The Art + Technology Lab originated in LACMA's Web & Digital Media department, and I appreciate my colleagues there who have been a part of the Lab's work over the years: Nandi Dill Jordan, Fernando Sanchez, Bryan Arita, and, formerly, Alexander Kwong and Agnes Stauber. Susan Chun and Bruce Wyman, in their capacity in Digital Strategy, have been indispensable collaborators. I also wish to acknowledge Tomas Garcia, LACMA's former head of Web & Digital Media, and his dog, Boy George, who together provided guidance and friendship for many years during the program's ups and downs.

Sharing the iterative and experimental work of the Lab with the world has had its challenges, and I am grateful to the teams that rose to the occasion. For supporting the Lab's public engagement efforts, I appreciate Nateene and Toph Diu, Elizabeth Gerber, Alicia Vogl Saenz, and Holly M. Crawford in Education and Public Programs; Doug Leonhardt, Jason Macaya, and Allison Jaynes in Visitor Services; Vinny Droughton and Richie Guerra in Program Audiovisual; Jarid Sumner, Alfredo Medina, Cristina Alva, Davidra Jackson, and Luis Escobar in Facility Engineering, Services, and Operations; Sean Moye and Sameer Rasheed in Security; and Victoria Behner, Christine Ferriter, Gerardo Gamez, Mark Ayala, Martin Sztyk, and Jeff Young in Exhibition Design and Production. Special thanks to John Rice and Monica Carranza in Marketing, and to Chi-Young Kim, Alexander Schneider, Katie Booth, Victoria Draovitch, Jessica Youn, and Kathryn Hanlon-Hall in Communications.

For keeping the Art + Technology Lab afloat, I thank Veridiana Pontes, Sophia Kritselis, Mirabelle Alan, Annique Mitchell, Elizabeth Wiatt, Celia Yang, Sofia Treviño, Erin Wright, and, formerly, Melissa Bomes, Katie Kennedy, and Jenn Snow in Development; and Arun Mathai and Wesley Brown in Finance and Accounting.

I thank Amy Heibel and Claire L. Evans for their thoughtful and engaging essays, which have brought additional depth and insight to this volume. William Hackman's extensive research and writing was invaluable, as was John Alan Farmer's editorial support. Matthew Harrison meticulously proofread texts from the 1971 book. Within LACMA's Publishing Division, Susan Chun, David Karwan, and Sara Cody have been nothing short of heroic in producing, designing, and editing this publication, and I am deeply grateful for their knowledge and expertise. With the support of Dawson Weber, Charlie Kang, and Laura Cherry, their work brings elegant clarity to a singular and experimental art museum program.

The magnitude of this ongoing program makes it impossible to include all those who have contributed to its projects over the years. Many artists, technologists, engineers, arts professionals, executives, scholars, scientists, and technicians have offered introductions, expertise, suggestions, drawings, technical support, material resources, and more. These individuals can be loosely grouped as advisor-collaborators. To the following, I offer my deepest gratitude: Adetokunbo Ayoade, Farnaz Azmoodeh, Catherine Carlisle-McMullen, Elian Carsenat, Bryan Catanzaro, Erika Clark, Sue Cool, Jesse Damiani, Tim DeBenedictis, Chris deFaria, Chris DeFay, David Delgado, Elena Dorfman, Regan Dunn, Rylee Duvall, Dr. Anthony Freeman, Dan Goods, Bill Griffith, Jia Gu, Lilian Haney, Micol Hebron, Walter Holemans, Ben Hooker, Ayana Jamieson, Julie Joyce, Andrew Kalman, Frida Kano, Zachary Kaplan, Alex Klein, Adam Kleinman, Roger Klemm, Dan Kohne, Dr. E. C. Krupp, Emily Lindsey, Xin Liu, Charles Loveman, Chris Malachowsky, Philip Martin, Elijah Martinez, Steve Matousek, Max Maxwell, Jeff McHugh, Frank Miuccio, Brian Mulford, William Nelson, Dave Nordling, Tom Norris, Robert Takahashi Novak, Sarah Conley Odenkirk, Philippe Pare, Natalie Rubio, Emily Shanklin, Thor Shannon, Gwynne Shotwell, Sara Simon, Anthony Sims, Neale Stokes, Dimitri Timohovich, Chester Toye, Chris Tynan, Christina Valentine, Kahin Vasi, Mathias Verhasselt, Anuradha Vikram, Addie Wagenknecht, Shari Wenker, and Liam Young.

The above list includes colleagues from our sponsors, including Accenture, Algorand Foundation, DAQRI, DreamWorks Feature Animation Group, Getty's PST ART: Art & Science Collide initiative, Gensler, Google, Hyundai Motor Company, Los Angeles County Productivity Investment Fund, NVIDIA, Snap Inc., and SpaceX. Individuals acknowledged above also offered their expertise and collaboration on behalf of the following organizations: 18th Street Arts Center, Art Center College of Design, ArtConverge, Carnegie Observatories, Chapman University, The Contemporary Austin, Craft Contemporary, David Zwirner, Dickinson Lab (California Institute of Technology), Fulcrum Arts, Griffith Observatory, Heritage Housing Partners, Jet Propulsion Laboratory, Kunsthall Trondheim, La Brea Tar Pits and Museum, L.A. Dance Project, Los Angeles Public Library, MAK Center for Art and Architecture, MIT Media Lab Space Exploration Initiative, Mount Wilson Observatory, National Park Service, Octavia Butler Legacy Network, Philip Martin Gallery, Planetary Systems Corp., Pumpkin Inc., Reality Studies, Reaction Research Society, SCI-Arc–Southern California Institute of Architecture, SIGGRAPH, Sleeper9 Films, Southern Stars Group, LLC, Tallix Foundry, and UNCOPIED.

I would like to extend my heartfelt personal recognition to Jessica Blemker-Ferree, Cathryn Ferree, Margie Jones, Lane Ferree, Mary Ferree, and Rowan Bir Ferree.

Finally, I express my profound gratitude and respect to all of the artists who have participated—and who will, I hope, continue to participate—in the Art + Technology Lab program. While this publication recognizes their contributions, their impact remains immeasurable.

Joel Ferree
Program Director, Art + Technology Lab
Los Angeles County Museum of Art

Los Angeles County Museum of Art Staff

As of January 14, 2026

Samantha Abbott
Jacqueline Acosta
Kelly Adrianse
Miguel A. Aguilar
Belby Aguillon
Mirabelle Alan
Kc Alduenda
Renaissance Alexandre
Cristina Alva
Chelsea Alvarez
Melissa Alvarez
Samuel Ancona
Anton Anukhin
Sarah Rebecca Applegate
Gerardo "Shorty" Arciniega
Bianca Argueta
Natalie Arias
Bryan Arita
David Armendariz
Allyson Armstrong
Eden Arriaga-Sotelo
Brandi Arteaga
Tiffany August
Brenda Avila
Eliana Axelrod
Mark Ayala
Kevin Babeshkov
Michelle Bac
Arturo Baez
Ryan Baker
Reeza Baldonado
Fiona Baler
Ben Balken
David P. Bardeen
Ray Barela
Ramon Barrera
August Barringer
Stephanie Barron
Mina Bastani
Victoria Turkel Behner
Jeanette Benitez
Timothy O. Benson
Kyna Biggs
Chiara Biribicchi
Kyrie Blackman
Zoe Blackwell
Riley Block
Silviu Boariu
Kathryn Taylor Booth
Kit Bradley
Erin Branham
Evangeline Brasher
Grant Wm. Breding
Adriana Breisch
Chrystal Brooks
Amelia Brown
Wes Brown
Wesley Brown
Nayeli Buffi
Catherine Burce
Amanda Burr
Julia Burtenshaw
Mark C De Baca
Avery Caesar
Eduardo Camacho
Alex Candeloro
Crystal Cano
Ermanno Carbonara
Monica Carranza
Ana Carrillo
Biaani Carrillo Munoz
Azucena "Susi" Castillo
Sonja Cayetano
Claudia Ceja
Amara Channer
Sara Chao
Jessica Chasen
Marina Chedrina
Laura M. Cherry
Samuel Choi
Jimmy Chui
Susan Chun
Mariano Cinat Vinci
Jasmine Cleveland
Sara Cody
Emma Collins
Giuliana Cologni Silva
Britta Conroy-Randall
Brendan Constantine
Khita Constantino
Grace Converse
Errin Copple
Doug Cordell
Carmina Cortes Gonzalez
Ixayac Cortez
Emily Craig
Claire Crighton
Emma Crow
Ilaria Crum
Vikki Cruz
Alexis Curry
Elizabeth Dallas
Zoe Dalton
Dale Daniel
Jordan David
Kimberly Davis
Alyce de Carteret
Joseph De La Hay
Amanda Dearolph
Zachary Degreeff
Polly Dela Rosa
Eszter Delgado
Craig Dietrich
Debra Disman
Nateene Diu
Claudine Dixon
Victoria Draovitch
Matthew Driggs
Elizabeth Drolet
Christine Drosse
Vinny Droughton
Dakota Dry
Rachel Du
Abigail Duckor
Thomas Duffy
Miranda Dunn
Kelly Eduardo
Lucia Elledge
Sarah Ellison
Luis Escobar
Clarissa Esguerra
Alyssa Estrada
Nicanor Evangelista
Joseph Facundo
Michael Farland
Joel Ferree
Susanna Sara Ferrell
Christine Ferriter
Alice Flather
Hope Flores
David Foster
Nancy Fox
Chanel Francisco
Marlon Franco
Erika Franek
Joseph Fronek
Yurie Fujimoto
Soko Furuhata
Juan Gallo
James Gamboa
Gerardo Gamez
Kevin Gamez
Laura Garavoglia
Adriana Garcia
Alexis Garcia
Dominique Garcia
Michelle Garcia
Jaime Garcia Gaytan
Samantha Garduño
Meagan Garvey
Angel Ge
Natalie Gearhart
Homer Gentry
Elizabeth Gerber
Paola Gil
Holly Marie Gillette
Celena Gilmore
Mitch Glickman
Katherine Go
Milena Golshan
Anthony Gonzales
Cameron Gonzales
Daniela Gonzalez
Joal Gonzalez
Jose Gonzalez
Laura Gonzalez
Rita Gonzalez
Villano Gonzalez
Violeta Gonzalez
Steven Gonzalez Lopez
Vanessa Gonzalez-Soto
Virginia Gormley
Danielle Gorodenzik
Derek Gougis
Michael Govan
Ayda Gragossian
Shannon Green
Tariq Nasir Grissom
Theo Grober
Jane Grossman
Ricardo Guerra
Jasmine Guerrero

Claudia Gutierrez
Mario Gutierrez
Emily Halaka
Kristal Hale
Julia Heeju Han
Kathryn Hanlon-Hall
Lauren Elizabeth Hanson
Margaret Hanson
Christianne Hanych
L. J. Hartman
Margot Healey
Joey Heinen
Michael Held
Lauren Helliwell
Kimberly Hernandez
Allison Hewitt
Rika Hiro
John Hirx
Holly M.
Rebecca Horta
Jiayi Hou
Melissa Howley
Darwin Hu
Aija Hunt
Sheridan Hunter
Madeline Hutson
Curt Huynh
Jennifer Iacovelli
Brynnea Irvine
Davidra Jackson
Daniel Allyn Janisch
Elena Janney
Beatriz Jaramillo
Isabella Jarrard
Allison Jaynes
Sierra Jenkins
Sara Jessamine
Riley Joe
Camieo Johnson
Daniel Johnson
Ryan Johnson
Madalyne Johnston
Jennifer Jordan
Nandi Dill Jordan
Sarah Isadora Justeson
Alexandra Kaczenski
Tuerxun “Kal” Kalibinuer
Carly Kamei
Charlie Kang
Rachel Kaplan
Wendy Kaplan
David Karwan
Ilona Katzew
Kelly Kawata
Auni Kazarians
Narjis Kazmi
Naima J. Keith
Kidogo A. Kennedy
Chi-Young Kim
Haley King
Lana Klaib
Carinne Klaristenfeld
Rosanne Kleinerman
Megan Knox
Cynthia Kok
Linda Komaroff
Sydney Krantz
Laura Krapacher
Sosse Krikorian
Sophia Kritselis
Priyanka Kuckian
Diana Conzett Kuroda
Nora Kuyumjian
Nicole LaBouff
Olivia Labows
Kelsey Lacanilao
Zachary Lacanilao
Gem Lagonoy
Grace Lamdin
Leila Landers
Julia Latané
Magdalena Latorre
Dhyandra Lawson
Frances Lazare
Kristina Leal
Joseph Leavenworth
Linda Leckart
Leah Lehmbeck
Douglas Leonhardt
Nicole Leslie
Letia Lewis
Katie Lipsitt
Stephen Little
Sarah Locke
Briana Lopez
Jackeline Lopez
Joe Lopez
Agustin Lopez Jr.
Stephanie Lozano
Jazmyn Lu
Madison Lucas
Henry Lui
Heather Lui
Samuel Lynn
Jason Macaya
Laura Maccarelli
Matthew MacDonald
Cam Alan Mach
Emily Rose Madigan
Diana Magaloni
Arvin Maghsoudlou
Delfin Magpantay
Gina Mahboob
Jayne Manuel
Stephannie Marcelino Sanchez
Stephen Markel
Tia Marone
Antonio Gabriél Martinez
Gabriela Martinez
Sarah Martinez
Jesus Mascorro
Claire Mata
Arun Mathai
Paola Mathus Garza
Erin Sullivan Maynes
Ariel Mazariegos
Alexandra McKiney
Paul McKinney
Debra McManus
Michael Meador
Johnny Medina
Erica Mercado
Annique Mitchell
Ryan Mojarad
Anthony Monroy
Rachel Moore
Andrea Moreira
Suzanne Morris
Rebecca Morse
Sean Moye
Moupi Mukhopadhyay
Roy Mukogawa
William Murray
Krystine Murry
Char Nacion
Rebeca Navarro
Diana Nawi
Anna Nelson
Sarah E. Newby
Arthur Nguyen
Ryan Nieto
Jeffrey Nishinaka
Elonda Norris
Maia November
Ericka Nowell
Kristin Nyquist
Patsy O'Brien-Diflauro
Elma O'Donoghue
Raquel Olmedo Ines
Olga Ordaz
Christian Ortiz
Julianna Ostrovsky
Eric Owusu
Nadia Pacheco
Minyoung Park
Jenebrith Pastran
Elspeth Patient
Thaddeus Pedisich
Denisse Pedroza
Lucinda Pelton
Patrick Pelz
Belén Pena
Elisabetta Perfetti
Jean-Guerly Petion
Jacqueline Piña-Ascencio
Kathryn Pinto
Claudia Polanco
Angel Ponce
Veridiana Pontes
Melissa Pope
Colette Porter-Kaplan
Ernesto Portillo
Charlie Michael Powers
Michael R. Price
Christel Quinn
Gladys Quintero
Frank Quiroz
Valerie Rainey
Angelica Ramirez
Marisela Ramirez
Alexis Ramos
Sameer Rasheed
Virginia Rasmussen
Aleeza Raveh
Joey Ren
Ana Reyes Mejia

Eva Reyman
John Rice
Giulia Rioda
Holly Rittenhouse
Sara Roberts
Armida Robles
Natalie Rocha
Sam Rodriguez
Yosi Rodriguez-Pozeilov
Connie Rohman
Geena Roth
Stephanie Rouinfar
Larry Rubin
Claire Rutenberg
Shirin Mikiko Sadjadpour
Judith Salazar Peralta
Daniel Sales
Christian Salguero
Mariama Salia
Sheila Salley-Thien
Britt Salvesen
Diego Sanchez
Fernando Sanchez
Liliana Sanchez
Nathalie Sánchez
Richard Sandomeno
Naiela Santana
Alexis SantaRomana
Adrian Santiago
Jonathan Santos
Amanda Saracho
Sierra Schiano
Lara Schilling
Eve Schillo
Susan Schmalz
Louis Schmidt
Alexander Schneider
Tracey Scott
Piper Wynn Severance
Shadi Shafiei
Joseph Shaikewitz
Diana Shlikhtova
Lauren Bergman Siegel
Patrick J. Silva
Kristina M. Simonsen
Leah Singsank
Megan Smith
Pamela Smith
Shelley Smith
Alyson Souza
Claire Spadafora Baes
Caitlin Spencer
Christopher Stavroudis
Staci Steinberger
Jacob Stock
Kristin Strid
Jarid Sumner
Jaymee Sumpter
Michael Sze
Martin Sztyk
Sharon Takeda
James Takeuchi
Jordan Tanguay
Kathy Tenorio-Ramos
Shea Territo
Nancy Thomas
Kamla Thurtle
Elsa Thyss
Jun Tiangco
LeAnn Tice
Bobbye Tigerman
Emily Tipton
Ariya Sivarat Tok
Anastasia Tokmakova
Ivana Torres
Leslie Torres
Michael Hai Tran
Alec Trevino
Sofia Treviño
Zach Trow
Rachel P. Tu
Mary Tyler
Katy Unger
Jonathan Urban
Albert Valdez
Gina Valentine
Marco Valenzuela
Jose Vallecillos
Zandra Van Batenburg
Aurora van Zoelen Cortés
Victoria Vargas
Walter Vargas
Maria Velasquez
Stacey Vigallon
Cassandra Villareal
James Vitale
Shannon Vittoria
Alicia Vogl Saenz
Amanda Wada
Allison Wall
Lauren Waller
Brooke Wanzenberg
Matazi Weathers
Dawson Weber
Tiffany Wernik
Charlene Wesley
Gloria Westcott
Ivette Weyman
Daniel Vernon Wheeler
Elizabeth Wiatt
Senai Wilks
Judes Williams
Sandra S. Williams
Pauline Wolstencroft
Erin Wright
Reda Yahoum
Celia Yang
Emmeline Yen
Naomi Yin
Margarita Ylo
Chamin Yoon
June Yoon
Patricia Yossen
Jessica Youn
Jeffrey Young
Ava Youssefi
Kristi Yuzuki
Deliasofia Zacarias
Marlene Zambrano
Dariia Zamrii
Koni Yijun Zhang
Russell Zych

Image Credits

Works, photographs, and images are copyright of the creators and are reproduced courtesy of the creators, estates, and lenders of the materials depicted, unless otherwise noted. The following images, keyed to page number, are those for which additional or separate credits are due. We have made every effort to contact rightsholders to obtain all necessary permissions to publish images and text materials, and to provide accurate credit information. Please contact the publishers with any corrections.

2, 179 bottom: photos by Mathias Völzke, courtesy of Kunstverein Hannover; 4, 245: photos courtesy of EPOCH Los Angeles and the LACMA Art + Technology Lab; 10, 14, 37, 38, 39, 43, 46, 69, 105, 106, 107, 109, 112, 194–95, 196, 197, 242–43, back cover: photos © Museum Associates/LACMA; 18, 161, 162–63, 165, 166, 167: photos © Museum Associates/LACMA, by Ian Byers-Gamber; 51 bottom: photo by Matthew Reyes; 55, 239, 241: photos by Paul Salveson; 67: photos by Elena Dorfman; 84–85: photo by Shawn Harris Ahmed, 2017; 91 top left, 91 bottom, 93 top: photos by Kovács/O'Doherty; 95: image: Kris Slyka; 120–21: photo by Stan Douglas; 123: photo courtesy of Arcus Project, 2017; 131, 133: photos courtesy of Jen Liu and Upstream Gallery, Amsterdam; 139, 140–41: photos by Fredrik Nilsen; 145: photos by Ebru Kurbak; 146–47: photo by Steve Boxall/ZeroG/MIT SEI; 169: photo by Joshua White Photography; 175: photo by Claire Gatto, image courtesy of Matthew Angelo Harrison and Jessica Silverman, San Francisco; 179 top: photo by Michiel de Cleene, courtesy of Kunsthal Gent; 183 top: photo by Kyle McDonald, Holau Vaka Taumako Association, and Pacific Traditions Society; 183 bottom: © 2020 Vaka Taumako Project and Duff Islands/Vaeakau people; 187, 189: photos by Elliot Ross; 191 bottom: courtesy of the JPL Archives; 201, 203: courtesy of Lawrence Lek and Sadie Coles HQ, London; 205: images: Bruno Cornejo and Oswaldo Erréve; 207: images: Oswaldo Erréve; 209, 210–11: photos by Paul Salveson, courtesy of Kelly Akashi and Lisson Gallery; 219, 221, 376: photos by Gabriel Noguez; 246: © 2026 Artists Rights Society (ARS), New York/ADAGP, Paris, photo © Museum Associates/LACMA; 247, 249: images courtesy of Casey Reas and bitforms gallery; 252: photo by Robert Cumming; 254, 256, 270, 313, 350 middle and bottom, 358–67, 368, 371: photos: Los Angeles County Museum of Art Archives; 276: © 2026 John Chamberlain/Artists Rights Society (ARS), NY, photo: Los Angeles County Museum of Art Archives; 284, 314, 328 top, 350 top: photos by Malcolm Lubliner; 300: photos by Tami Komai; 307: photo by William Crutchfield; 328 middle and bottom: © Robert Rauschenberg Foundation, photos: Los Angeles County Museum of Art Archives; 334 top: © 2026 Richard Serra/Artists Rights Society (ARS), New York, photo by Malcolm Lubliner, photo: Getty Research Institute, Los Angeles (2012.R.21); 334 bottom: photo by Maurice Tuchman; 337 top: © Hans Namuth Estate, courtesy Center for Creative Photography, The University of Arizona; 337 bottom: © 2026 Tony Smith Estate/Artists Rights Society (ARS), New York, photo: Los Angeles County Museum of Art Archives; 345: © 2026 The Andy Warhol Foundation for the Visual Arts, Inc./licensed by Artists Rights Society (ARS), New York, photo by Tami Komai

All Impossible Deeds: A Report on the LACMA Art + Technology Lab, 2014–2025

The Art + Technology Lab is presented by

HYUNDAI

The Art + Technology Lab is made possible by Snap Inc.

The Lab is part of the Hyundai Project: Art + Technology at LACMA, a joint initiative between Hyundai Motor Company and LACMA exploring the convergence of art and technology since 2015.

Los Angeles County Museum of Art
5905 Wilshire Boulevard
Los Angeles, CA 90036
www.lacma.org

DelMonico Books • D.A.P.
75 Broad Street, Suite 630
New York, NY 10004
www.delmonicobooks.com

For the Los Angeles County Museum of Art
Publisher: Susan Chun
Creative Director: David Karwan
Editorial Director: Sara Cody
Managing Editor: Dawson Weber

Designed by David Karwan
Edited by Sara Cody, with John Alan Farmer
Project descriptions by William Hackman, with John Alan Farmer
Production by Janet Klein

For DelMonico Books • D.A.P.
Publisher: Mary DelMonico

This book is typeset in Programme.

For additional resources on the artists and projects discussed here, or to access a downloadable scan of the original Art and Technology publication, please visit www.lacma.org/art/lab.

Artificial Intelligence (AI) Disclosure:
No original texts or images in this book were generated by AI, except where explicitly identified. All texts were edited, proofread, and fact-checked by humans, whose names are included above.

Library of Congress Control Number: 2026931751
ISBN: 978-1-63681-161-1

Color separations by Ozzie Villalobos
Printed and bound in the United States of America by Acuprint, Los Angeles

Lauren Lee McCarthy & Casey Reas, *Auto Tune*, Los Angeles County Museum of Art, June 30–July 3, 2025

back cover
Casey Reas, *An Empty Room*, 2023, commissioned by the Los Angeles County Museum of Art

Annina Rüst

John Craig Freeman

Rachel Sussman

Taeyoon Choi and E Roon Kang

Tavares Strachan

Nonny de la Peña and Alex Rivera

Cayetano Ferrer

Jonathon Keats

Nana Oforiatta Ayim

Gabriel Barcia-Colombo

ScanLAB Projects

I. R. Bach

john gerrard

Kirsten Mosher

Kovács/O'Doherty

Michael Mandiberg

Carl Cheng

Curtis Tamm

Julia Christensen

Stan Douglas

Diana Thater

Jen Liu

Sarah Rara

Tahir Hemphill

Ebru Kurbak

Eun Young Park

Rashaad Newsome

Sarah Rosalena

Tom Sachs

Agnieszka Kurant

Kyle McDonald, Dr. Marianne George, and the Holau Vaka Taumako Association

Matthew Angelo Harrison

Virginia San Fratello and Ronald Rael

American Artist

Jaqueline Kiyomi Gork and Rhett LaRue

Lawrence Lek

MUXX

Daniel R. Small

Kelly Akashi

Lauren Lee McCarthy

Nancy Baker Cahill

Gala Porras-Kim

Haleigh Nickerson

Patty Chang and David Kelley

Tristan Duke

In 2013, LACMA's Art + Technology Lab relaunched the museum's pioneering 1967–71 program for a new era. *All Impossible Deeds* documents the Lab's first ten years through descriptions of forty-five artist projects exploring technologies ranging from augmented reality and blockchain to space exploration and robotics. Essays reflect on a transformative decade when cultural attitudes toward emerging technologies shifted from optimistic possibility to urgent critique, and while archival material from the original program's 1971 publication demonstrates that the tensions between art and technology remain as vital—and unresolved—as ever.

ISBN 978-1-63681-161-1

9 781636 811611

DelMonico Books + D.A.P.