"To Avoid the Waste of a Cultural Revolution": Experiments in Art and Technology

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Experiments in Art and Technology

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Abstract

This dissertation does not examine a single artist. Rather, it addresses a vast organization: Experiments in Art and Technology, or E.A.T., founded in 1966 by artists Robert Rauschenberg and Robert Whitman and AT&T Bell Laboratories engineers Billy Klüver and Fred Waldhauer. E.A.T. grew to five thousand members at its peak. Together, they sought to form collaborations between artists and engineers, a grand union of culture and technology, of minds, fields, and competencies. They hoped for nothing less than "to avoid the waste of a cultural revolution." But what E.A.T. produced was far more restless, complex, and divided—a sprawling and unruly alchemy. In what follows, I offer the first comprehensive analysis of this extraordinary group.

Building on the contemporaneous contravention of conventional models of composition and intention in the work of Rauschenberg, John Cage, Judson Theater, Pop, Op, Happenings, Minimalism, Conceptual, and kinetic art, E.A.T. sought to destabilize the normal process of artistic making, introducing collaboration and conflict into the process. But the organization also strayed far from the art world, looking instead to a very different realm: big science, the explosion in large-scale research in postwar

technology, from the military-industrial complex to the rise of the global telecommunications network. Engineers and scientists, in turn, hoped to learn from artists—to upend linear teleologies of technological innovation and instrumental reason; to think more "creatively," in a harbinger of Silicon Valley-speak. I examine the ways in which these different disciplines convened on the terrain of a shared interest in systems, cybernetics, drugs, lasers, computer graphics, electronic sound, plastics, risk; E.A.T. thereby modeled a new kind of knowledge transfer and material exchange at a scale never before seen in the arts. In doing so, I maintain, E.A.T. took on the colossus of universal connectivity—the very goal of AT&T and NASA, military think tanks and corporate laboratories—and posed a new kind of network.

By focusing on this unorthodox organization, I hope to redress a blind spot in an art historical literature that persists in concentrating on individual artists, historical actors, and heroes. Indeed, if most art of the postwar period is seen as challenging traditional models of individual authorship, few studies have actually examined the most trenchant confrontations with modernist constructions of individual subjectivity, rationality, agency, and form. And if much Conceptual art eventually folded radical systems, events, and language back into a kind of pure ideation, E.A.T. models a different path for art in the 1960s and '70s: a resolutely multiplicitous array of things, people, media, information, codes, sensations, and temporalities; a massive dispersion and disruption of technological life, in the ether but also on the ground.

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INTRODUCTION

The history of art and technology is a history of envy. The rival fields have long challenged, borrowed, or stolen from each other. Each wants what the other has: Art desires technology's seeming omnipotence, its cold power, its cutting-edge materials and processes; technology wants art's creativity, its free thinking, its radical innovation. And yet in spite—or because—of this fraught relationship, art and technology have converged in many ways, with enormous consequences for contemporary experience.

The jealousy and the joining are the subject of this dissertation. In the study that follows, I examine an extraordinary moment in the twentieth century when artists and technologists came together, in both antagonism and amity: The formation of Experiments in Art and Technology, or E.A.T., an organization that aimed to create widespread collaborations between artists and engineers. Sometimes these encounters reflected the postwar dream of universal connectivity, of communications media that would link us all, in global simultaneity. Sometimes they reflected the dystopian nightmare of machines run amok, of the horrors of Vietnam and Silent Spring. But often these encounters cannot simply be described as critical or affirmative, utopian or despairing, conflicted or cooperative.[1] Sometimes, these collaborations promised a different horizon of possibilities, possibilities that did not merely reflect—but actively changed—the colossal proliferation of networks to come.

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[1] Thus E.A.T.'s project of overt unification departs, I argue, from the sublimated union between the historical avant-gardes and instrumental technology, which Andreas Huyssen has described. The futurist and constructivist engagements with technology, for example, "reveal the *secret* bond between avant-garde and official culture in advanced industrial societies," whether that use of technology was critical or affirmative. Andreas Huyssen, *After the Great Divide: Modernism, Mass Culture, Postmodernism* (Bloomington and Indianapolis: Indiana University Press, 1986), 173. Emphasis added.

E.A.T. was founded in 1966 by artists Robert Rauschenberg and Robert Whitman and Bell Laboratories engineers Billy Klüver and Fred Waldhauer. The group sought to form an alliance between artists and engineers, a grand union of disciplines, fields, and competencies. But what E.A.T. produced was far more restless, complex, and divided—a vast and unruly alchemy.

Art and technology were divided indeed in the late 1960s, infamously split between the "Two Cultures," in the words of Cold War–era doomsdayer C. P. Snow. Many warned that this rift would lead to technocratic domination, nuclear winter, ecological ruin. E.A.T. echoed this alarm. As the organization's inaugural manifesto proclaimed, culture and technology were dangerously developing "in isolation." Yet their response was wholly unorthodox. Unlike Snow's technocratic call to arms, which argued that culture abdicate to modern science and which Klüver and Rauschenberg ultimately opposed, E.A.T. posed a way to bring disparate fields together—to create a "catalyst for the inevitable fusing of specializations," as Rauschenberg put it.[2] If artists and engineers actually talked to one another, shared information, broke out of professional specializations, they might change one another, change their disciplines, change the structure of invention itself. The gulf between art and technology might become a contest, a rivalry, and a transformation.

Rauschenberg met Klüver in 1960. The engineer was a high-level specialist in lasers and optics at AT&T Bell Laboratories, epicenter of the modern telecommunications revolution. Born in Monaco, raised in Sweden, then receiving his

2. Robert Rauschenberg, *Autobiography*, 1968, three-panel lithograph, in the collection of the San Francisco Museum of Modern Art, containing a text that is included as an appendix in Calvin Tomkins, *Off the Wall: Robert Rauschenberg and the Art World of Our Time*, 1980, rev. ed. as *Off the Wall: A Portrait of Robert Rauschenberg* (New York: Picador, 2005), 294.

Ph.D. in physics at Berkeley, Klüver had unorthodox connections from the start. The curator Pontus Hultén, a friend and fellow Swede, had introduced Klüver to the artist Jean Tinguely, with whom he would work on *Homage to New York*, a kinetic sculpture that self-destructed in the Sculpture Garden of The Museum of Modern Art in 1960. It was there that the engineer encountered Rauschenberg, who had constructed the small, coin-tossing sculpture *Money Thrower* for the event; they struck up a friendship, and Klüver subsequently helped Rauschenberg and a number of other artists with various electrical or mechanical needs. But from project to project—from Jasper Johns's *Field Painting* (1962) to Andy Warhol's *Silver Clouds* (1965)—Klüver's participation went beyond technical assistance; it altered the very form of the work.

In Chapters 1 and 2, I examine several of these early collaborations between Klüver and various artists. After his work with Johns and Tinguely, for example, Klüver would go on to produce the transistor-radio-powered, sound-emitting sculpture *Oracle* (1962–65) with Rauschenberg and his Bell colleague Harold Hodges. The very concept and material of the piece were literally shaped by its technological means. And so the question arose: what if more artists and engineers could work together and exchange ideas, techniques, and media, generating something that neither would ordinarily produce on their own? Or, as Rauschenberg scrawled in a note in 1967, "to make work that could not exist otherwise"?[3]

Rauschenberg and Klüver soon decided to find out. They embarked on *9 Evenings: Theatre and Engineering*—a legendary performance series that would directly lead to the formation of E.A.T. As I argue in Chapter 2, the event was a colossal

[3] Robert Rauschenberg, handwritten note, c. 1967. Experiments in Art and Technology Records 1966–1997, Getty Research Institute, Los Angeles, accession no. 940003, box 4, folder 18.

enterprise, its ambition matched only by its size. It lasted the titular nine nights in the cavernous 69th Regiment Armory in New York and was attended by more than 10,000 people. Nearly forty engineers from Bell Laboratories worked with ten artists; their struggles against and with one another brought the working methods of the industrial laboratory and artistic studio into unprecedented intimacy.

And yet the participants began conceiving *9 Evenings* in order to bring this intimacy, these one-to-one collaborations, to a larger scale—to see what would happen when a critical *mass* of artists and engineers explored new materials and technologies. They connected with other artists, choreographers, and musicians—many of whom Rauschenberg had been working with since 1962 in the experimental dance and theater group "Bastard Theater"—including John Cage, Yvonne Rainer, and Deborah Hay. Klüver pulled in Bell colleagues who were researching everything from integrated circuits to making computers talk—technologies that would usher in wireless communication, personal computing, and the Internet. These were the architects of the information age.

Such unorthodox collaborations disturbed the model, the linear logic, of modernist progress and technological innovation alike. They inspired the founding of E.A.T. proper. In Chapter 3, I investigate the ways in which the organization was structured, funded, realized, and, most important, how it grew. I focus on the group's unique attempt to exponentially expand the field of experimentation—by both modeling and diverting from the protocols of big science, the mammoth expansion in scientific and technological research in same decades; and the emergence of a global network of information and telecommunications at the very laboratory from which many of E.A.T.'s engineers came. Indeed, AT&T's mission was *universal connectivity*. Until divestiture, Bell *owned the network*. And the network begat Bell Labs, hailed as "the world's greatest industrial laboratory."[4] Bell Labs envisioned a new model of scientific research in industry, of basic science practiced in the context of applied science. Moreover, they pioneered the idea that a kind of critical mass could be achieved by research at a large scale. This was the model for modern research, multiplying in "aggregate force"—and gaining this force via the resources, and capital, of an industry predicated precisely on building the largest network in the world.

I therefore focus on E.A.T.'s development of an astonishing set of media apparatuses—an early form of information processing, at the very moment of landmark innovations in computing at Bell—to register, sort, and match artists and engineers with automation and at scale. I examine the kinds of collaborations and relationships and networks these matches generated—and the phenomena of solutions without problems, inventions without end. Moreover, I explore the ways in which these media processes produced new kinds of collaborating subjects.

Chapter 4 explores the growth but also dispersion of E.A.T., in relation to the distribution of big science and large-scale research, and their strategies of diversification, specialization, and expansion. I examine the tensions between these aims in big science writ large, the specific case of Bell Labs, and the even more specific case of E.A.T. If big science ultimately subsumed pure science into applied science, Bell Labs broke down the distinctions between the two, for a brief but extraordinary period in the twentieth century. And if big science ultimately sought a paradoxical combination of

[4] Francis Bello, "The World's Greatest Industrial Laboratory," *Fortune* 58 (November 1958): 214.

decentralization and centralization, E.A.T. pursued a leviathan expansion and decentralization of activity, but struggled *against* a vertical hierarchy that would unify and consolidate its research. This struggle would be borne out in E.A.T.'s spread via Local Groups, branches of the organization around the world, and the questions of network, system, and structure this multiplication raised. Finally, I investigate E.A.T.'s largest single collaboration—the Pepsi Pavilion at Expo 70 in Osaka—and its enactment of and participation in utterly new forms of simulation, computation, and experience.

E.A.T. changed both subjects and objects, I argue, and these shifts form the focus of Chapter 5. Examining the crises of automation, technological development, and aesthetic experience, I address Automation House, a building-cum-artwork that E.A.T. constructed as its headquarters in New York in 1970. Here, the organization made myriad efforts to create a networked, architectural space; pioneering experiments in early television and video broadcasting; produce a participatory space of display; pursued a number of social and environmental endeavors, dubbed Projects Outside Art; and sought to explore the technological transformation of labor, but also the disruption of automated systems, particularly those of communication. In this way, E.A.T. began to address the destabilization of the institutions of capitalism and modernism, and the advent of man-made catastrophes—whether ecological, economic, actuarial, or military: the ways in which large-scale systems were proving not to beget order but disorder. This shift, I argue, provides a different way to think about power, control, technocracy, systems, and subjectivity under late capitalism.

*   *   *

The history of Experiments in Art and Technology is a major history. This is not a claim for grandeur or grand narratives. On the contrary, I want to acknowledge the critical burden of my project. Unlike a Deleuzian minor history, the following dissertation does not deal with a small, loose, or circumscribed group of individuals operating on the margins of culture, all the better to radically oppose large institutions and societies of control. Instead, I aim to understand an organization that took as its model the very definition of large-scale hegemony: big science.

E.A.T. looked to the massive systems of technological invention and innovation in the postwar period—to the international corporate research laboratory—in order to bring art and technology together. They did so at a time when these "two cultures" were seen as dangerously estranged, if not diametrically opposed, and when science itself had become synonymous with the corruption and maleficence of the military industrial complex, the leviathan of big science.

And yet E.A.T. did not simply reproduce the structures of big science to absorb or coopt those of culture. Instead, the organization produced a seeming paradox: E.A.T. advanced and transformed the radical aims of the minor, the underground, the neo-avant-garde, from *within* the deepest recesses of the major, the hegemonic, the web of the military-industrial complex and global technological communications. The organization sparked unprecedented collaborations between artists and engineers, individuals and corporations. In turn, it spawned new conflagrations of people and papers and knowledge, of technologies and new materials and found objects, of relationships and epistemologies. Growing to more than five thousand members at its height in the late

1960s, E.A.T. was as big as it was far-flung, penetrating an astonishing web of practices, institutions, and networks.

And so, using sociological tools—tools for the study of the many rather than the few—I examine this pioneering constellation as a large-scale aggregate of actors, one that did not operate as a collective in the traditional sense. The group's unprecedented transformation of artistic production must be understood in terms of a different (historical and sociological) *scale*. I take this scale as both subject and structure of analysis. Bruno Latour's actor-network theory, the rubric of big science, Bernhard Siegert's notion of cultural techniques, and Ulrich Beck's concept of the risk society underpin the art historical investigations I undertake.

As a result, this thesis is not monographic. It departs from (the few) other studies of E.A.T., which have largely relied on winnowing the analysis of multitudes into discrete narratives of individuals: Rauschenberg, Klüver, Whitman. Unlike such a conventional art historical monograph, focusing on the production of one artist or one workshop, I contend with a sprawling, proliferating network of thousands; with relationships rather than distinct subjects; and with actors, subjects, and objects that are never unified, integral, or autonomous individuals but are always divided, individuated, attenuated, and linked.[5] And so rather than a discipline or habitus, defined by a relatively

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[5] This has implications for research in the humanities. Writing on the historiography of big science, Bruce Hevly poses the necessity of new models for historical research that are not individual but are collaborative and even collective, scaled to match their subjects. This is because scientific concepts themselves "have undergone a complex social history before ever emerging from the laboratory": "The coordination and management of research, the sharing of key instruments, the preparing of reports and proposals for funding agencies, and the division of labor among those designing, building, and interpreting instruments and experiments all complicated the production of knowledge." Hevly, "Reflections on Big Science and Big History," in Peter Galison and Bruce Hevly, eds., *Big Science: The Growth of Large-Scale Research* (Stanford: Stanford University Press, 1992), 361.

stable and coherent set of "socio-transcendental conditions"[6]—a style—I understand E.A.T. as a field, in Latour's sense: a constantly shifting, split, and multiplicitous array.

[6] See Pierre Bourdieu, *Science of Science and Reflexivity*, trans. Richard Nice (London and Chicago: Polity Press and University of Chicago Press, 2004), 64-65; 80.

CHAPTER 1

TEST SITES:

PRODUCTION AND EARLY WORKS, 1962-66

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In the 1960s, invention was a problem. The art historian Leo Steinberg highlighted this predicament in 1968. In a lesser-known passage from his celebrated essay "Other Criteria," Steinberg boldly proclaimed that the progress of mid-century modernist painting followed a "corporate model of artistic evolution"—a scenario in which "the artist as engineer and research technician becomes important insofar as he comes up with *solutions to the right problem*."[1] Steinberg argued even more heretically that "tasks [are] set for the artist as problems are set for researchers in the big corporations," thereby equating scientific positivism and instrumentalized research with Greenbergian modernism's self-reflexive goal of flatness and opticality, of reducing all pictorial elements to a "pure" medium of painting.[2] The art historian likened Greenberg's deterministic critical apparatus to the streamlined ideals of efficiency in the Detroit

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[1] Leo Steinberg, "Other Criteria" (first presented as a lecture at the Museum of Modern Art, March 1968), in Steinberg, *Other Criteria: Confrontations with Twentieth-Century Art* (New York: Oxford University Press, 1972), 77-78. Emphasis added.

[2] Steinberg, "Other Criteria," 77. For Steinberg, "In formalist criticism, the criterion for significant progress remains a kind of design technology subject to one compulsive direction: the treatment of 'the whole surface as a single undifferentiated field of interest'… The painter's industry is a closed loop. The search for the holistic design is simply self-justified and self-perpetuating… It is probably no chance coincidence that the descriptive terms which have dominated American formalist criticism these past fifty years run parallel to the contemporaneous evolution of the Detroit automobile. Its ever-increasing symbiosis of parts—the ingestion of doors, running boards, wheels, fenders, spare tires, signals, etc., in a one-piece fuselage—suggests, with no need for Kant, a similar drift towards synthesizing its design elements." Ibid., 79. The major statement advocating a bond between empirical rationality and modernist painting's self-referential opticality had been Clement Greenberg's "Modernist Painting" (1960), in which the critic argued "That visual art should confine itself exclusively to what is given in visual experience, and make no reference to anything given in any other order of experience, is a notion whose only justification lies in scientific consistency." Clement Greenberg, "Modernist Painting," in *Modernism with a Vengeance, 1957-1969*, vol. 4 of Greenberg, *The Collected Essays and Criticism*, ed. John O'Brian (Chicago: The University of Chicago Press, 1993), 91.

automobile industry. Both enterprises, in other words, were premised on self-perpetuating and empirical *tests*. They could each be understood as a kind of administered problem solving.[3] Steinberg thus startlingly aligned the transcendent aims of modernist formal invention with what seemed to be the most repressive, intransigent, and instrumentaized system possible: technological research and development.[4]

But Billy Klüver's early collaborations with artists confounded Steinberg's equation of "reactionary" formalist and engineer. In projects with Jasper Johns, Robert Rauschenberg, Andy Warhol, and others, the engineer and the artists worked in conspicuous absence of any "right" problems. They upset teleologies of modernist invention and technical innovation alike. Indeed, the projects I discuss in this chapter demonstrate that models of postwar industrial research and development actually provided the possibility of alternate, unforeseen paths—ludic and non-functionalist modes of production that resulted in unstable objects or technological failure. This contact between the disciplines of engineering and of art was to shift the terms of

[3] Steinberg, "Other Criteria," 79.

[4] Four years after Steinberg's lecture, Rosalind Krauss' landmark essay "A View of Modernism" mounted an even stronger critique of Greenberg and Fried's modernisms as positivist and prescriptive models of art. See Krauss, "A View of Modernism," *Artforum* 11, no. 1 (September 1972): 48-51. According to Krauss, Greenberg and Fried grounded their esthetic criteria in the evaluation of rational decision-making ("[Fried] confined his analysis to the structure and not the color [of painting], because the first being the result of rational decisions could be usefully described, while the second being arbitrary could not") and the invention of a self-evident, reflexive structure. Their critical method "demanded lucidity. It demanded that one not talk about anything in a work of art that one could not point to. It involved tying back one's perceptions about art in the present to what one knew about the art of the past. It involved a language that was open to some mode of testing." Ibid., 49. Krauss thus explains Greenberg and Fried's system of judgment in terms of verifiability and empiricism—leading her to point out the practices (such as sculpture) that remain unaccounted for by this theoretical apparatus. Remarkably, Krauss describes these aberrations as Kuhnian "anomalies," symptomatic of "those periods in which evidence begins to be assembled which the reigning paradigm cannot explain; that is, under the terms of the existing paradigm the new evidence appears anomalous, freakish. But it is the pressure of this anomalous evidence that characterizes scientific advance, calling not only for its own acknowledgement, but demanding as well the invention of an entire new paradigm, or as Kuhn puts it an explanation of what has by then become a 'new world.'" Ibid., 51, n. 9. The debate on modernist formalism in terms of instrumental rationality, determinism, and causality will be elaborated throughout this chapter.

aesthetic process itself, seismically disrupting both the relentless forward drive of modernism and its dialectical negation by various neo-avant-gardes. The resulting frictions and shocks are, as we shall see, the reverberations of experimentation gone askew. They point to unexpected and anomalous testing.

Such catalytic contact between art and engineering was all the more surprising given the historical moment—one in which postwar technology was inseparable from the logic of large-scale organization, and when a deep-seated pessimism concerning the hegemonic presence of the command and control sciences arose even within the spheres of the military-industrial complex itself. Dystopian critiques of technology were partly spurred by histories and philosophies of science published in the 1960s that challenged teleological views of scientific experimentation and progress and their positivist armatures. Chief among these texts was Thomas Kuhn's *The Structure of Scientific Revolutions* (1962) and its elaboration of Gaston Bachelard's prior concept of the "epistemological rupture"; Kuhn, Alexandre Koyré, and Bachelard stood at the center of incipient anarchist and sociological models of science that would later be proposed by Paul Feyerabend and Bruno Latour.[5] Everett Mendelsohn has outlined the varying challenges posed by Kuhn but also by critics, philosophers, and historians ranging from Lewis Mumford to Herbert Marcuse, Theodore Roszak, C. Wright Mills, and Rachel Carson.[6] Klüver was steeped in these discourses, and he provided Rauschenberg and

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[5] Thomas Kuhn, *The Structure of Scientific Revolutions* (1962), (Chicago: University of Chicago Press, 1996); Gaston Bachelard, *Le nouvel esprit scientifique* (Paris: Librairie Félix Alcan, 1934); Paul Feyerabend, *Against Method* (New York: Verso, 1978); Bruno Latour, *Science in Action* (Cambridge: Harvard University Press, 1987).

[6] Everett Mendelsohn, "The Politics of Pessimism: Science and Technology circa 1968," in *Technology, Pessimism, and Postmodernism*, eds. Yaron Ezrahi, Everett Mendelsohn, Howard Segal (Dordrecht, Boston: Kluwer Academic Publishers, 1995), 151-173. While the critiques of Mumford and Marcuse are

other artists with a direct link to both technocratic thinking and its discontents—just as artists were contending with the aesthetic criteria advanced by Greenberg and then Michael Fried, another kind of positivist empiricism (as forcefully elaborated by Rosalind Krauss, four years after Steinberg).[7] Strangely enough, repurposing models of scientific inquiry and technological invention promised a route that might circumvent Greenbergian formalism. It might also, surprisingly, provide an alternative to neo-avant-garde strategies based on negation, ludic participation, and indeterminacy. Indeed, art historians have overwhelmingly evaluated the neo-avant-gardes (however diverse) as defensive postures (however slight or oblique) against instrumental technocracy—a position that cannot be said of the specific works and encounters I am discussing here.

Examining the early collaborative pieces *Zone* (1962), *Field Painting* (1963-1964), and *Silver Clouds* (1966) will provide entry points into this largely buried history. I view these initial works as attempts to grapple with, on the one hand, the increasing foreclosure of key aesthetic strategies in the postwar period; and on the other, the extraordinary systems in place for technocratic invention and control. Out of this impasse, this crucible, would develop the conditions of possibility for larger projects that involved larger systems—communications media, information networks, numerous participants: Rauschenberg and Klüver's *Oracle* (1965) and the performance series *9 Evenings: Art, Theatre, and Engineering* (1966); and, later, the founding of Experiments in Art and Technology at the end of 1966, yet another unruly and volatile test.

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well known, perhaps the sociological work of Mills and the environmental activism of Carson had the greatest impact on cultural views of technology at large.

[7] See Krauss, "A View of Modernism," 48-51.

I. Force Fields

Through his fellow Swede, the curator Pontus Hultén, Klüver met an increasing number of artists between 1958 and 1960—including Jean Tinguely, Robert Breer, Claes Oldenburg, Rauschenberg, and Warhol. After working with Tinguely and Breer on the former's *Homage à New York* in 1960, one of Klüver's earliest and most significant American acquaintances was Jasper Johns.[8] At the time of their meeting, the artist had recently stopped working with his signature "target." Yet the new motifs that replaced the target nevertheless continued an investigation into readymade and quasi-mechanical procedures conflating iconic sign and referent (Johns's depicted target could also be used isomorphically *as* a target; in a similar way, the wooden slat "device" he deployed as a makeshift compass and left hinged to a painting's surface remained fully operational).[9] Klüver selected a work that typified these concerns, Johns's *Thermometer* (1959), for the section the engineer curated in Hultén's landmark exhibition "Art in Motion" (*"Bewogen Beweging*") at the Stedelijk Museum in Amsterdam and the Moderna Museet in Stockholm in 1961.[10] Johns had embedded a functioning thermometer in the center of the painting, recalling Marcel Duchamp's seminal *Why Not Sneeze Rose Sélavy?* of 1921

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[8] Klüver briefly outlines the chronology of his meeting with Johns in Klüver, "What are You Working on Now?: 1960-1970," *Abstract Painting: 1960-69*, exh. cat. (Long Island City, NY: P.S. 1, The Institute for Art and Urban Resources, 1983), n.p.

[9] Jeffrey Weiss places new emphasis on the performativity and procedural nature of Johns's motifs in Weiss, "Painting Bitten By a Man," Jeffrey Weiss, ed., *Jasper Johns: An Allegory of Painting*, exh. cat. (Washington, D.C.: National Gallery of Art, 2007), 2-57.

[10] K.G. Pontus Hultén, ed., *Bewogen Beweging*, exh. cat. (Amsterdam: Stedelijk Museum, 1961). For the main exhibition, Hultén led a team of four curators—himself, Tinguely, Willem Sandberg, and Daniel Spoerri; Klüver was invited to select approximately twenty American artists for contributions (he asked Johns and Rauschenberg to produce kinetic works specifically for the show). The exhibition, the title of which is more accurately translated as "Moving Movement," has generally been characterized as a utopian bid for kineticism and its supposed unification of disparate mediums and phenomena; yet the circumstances are ultimately more complex. For a discussion of the exhibition's reception and the context of kineticism, see Chapter 3.

(which would have already been displayed as part of the Arensberg Collection by the Philadelphia Museum of Art).[11] But unlike Duchamp's piece, there were no preprinted numbers on the glass alongside Johns's mercury column—only numbers stenciled by Johns on the bordering canvas—and so the mercury's oscillating height wittily appeared to measure the "temperature" of the painting's hues.[12] In the midst of kinetic pieces by the likes of Tinguely and Len Lye at the "Art in Motion" exhibition, *Thermometer* must have seemed much more resolutely tied to the semiotic aspects of motion, foregrounding the status of a "natural" chemical process as arbitrary standard of measurement. Chromatic quantification and production would reappear as a central issue in Johns's work with Klüver the following year, in the form of the stenciled names of colors—a practice the artist had begun in 1959 and which further explored the relationship between use, convention, and representation.[13]

In 1962-64, Klüver partnered with Johns for two works incorporating oil paint and assorted objects on canvas: *Zone* (1962) and *Field Painting* (1963-64) [Figs. 1.1, 1.2]. Klüver and his colleagues Howard Hodges and Richard Payne fashioned portable,

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[11] The Philadelphia Museum of Art acquired the Arensberg collection in 1950, and it was first exhibited in October 1954. Kazimir Malevich's *Reservist of the First Division* (1914), in the collection of the Museum of Modern Art, New York, also included an actual thermometer—but whether Johns would have known this work is open to question.

[12] Roberta Bernstein, *Jasper Johns' Paintings and Sculptures 1954-1974: "The Changing Focus of the Eye"* (Ann Arbor and London: UMI Research Press, Studies in the Fine Arts: The Avant-Garde, 1975), 44.

[13] The earliest recognition of the complex relation between the readymade, action, and representation in the targets, "device," and stenciled letters appears in Leo Steinberg, "Jasper Johns: the First Seven Years of His Art" (1962), *Other Criteria,* 32-33. In an interview with Johns, Steinberg asked the artist repeatedly about the use of stenciled letters and whether he imputed conscious choice into the style or form of the letters: "*Q: Do you use these letter types because you like them or because that's how the stencils come? A: But that's what I like about them, that they come that way*.… I [Steinberg] had tried to distinguish between designed lettering subject to expressive inflection, i.e. letters that exist in the world of art, and those function letters that come in mass-produced stencils to spell THIS END UP on a crate. Proceeding by rote from this distinction between life and art, I asked whether the painter entertained an esthetic preference for these crude stenciled forms. Johns answers that he will not recognize the distinction." *False Start* (1959) is generally recognized as the first work in which Johns incorporated these stenciled names of colors.

high-voltage electric neon lights in the stencil-cut shape of the letters "A" and "R", respectively, for these works.[14] Johns did not want any electrical cords running to the paintings; to fulfill this request, the engineers knew they would need a battery-powered, high-voltage supply. But to stack batteries attached to the required amount of voltage would have been "messy, dangerous, and impractical," as Klüver said.[15] The engineers managed to construct a neon light powered by a battery cell with exceptionally long duration and minimal size. They began with rechargeable batteries of 12 volts each and devised a multivibrator circuit that, together with a transformer, gave them the 1200 volts needed. The result, Klüver proudly claimed, was "the first portable neon sign…the technical equipment, all four hundred dollars worth, was mounted behind the paintings."[16] A strangely indeterminate (and potentially useless) type of technical innovation thus emerged from the production of these works—and, with astonishing simultaneity, Klüver's work with Johns staged a profound morphological shift at the extremes of the artist's inquiry into the pictorial and optical [Fig. 1.3].

In both *Zone* and *Field Painting*, the dimension of the neon light is nearly perpendicular to the surface of the painting. Two distinctly opposed orientations and

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[14] P. Miller, "The Engineer as Catalyst: Billy Klüver on Working with Artists," *IEEE Spectrum* 35, no. 7 (July 1998): 24. For a brief formal description of the painting in the context of Johns's production in 1963-64, see Weiss, "Painting Bitten By a Man," 14. On the collaboration between Klüver and Johns, see also: Grace Glueck, "Scientist Brings Art to His Work," *The New York Times*, Dec. 17, 1965; Billy Klüver, "The Artist and Industry," lecture at Museum of Modern Art, New York, 1968, Sound Recording #68.26, Museum of Modern Art Archives, New York.

[15] Miller, "The Engineer as Catalyst," 24. See also Billy Klüver, "Artists, Engineers, and Collaboration," in *Culture on the Brink: Ideologies of Technology*, eds. Timothy Druckrey and Gretchen Bender (Seattle: Bay Press, 1994), 210.

[16] R.G. Miller, "Technology and the Arts," *Bell Telephone Laboratories Reporter* 15, no. 2 (March/April 1966): 18. *Field Painting* has been rewired several times, once in 1978 and again in 1995; according to Jay Krueger, head paintings conservator at the National Gallery of Art, Washington, D.C., the initial wiring was so disorderly that it constituted an electrical hazard.

gestalts arise. From a side view, the letters threaten to break away from the painting, functioning as objects that stand wholly apart from the picture plane. From the front, they flatten and recede. In *Field Painting*, the neon letter "R" forms part of a single vertical strip of elements down the center. Metal stencil-cut letters (a three-dimensional version of the painterly stenciled names of colors seen on either side) are attached by hinges to the painting and can be moved. An electrical switch sits on the left side of the painting—in the initial installation, this switch and button actually turned the light on and off. Magnetically charged objects (a bric-a-brac selection of iconic "Johns" objects—Savarin coffee and Ballantine beer cans, a paint brush, printmaker's squeegee and so forth) further augment the surface of *Field Painting* as a kind of switchboard or electromagnetic field across which various operations can be performed.[17] In *Zone,* these kinds of operations explicitly contend with those of painterly mark-making and depiction: the electric light cast by the neon letter over the painting is rhymed by a heavily brushed zone of depicted light and shadow "emanating" from it, as well as the painted shadow of the dangling brush, which competes with any actual cast shadow generated by the lights of the work's exhibition space. Incongruent axes of beholding, then—one an illusionistic vertical plane, the other approximating a horizontally oriented matrix of information, what Steinberg would famously call the horizontal "flatbed picture plane" six years later—are already in overt contestation.[18]

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[17] On the magnetic charge and placement of these objects, as well as the incidence of museum visitors moving or taking off the magnetic letters and turning off the light switch, see Jay Krueger, National Gallery of Art Painting Conservation Department Memo, March 14, 1994. Conservation Department file for *Field Painting*, National Gallery of Art, Washington, D.C.

[18] Steinberg's flatbed picture plane—much belabored—is of course fundamental to this discussion. It is the "opaque flatbed horizontal" that Steinberg opposes to the vertical and anthropomorphic plane of color field painting; moreover, it is the flatbed with all its connotations of detritus, noise, matrices of information and deposits of culture that Steinberg contrasts with the streamlined, empiricist "solutions" of Greenberg's

This play between pictorial, linguistic, material, and technological registers is most sharply articulated by the works' inquiry into *color as convention*. In *Field Painting*, the "R" is indeed red—one of the few instances in Johns's work where the linguistic sign directly corresponds to the color it names. And this was clearly important: according to Klüver, the engineers first made the letter "R" blue; Johns insisted that it be red.[19] Yet just to the right of the neon "R" is a stenciled "R" in grey oil paint over a red underlayer, and mirroring it to the immediate left is a stenciled "R" in blue-grey oil; the pigmented colors of each are nearly effaced by the red glow of the neon light and the reflective sheen of the paint surface [Fig. 1.4]. In this sense, the artificiality of the color produced by the neon light only serves to heighten the arbitrariness of color as named and perceived. With *Field Painting* the category of "red" is made to appear in all its guises: as a contest between incandescent and pigmented color, phenomenological versus literal hue, public convention versus private perception.[20] As Johns told Klüver in an interview in March 1963,

> "Well, you and I agree that there is red, but once there is an agreement then you use it in that way in terms of that convention. If we disagreed as to what red was, you said it was red and I said it was yellow, then what we have is a situation to which we would both respond differently. And I think that's frequently the case in painting."[21]

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aesthetic criteria. I will elaborate upon Steinberg's flatbed and Johns's reassessment of the readymade in relation to *Zone* and *Field Painting* in what follows. Steinberg, "Other Criteria," 82-91.

[19] Klüver, "Jasper Johns," in P. Miller, "The Engineer as Catalyst: Billy Klüver on Working with Artists," 24.

[20] In addition, the strong afterimage produced by the neon light provides another kind of embodied, phenomenal experience of color—one that Dan Flavin, for example, would go on to directly exploit in his all-green exhibition at the Kornblee Gallery in 1967.

[21] Johns, interview with Klüver, March 1963, sound recording on 33 1/3 inch vinyl record included in *The Popular Image,* exh. cat. (Washington, D.C.: Washington Gallery of Modern Art, 1963). Klüver interviewed eleven artists for this record (Jim Dine, George Brecht, Lichtenstein, John Wesley, Robert Watts, Tom Wasserman, Warhol, Claes Oldenburg, Jim Rosenquist, and Rauschenberg); Warhol designed the album cover. For partial transcripts of the interview with Johns, see also "Interview with Billy Klüver,"

Johns had explored this arbitrariness of color in the pendant to *Field Painting*, a work titled *Slow Field* (1962) [Fig. 1.5]. Here, the names of colors are primarily painted in a muted blue-gray, not corresponding to the hues that these words reference. In *Zone,* too, the less saturated and much more diffuse blue of the neon letter "A" likewise dissociates optical chromatic qualities from any linguistic signifier (such as a "B" for blue). In fact, color takes on the status of an active force or process. If Johns generally addressed color as an entire spectral set of red, yellow, and blue *pigment* (or, later, their complementary colors of orange, green and purple), in *Zone* the luminescent neon blue finds its uncanny partners in the mottled, prefab yellow of the paintbrush handle and the brownish-red "residue" in the dangling coffee cup—all various forms of readymade color that serve as indices for actions and processes in addition to that of painting, whether electrical, industrial, or gustatory.[22]

Such experimental procedures and materials challenged both visual certitude and scientific empiricism. They militated against a kind of opticality which would have been associated at the time with the most rational, or empirical, of the senses—not to mention the empiricism structuring Greenberg's modernist operations of negation and medium

in Kirk Varnedoe, ed., *Jasper Johns: Writings, Sketchbook Notes, Interviews* (New York: Museum of Modern Art, 1996), 87; and Klüver, *On Record: 11 Artists 1963, Interviews with Billy Klüver* (New York: Experiments in Art and Technology, 1981), 15-16.

[22] Steinberg recognized this systemic completeness in Johns's work with respect to color: "It is the same with his color. When he is not painting monochromatically, his colors present a schematic abstract of the whole spectrum." Steinberg, "Jasper Johns: The First Seven Years of His Art," *Other Criteria*, 35. On the conventionality of the names of colors in Johns's work, as well as his similar use of rulers, thermometers, color charts, and compasses as "instruments of hard quantification"—but with a different set of conclusions than the ones I make here—see Kirk Varnedoe, "Introduction: A Sense of Life," in Varnedoe, ed., *Jasper Johns: A Retrospective*, exh. cat. (New York: The Museum of Modern Art, 1996), 26.

specificity.[23] Each painting is mysteriously severed from the mark of technology and connectivity—no electrical cord, the internal wiring safely hidden behind the stretcher—yet both *Zone* and *Field Painting* become literal fields of action for non-pictorial forces: electricity, reading, and magnetism. It was in this sense that the surfaces of Johns and Klüver signaled the "radically new orientation" of Steinberg's flatbed picture plane, in which "the painted surface is no longer the analogue of a visual experience of nature but of operational processes."[24]

Yet *Zone* and *Field Painting* also exceeded the flatbed. Indeed, in these works the term "field" indicates not only a tabular plane, but also a fully three-dimensional space of operation. The stretchers in both *Zone* and *Field Painting* are unusually deep, nearly four inches in thickness. They house a box-like environment for the complex system of wiring running through the paintings—a system, in fact, not quite as streamlined as the one Klüver described. A photograph of the back of *Field Painting* (taken before a 1995 restoration at the National Gallery of Art in Washington, D.C.) actually shows a circuitous and unkempt system of wiring between neon light, switch, and battery [Fig. 1.6]; conservators and electricians at the National Gallery even deemed the original wiring system a highly dangerous fire hazard.[25] The instability and bulk of this

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[23] I have alluded to the discourses of Greenberg, Fried, Steinberg and Krauss; the historical intertwining of scientific positivism, repressive administration, and modernist art as a disciplinary regime has also been schematically articulated in Hal Foster, *The Return of the Real* (Cambridge: MIT Press, 1996), 53.

[24] Steinberg, "Other Criteria," 84.

[25] National Gallery of Art Painting Conservation Department, Treatment Report, *Field Painting,* May 25, 1995. Conservation Department file for *Field Painting*, National Gallery of Art, Washington, D.C. The condition revealed "…damage to the neon bulb resultant from a shortage associated with the method of original fabrication. The epoxy putty used to secure the neon bulb to the painting allowed transfer of current between the two ends of the bulb, eventually causing burning of a hole in the bulb and escape of the neon gas. Further inspection of the reverse of the artwork revealed a high risk of fire or electrical malfunction due to improper wiring. A 120 volt lamp wire stapled in scattered areas to the reverse of the

arrangement was due in part to the problem of neon lighting itself: behind the production of chromatic neon light was a fluctuating system of precariously calibrated gases and electric charge.[26]

Although the neon light is a nineteenth-century invention, its inherent volatility continued to pique engineers in the twentieth, sparking a resurgence of research into the increased stability of neon lights at General Electric and other companies in the early 1960s.[27] The crux of the problem is this: a neon lamp is a gas-discharge lamp containing neon and argon gases at low pressure; an electric current causes the gas to glow. Once lit, neon lamps exhibit the characteristic of "negative resistance"—increasing the current flow through the device decreases the resistance of the lamp and allows even more current to flow. To counteract this tendency, electrical circuitry external to the lamp must provide a means to limit current flow through the circuit or else the current will rapidly increase until the lamp is destroyed. If the current runs too low, however, the lamp will flicker and eventually die out. For lamps the size of the letters in *Zone* and *Field Painting* (approximately 8 inches long), a specially constructed voltage transformer is

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stretcher was used as a connecting wire to a 3,000 volt neon bulb. The reverse of the artwork was a tangle of wires with considerable build-up of dust and grime."

[26] Klüver's instructions for installing the neon letter "R" also accentuated the deep space of the stretcher as a site for dexterous and potentially thorny manipulations: "The letter 'R must be passed through the slot from the back of the painting. Then, holding the letter from the front of the painting, lift to insert it into the socket. With the top of the letter slightly tilted to the left from the vertical, very gently insert the plug into the socket, then gently turn clockwise to lock in position." Klüver, "Instructions for Neon Letter 'R'," document attached to reverse of *Field Painting*.

[27] Nikola Tesla first displayed his neon lights at the World's Columbian Exposition in 1893. In 1902, the French inventor Georges Claude was the first to apply an electrical discharge to a sealed tube of neon gas; in 1923, his company Claude Neon introduced the neon sign to the United States market. See John Waymouth, *Electric Discharge Lamps* (Cambridge: MIT Press, 1971).

required to limit the available current.[28] This type of transformer is precisely what Klüver, Hodges, and Payne fabricated for the paintings, in order to delicately regulate a constantly shifting system affected by current level, temperature, ambient radiation, and gas pressure. In these works, then, the two axes of vertical "window" and horizontal flatbed are joined by a third: a coursing field of the electromagnetic and the gaseous. *Zone* and *Field Painting* represent the irruption of the flatbed picture plane into a literally dynamic system of particles and waves.

And this was not the only incursion. The engineers' introduction of neon systems into *Zone* and *Field Painting* also radically extended Johns's manipulation of the Duchampian readymade. For Steinberg, the flatbed picture plane found perhaps its "most vital source" in Duchamp. More precisely, it was the matrices of diagrammatic and indexical information Duchamp presented in *The Large Glass* (1915-1923) and *Tu'm* (1918), or the upending of the tilted *Urinal* and floor-bound *Coatrack,* that demonstrated the readymade object's ground-breaking inversion of the upright, retinal picture plane.[29] As David Joselit has recently argued, Johns's major innovation was to wholly remake this Duchampian readymade object into a *verb*, a syntactical and temporal action.[30] The artist's penchant for molds and stencils in *Target with Plaster Casts* (1955) or *Gray*

[28] Eric Schiff, "How Do Neon Lights Work?", *Scientific American*, December 4, 2001, accessed at http://www.sciam.com/article.cfm?id=how-do-neon-lights-work.

[29] Steinberg, "Other Criteria," 85. Aside from Duchamp, of course, Steinberg singles out Rauschenberg's work of the early 1950s as the locus of the "great shift" in postwar New York art—the implications of which will be addressed in the subsequent section on Rauschenberg, Klüver, and *Oracle* in Chapter 2.

[30] David Joselit, "No Exit: Video and the Readymade," *October* 119 (Winter 2007): 37-45. For instance, "The verb's temporal modes coexist, as in the *Device* paintings, where the ruler itself might be considered in the present tense, while the marks it has made on the canvas are in the past." Ibid., 42. On Johns and the acoustic implications of works in terms of word, sound, and score (for example, the analogy between canvas tension and drumhead, or the potential ability to "play" the moveable wooden slats in the uppermost section of *Target with Plaster Casts* of 1955, see Harry Cooper, "Speak, Painting: Word and Device in Early Johns," *October* 127 (Winter 2009): 65-76.

Alphabets (1956), for example, "emphasizes the painterly mark's passage through a readymade threshold: the contours of an organ pressed into a mold function as a 'mark,' while stencils discipline brushstrokes in paintings composed of letters and numbers."[31] Bodily action upsets the codes of abstract language, echoing *Zone* and *Field Paintings'* destabilization of color as name or linguistic convention. But in these two paintings, the actions are not only mechanical. They do not "still require the motility of a body," as Joselit rightly maintains for Johns's other work of the same period.[32] The processes occurring in *Zone* and *Field Painting* are not just those of gravity or physical gesture but, as we have seen, those of electromagnetically charged currents and pulsing systems of light and vapor. In other words, the readymade as action verges on the condition of the readymade as *circuit* or network—a transition that Joselit has claimed for the advent of video art and Nam June Paik, but which I would suggest finds even deeper and earlier manifestations in Johns than previously expected.[33] The artist's collaboration with Klüver recast the readymade as a charged field. And this kind of field was shown to be fully subject to the logic of technological consumption.[34]

For just as these works converted the experience of painting into a set of mediated, "readymade" sensations and forces, they fittingly became barometers of

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[31] Ibid., 42. Along similar lines, Joselit briefly has discussed the various stenciled letters in *Field Painting* in terms of imprinting and reflection in "Mirroring and Molds: The Johns Theory of the Readymade," lecture, "Jasper Johns: The First Decade," public symposium, National Gallery of Art, Washington D.C., April 28, 2007.

[32] Ibid.

[33] Interestingly enough, Gyorgy Kepes is credited as the first artist to use neon tubing on a grand scale, in a light mural he constructed for the façade of a Radio Shack store (!) in downtown Boston, 1950. Douglas Davis, "Art & Technology—The New Combine," *Art in America* 58, no. 1 (January/February 1968): 39.

[34] Indeed, neon technology was instrumental in many consumer devices, including early mechanical television. J. van den Ende, W. Ravesteijn, D. de Wit, "Shaping the Early Development of Television," *IEEE Technology and Society Magazine* 16, no. 4 (Winter 1997/1998): 13-26.

technological obsolescence: *Field Painting,* for instance, has been updated twice with new technology by various parties. In 1978, Klüver supervised a rewiring of the piece that, as evidenced by an original document of instructions posted on the back of the painting and modified in 1978, changed the transformer and left the switch operative but made the button unnecessary [Fig. 1.7]. In its present state, after the 1995 restoration at the National Gallery of Art, the piece runs on electric rather than battery power; the switch and button no longer control whether the light is on or off.[35]

As a relentlessly ongoing procedure, *Field Painting* demarcates an alternate path for what would come to be called process art. I use "process" broadly, in terms of both simple *and* complex actions, mechanical *and* chemical. Process and duration are manifested here not just as gravity or bodily gesture or physical event but as temporality and movement keyed to that of technological obsolescence, both planned and contingent. The work recalls Lucio Fontana's use of neon in his hanging sculptures, which evacuated the gestural line with a nod to spectacle and kitsch (and against Italian luxury) in an exploration of fragility, the mundane, and the obsolescence of systems and technological parts themselves—less wondrous candelabra of artifice than sputtering sign.[36] Likewise, in *Field Painting*, any scientism or fetishization of technological wonder is immediately inscribed into the linguistic signification structure of advertising.

The interaction between Johns, Klüver, Hodges, and Payne was rather traditional in the sense that Johns, as the artist, initially determined the functional and material

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[35] National Gallery of Art Painting Conservation Department, Treatment Report, *Field Painting,* May 25, 1995. Conservation Department file for *Field Painting*, National Gallery of Art, Washington, D.C.

[36] See Anthony White, "Lucio Fontana: Between Spectacle and Kitsch," *Grey Room* 5 (Fall 2001): 55-77. Richard Serra's subsequent use of neon circa 1967 is equally apropos here, but deployed in construction with vulcanized rubber and other abject materials, Serra's works would not foreground the semantic aspects of neon tubing.

characteristics of the projects. Yet both the production of the pieces and their form—their conversion of the vertically oriented picture plane into an engagement with alternate orientations and non-pictorial forces and energies; the perpetual obsolescence of materials encoded into the works themselves—signaled an intervention into both aesthetic and technocratic spheres, one that did not obey normal rules of "problem solving" in either discipline.

***II. The Uncertainty Principle:* Silver Clouds**

A series of pneumatic, lambent forms drifted through New York's Castelli Gallery in April 1966 [Figs. 1.8, 1.9, 1.10, 1.11]. Dubbed *Silver Clouds*, the objects traced aleatory paths of movement—buoyed by air pressure, currents, spectators' bodies, architectural obstacles. The very act of observing the *Clouds* disturbed their position, following a kind of Heisenbergian uncertainty principle writ large.[37] Accident was kinetically enacted, never leaving a stationary trace or index. Some metallicized forms simply drifted out the gallery window.[38] And the *Clouds'* construction echoed such indeterminacy: Andy Warhol had worked with Klüver, Hodges, and other engineers in an open-ended process that aligned artistic production with scientific experimentation.

Silver Clouds interrogated the relationship between art, technology, and contingency. In both its collaborative production and entropic presentation, the *Clouds*

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[37] The physicist Werner Heisenberg's uncertainty principle provides an apt structural and contextual analogy for *Silver Clouds* (despite its admittedly overdetermined lay reception). Published in 1927 and a cornerstone of quantum mechanics, the uncertainty principle states that the more precisely the position of a subatomic particle is determined, the less precisely its momentum is known in that instant, and vice versa. The indeterminate relation between position and momentum had profound implications for the role of probability and causality in the determination of the future behavior of a particle: "quantum mechanics was the first theory that was universally recognized to be irreducibly probabilistic and therefore indeterministic with respect to many significant observable applications." Gerd Gigerenzer et al, *The Empire of Chance* (Cambridge: Cambridge University Press, 1990), 282.

[38] W.B., "Andy Warhol," *Arts Magazine* 40, no. 8 (June 1966): 46.

questioned evolutionary schemes of technological progress and modernist formalism alike. Art-making and technology became riddled with risk, disorder, and breakdown. At the same time, *Silver Clouds* addressed the legacy of chance as a postwar neo-avant-garde strategy, used most famously in the early work of John Cage and Rauschenberg. For Warhol and Klüver, however, chance was now unthinkable without considering its inscription in new systems of technocratic management and control.[39]

Castelli's installation involved just two rooms: one for the *Clouds*, and one lined in Warhol's *Cow Wallpaper* (1966)—images of a pastoral cow's bucolic gaze, silkscreened in a vertical pattern of garish Day-Glo hues [Figs. 1.12, 1.13]. The filmstrip-like wallpaper was not simply a mural but had been printed and installed by a wallpaper manufacturer, physically attached to the walls with adhesive.[40] This twofold combination of *Wallpaper* and *Clouds* has been brilliantly read by Benjamin H.D. Buchloh as a devastating critique of modernist painting.[41] Both landscape and monochrome lost any "metaphysical residue," whether the utopian expansion of painting into architecture or the easel's conversion into public and participatory reception.[42] From Jackson Pollock's industrial enamel to Frank Stella's aluminum surfaces, from Kasimir

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[39] On chance and the art of the 1960s, see also Robin Kelsey, "Playing Hooky/Simulating Work: The Random Generation of John Baldessari," *Critical Inquiry* 38, no. 4 (Summer 2012): 746-755. The following section was delivered as the lecture "The Uncertainty Principle: *Silver Clouds*," in the panel "Art and Accident," organized by Kelsey and Yukio Lippit, College Art Association Conference, April 2006. My reading is indebted to study with Kelsey and his work on photography and chance more broadly; see Robin Kelsey, *Photography and Chance* (forthcoming, University of California Press).

[40] *The Andy Warhol Catalogue Raisonne*, v. 2, ed. Georg Frei and Neil Printz (London: Phaidon, 2002), 209.

[41] Benjamin H. D. Buchloh, "Andy Warhol's One-Dimensional Art: 1956-1966" (1989), Buchloh, *Neo-Avantgarde and Culture Industry: Essays on European and American Art from 1955-1975* (Cambridge: MIT Press, 2000), 461-529.

[42] Ibid., 18.

Malevich's black square to that of Ad Reinhardt, the devices of metallic light reflection and monochromy were literally blown up and sent away as *Silver Clouds*.[43] Warhol's own retrospective statements would seem to support this interpretation. As he stated a year after the exhibition, "I didn't want to paint anymore so I thought that the way to finish off painting for me would be to have a painting that floats."[44]

For the prevailing criticism, then, the *Clouds* were a strict response to—and remained *within*—the conventions of painting; they functioned as a coda to Warhol's "high art" as distinguished from his films. But I would wager differently: that if we examine Warhol's overlooked collaboration with Klüver, the *Clouds* actually open onto expanded sites of production far beyond the trajectory of modernist painting and the logic of the pictorial object. Warhol and Klüver migrate from the paradigm of modernist negation to that of technological experimentation and its limits: both art and technology are as prone to instrumentalized results as to the proliferation of accident, dead ends, aimless "research." As Klüver later pronounced (in clear debt to Kuhn), "The

[43] One rupture in this genealogy has been noted by Caroline Jones, who discusses the very different use of metallic paint in Pollock's work than in Stella and Warhol's: Pollock transformed the metallic pigment into a soft, much less reflective grey, as opposed to Stella and Warhol's repellent fields of metallic paint. However, Jones still describes the *Silver Clouds* in terms of *pictorial* units—as "Mylar [sic] pillows that were presented as pictorial units that would simply drift away." Caroline Jones, *Machine in the Studio: Constructing the Postwar American Artist* (Chicago: University of Chicago Press, 1996), 212, 234. As I discuss later, the *Clouds* are obviously "silver" not because of pigment, but because of their actual metallized surface, opening onto structural similarities with non-pictorial and non-painterly fields of production.

[44] Andy Warhol, quoted in Gretchen Berg, "Nothing to Lose," *Cahiers du Cinéma in English* 10 (May 1967): 43. Scholars have also connected this statement to Warhol's declaration in May 1965 that he was giving up painting (which would ultimately be false), at the opening of his *Flowers* exhibition at the Ileana Sonnabend Gallery in Paris.

relationship [between technology and art] should be experimental and intuitive in the same sense that scientific research is… and therefore full of risks."[45]

Indeed, Warhol's post-exhibition comments positioning the *Clouds* as the end of painting must be reconciled with Klüver's repeated account that, upon their first acquaintance in the summer of 1964, Warhol had initially conceived of battery-powered "floating light bulbs," *not* "a painting that floats."[46] A series of unpredictable turns ensued. Klüver and his assistant at Bell Labs, Harold Hodges, researched the problem for nearly a year and could not find a solution. An electric light bulb with its own self-contained energy source was simply too heavy to float, whether or not it was made from a material lighter than glass. Thus Warhol's request at once enacted a technological dead end, even as it coyly referenced the most immediate example of technology's contamination of painting: Klüver's recent fabrication of the red neon "R" for Johns's *Field Painting*, which, as we have seen, stood perpendicular to the picture plane and whose portable power source was hidden. In 1961, Warhol had purchased Johns's 1958 drawing of a round incandescent light bulb, a study for Johns's sculpmetal rendition. The transaction looms in Warhol lore as the artist's move from commercial design to "high

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[45] Klüver, interview with Douglas Davis, *Art in America*, vol. 58, no. 1 (January-February 1968): 41. Klüver continues, "Whether technology works or fails is not a very important aspect of this relationship. We know for sure we can always make something work." On Kuhn's early challenge to the cumulative picture of scientific progress (and therefore to both logical positivism and realism), see Kuhn, "The Essential Tension: Tradition and Innovation in Scientific Research" (1959), *The Third University of Utah Research Conference on the Identification of Scientific Talent*, ed. C. Taylor (Salt Lake City: University of Utah Press), 162-74.

[46] Numerous unpublished documents and published statements reiterate this account. See for example: Klüver, "Interface: Artist/Engineer," manuscript of talk given at MIT on the occasion of the inauguration of the Center for Advanced Visual Studies, Massachusetts Institute of Technology, April 1, 1967, Museum of Modern Art Documents on Experiments in Art and Technology, Folder I, Document #44; Klüver, "Artists, Engineers, and Collaboration," 211; David Bourdon, *Warhol* (New York: H.N. Abrams, 1989), 228-230.

art."[47] Now the concept of a floating light bulb, wrested from Johns's pictorial plane or lugubrious sculpture, performed another escape from aesthetic object into industrial research and design.

While still pursuing the light bulb design, Hodges found the industrial textile Scotchpak, manufactured by the 3M Corporation (responsible for magnetic sound recording tape, dry-silver microfilm, and the Post-It). Scotchpak was a polyester film that could be aluminized, heat-sealed, and was relatively impermeable to helium. At the time of its patent in 1958, it had no designated application; in 1965, the U.S. Army was using the material to vacuum-pack sandwiches.[48] When Hodges and Klüver showed Warhol the silver material in the summer of 1965, the artist unexpectedly said, "Let's make clouds."[49] Klüver later commented in an unpublished interview, "I was quite surprised, of course, because that was nothing like what we had talked about."[50]

Klüver customized a heat-sealing machine for Warhol to test in his 47th Street studio, famously dubbed The Factory. After an unsuccessful attempt to create the curved

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[47] Leo Castelli remembers Warhol visiting his gallery in 1958 as "a great admirer of Rauschenberg and Johns and he even bought a drawing, a good one, a light bulb drawing of Jasper Johns." Leo Castelli, interviewed by David Bailey, in *Andy Warhol: Transcript of David Bailey's ATV Documentary* (London: Bailey Litchfield/Mathews Miller Dunbar, 1972), n.p. Warhol's contested relationship to Johns and Rauschenberg has been well documented. See also: Ann Hindry, "Andy Warhol: Quelques grands témoins: Sidney Janis, Leo Castelli, Robert Rosenblum, Clement Greenberg" (interview with Leo Castelli), *Artstudio* 8 (1988): 115.

[48] Minnesota Mining and Manufacturing, "3M Scotchpak™ Heat-Sealable Polyester Film ES-241: Product Information," 2005, n.p.

[49] Klüver also recalls that Warhol had made several realistic drawings of clouds while pursuing this idea. Klüver, interview with Matthew Wrbican, July 24, 1998, audiotape, Andy Warhol Museum Archives, Pittsburgh, PA. The account is repeated in Klüver, "Artists, Engineers, and Collaboration," 211.

[50] Klüver, interview with Matthew Wrbican. Warhol's own characteristic confusion of statements—for instance, declaring at one moment that he himself had "invented" the silver pillow, at others that Klüver had thought of the silver—furthers the impression that the origin of the *Clouds* was nonlinear and full of crossed signals, unrealized ideas. See Andy Warhol, 1966 interview with Alan Solomon, quoted in Rainer Crone, *Andy Warhol* (New York: Praeger, 1970), 30; Andy Warhol and Pat Hackett, *POPism: The Warhol 60s* (New York: Harcourt Brace Jovanovich, 1980), 149.

contours of a cumulus cloud, Warhol decided to simply fold the material once and heat-seal it on three sides [Fig. 1.14]. Instead of "light bulbs," then, Warhol and Klüver devised 3' x 4' rectangular balloons whose physical attributes—a monochrome field, light-reflective surface, and buoyancy—were shaped by the artist's interaction with engineers. The process redefined monochrome and light-reflective surface as *extra-painterly* traits of a technologically mediated field of production and materials, from recording film to satellites. Indeed, the objects bore more than a casual resemblance to Echo I—America's answer to Sputnik in 1960, a telecommunications satellite made of inflated Mylar (a material almost identical to Scotchpak, but which could not be heat-sealed) [Fig. 1.15]. The effort with Warhol also presented new morphological possibilities of Scotchpak and other aluminum laminates for industrial purposes (i.e., something other than sandwich preservation). *Silver Clouds* thus repurposed the functionalist teleology of industrial research even as it literally distended the endpoint of modernist painting (the monochrome).

Klüver's nonlinear view of production had persisted since his entry into the art world—his work on Jean Tinguely's *Homage to New York* (1960) [Fig. 1.16]. At the unveiling of the auto-destructive machine, Klüver declared, "No distinction can be made between the 'random' elements, the accidents, or the controlled parts in making the spectacle."[51] This position found later affinities with Kuhn's 1962 texts on scientific crisis and causality; but it also had earlier roots. Since 1958, we should recall, Klüver

[51] Klüver, "The Garden Party" (1960), *The Machine, as Seen at the End of the Mechanical Age* (New York: Museum of Modern Art, 1968), ed. Pontus Hultén, 171. Elsewhere in the essay, Klüver maintains the dissociation of engineering as a discipline from the nonfunctionalist possibilities of the machine: "During the construction of the machine, I was constantly amazed at Jean's disregard for the simplest rules of engineering. In one instant he would demand that something should function, and in the next he would violate his demand by the most trivial of actions." Klüver, 171.

had worked in Bell's Physical Optics and Electronics Research Division, as well as working closely with the Communication Sciences Division under John R. Pierce.[52] Both used applications of the mathematical theory of communication, developed in 1948 by their colleague at Bell (and Pierce's close friend) Claude E. Shannon, and based on the control of information through probabilistic means. In a new, specific use of the term, Shannon had dubbed "uncertainty" as "the very commodity of communication": in a message, *information is uncertainty*, that which we do not already know.[53] For Klüver, the production of meaning came from parsing information as a set of unknowns.

The first of the "clouds" also signaled a move away from aesthetic objecthood and into uncertainty (after all, according to Hubert Damisch, clouds embody chance and its formlessness, "having only accidental and transitory presence").[54] Rather than a pictorially sized rectangle, the prototype was an elongated, 30-foot column that Warhol, Klüver, and others fabricated in the Factory and launched into the sky on October 4, 1965. A series of photographs provides a suspenseful, play-by-play narrative of the launch [Figs. 1.17, 1.18, 1.19, 1.20, 1.21, 1.22]. And Warhol's little-analyzed audio recording of the event—taken with his ubiquitous tape recorder, which he called his "wife"—positions the *Cloud* as a projectile, a "silver space balloon".[55] As they prepare

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[52] Klüver, "Artists, Engineers, and Collaboration," 207.

[53] The known quantities in a message are pure redundancy. See Claude E. Shannon, *The Mathematical Theory of Communication* (1949), (Urbana: University of Illinois Press, 1998), 48-57; Warren Weaver, "Some Recent Contributions to the Mathematical Theory of Communication," ibid., 13; John R. Pierce, *An Introduction to Information Theory: Symbols, Signals, and Noise* (1961), (New York: Dover, 1980), 24.

[54] Hubert Damisch, *A Theory of /Cloud/: Toward a History of Painting*, trans. Janet Lloyd (Stanford: Stanford University Press, 2002), 54.

[55] Andy Warhol, audio recording, October 4, 1965. Audiotape 1199, Andy Warhol Museum Archives, Pittsburgh, PA. The recording also shows that Warhol is extremely assured in his handling of cutting and heat-sealing the Scotchpak, demonstrating his facility with the heat-sealer and inflation apparatus.

for liftoff, Warhol asks, "Is it safe for it to go up?" The balloon takes off amid Warhol's ecstatic cries, but concerns immediately arise. "It's a snake, it's a killer, it's scary! It's going to wander around into an airplane… They're going to call the police!" Warhol exclaims.[56] The sound of a helicopter emerges, and Warhol worries that the zeppelin-like balloon will cause a helicopter crash.

This fear of disaster permeates the rest of the event (and its audiovisual recording)—providing yet another way to view Warhol's *Silver Disaster* (1963) and his disaster series based on media images of plane crashes, car accidents, or electric chairs [Fig. 1.23].[57] These images merged monochrome and silkscreen reproduction in a visual evocation of the mass subject, as aftereffect of both mass media and technological failure.[58] But the kinetic spectacle of the test cloud moves *outside* such pictorial strategies, *actualizing as risk* the image of technological catastrophe.

Thus if the collaborative invention of Klüver and Warhol pointed to the possibilities of experiment and risk in method, this first incarnation of the *Clouds* undertook the *production of risk itself*: risk as technologically manufactured and, by necessity, managed.[59] For sociologists such as Ulrich Beck, Anthony Giddens, and

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[56] Andy Warhol, audio recording, October 4, 1965. Audiotape 1199, Andy Warhol Museum Archives, Pittsburgh, PA.

[57] The progenitor of this series, *129 Die in Jet!* (1962), was based on a clipping from *The New York Mirror*, June 4, 1962. Upon examination of the clipping, contained in Warhol's *Time Capsule 21* at the Warhol Museum Archives, it is interesting to note that the only other extremely legible information provided is "Weather: fair with little change in temperature"—linking the contingency of the accident to that of climate. Andy Warhol, *Time Capsule 21*, TC21.1, Andy Warhol Museum Archives, Pittsburgh, PA.

[58] Hal Foster, "Death in America" (1996), in *Andy Warhol*, ed. Annette Michelson (Cambridge: MIT Press, 2001), 80.

[59] This is in contrast to later recuperations of the cybernetic, as in the exhibition "Cybernetic Serendipity," at the ICA London in 1968; the catalogue defines 'serendipity' as "The faculty of making happy chance discoveries." *Cybernetic Serendipity*, ed. Jasia Reichardt (London: W&J Mackay, 1968), 3.

Niklas Luhmann, postwar modernity can be defined by this shift from risk as external force of nature to risk as man-made production, often attributable to specific agents. We had now entered a period when "uncertainty absorption," to use Luhmann's phrase, was the major task of organizations and individuals—not to mention wartime fields such as operations research, cybernetics, and information theory.[60] This represented the full-blown domination of the "taming of chance," the rise of statistics in all fields of life in the nineteenth century.[61] What better way than the test cloud to enact the contest between uncertainty and its absorption, at the very historical moment that fear of nuclear and ecological calamity had reached a fever pitch?[62] [Fig. 1.24.]

Silver Clouds' drift outside modernist negation hinges on unlocking the relationship between chance and nature.[63] Indeed, the dominant reading of the *Clouds* maintains that they are the culmination of a neo-avant-garde response to the modernist monochrome that begins with Rauschenberg's *White Paintings* (1951-53) [Fig. 1.25].

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[60] Niklas Luhmann, "Risky Behaviour of Organizations," *Risk: A Sociological Theory*, trans. Rhodes Barrett (Berlin: Walter de Gruyter, 1993), 199. In his analysis of high technology, Luhmann adds that after this shift, "the pertinent safety technology is more difficult to install than the technology that produces the originally intended effects." Luhmann, 92. The test cloud also brought into focus the dangerous proximity between *risk* and *uncertainty*: modern statistics defined "risk" as a calculable probability, as opposed to *uncertainty*, for which statistical data was either inestimable or unknown. See S. Reddy, "Claims to expert knowledge and the subversion of democracy: the triumph of risk over uncertainty," *Economy and Society*, vol. 25, no. 2 (1996): 222-54. On the status of fear and risk in postmodern society, see Brian Massumi, ed., *The Politics of Everyday Fear* (Minneapolis, MN: University of Minnesota Press, 1993). The views of Luhmann, Beck, and Giddens on risk should not be conflated and the difference between their arguments, in particular between that of Luhmann and the latter two sociologists, is addressed in the following chapters.

[61] See Ian Hacking, *The Taming of Chance* (Cambridge: Cambridge University Press, 1990), 180-215.

[62] T.J. Clark has also positioned steam as a cipher for modernism's paradoxical imbrication of contingency and industrial automation. See Clark, "Modernism, Postmodernism, and Steam," *October* 100 (Spring 2002): 154-174.

[63] One could argue that this route of negation into the arena of minimalism and toward conceptual art had already been broached in Robert Morris' *Mirrored Cubes* (1965) and solid, rectangular fiberglass *Cloud* (1963).

Cage's well-known description of these canvases posed them as "airports for the lights, shadows, and particles."[64] In these works, as Branden W. Joseph has argued, the self-reflexive flatness of the modernist monochrome, its drive of negation toward pure medium, was converted into a blank field for nature's chance operations, a ground for arbitrary shadows and dust to alight—much as Cage's infamous *4'33"* (1952) scored aleatory background noise.[65]

Like *White Paintings* and *4'33"*, *Silver Clouds* enacted a stochastic process. After the initial test launch, Warhol and Klüver made several dozen *Clouds* (the exact number is not known) for Castelli. The ratio of helium to other gases inflating the *Clouds* was indeterminate, producing varying levels of buoyancy.[66] The objects obeyed a kind of Brownian movement, always in motion relative to the heat gradient of their surroundings. (Because of this excessive motion, The Andy Warhol Museum in Pittsburgh has gated its current installation, after wayward *Clouds* escaped their gallery and floated into adjacent rooms.) The initial type of valve used could not withstand re-inflation, so each balloon deflated slowly at a different rate over time.

But the deployment of indeterminacy in the *Clouds* differs radically from Cage and Rauschenberg's work of 1951-52 (and, I would argue, other investigations of chance

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[64] John Cage, "On Robert Rauschenberg, Artist, and His Work" (1961), in *Silence* (Middletown, Conn: Wesleyan University Press, 1961), 102. See also Cage, "Experimental Composition," *Silence*.

[65] Branden W. Joseph, *Random Order: Robert Rauschenberg and the Neo-Avant-Garde* (Cambridge: MIT Press, 2003), 57.

[66] *The Andy Warhol Catalogue Raisonne*, v. 2, 209. The behavior of the gases, as Klüver was well aware, was a cardinal example of probability: a normal distribution applied to the temperature / velocities of molecules in an ideal gas. Gigerenzer et al, *The Empire of Chance*, 272.

up to the mid-1960's, such as that of early Hans Haacke or George Brecht).[67] For Cage, the use of chance in score or performance "brings us closer to *nature* in her manner of operation." Chance was nature's noise, in all its indeterminacy and temporal flux—witness Rauschenberg's continually crumbling *Dirt Painting (for John Cage)* (c. 1953) [Fig. 1.26]. In *Silence* (1961), Cage waxed romantic about such individuated experience of nature, as liberation from the technological instrumentalization of life (as well as theories of statistical prediction derived from instrumental reason): "The emotions of human beings are continuously aroused by encounters with nature. Does not a mountain unintentionally evoke in us a sense of wonder? Otters along a stream a sense of mirth?"[68] While this statement might seem to contradict Cage's view of nature as fundamentally anti-anthropomorphic, a state of raw matter divorced from models of subjective interiority, I would argue that it actually serves to highlight the contradictions in Cage's theory of flux and material equivalence among all things and beings—a materialist theory of nature that was nevertheless heavily influenced by the work of Bergson, and

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[67] Haacke and Brecht's uses of chance were in many ways highly scientistic or at least reliant on metaphors from science (i.e., Brecht's 'event' as a term taken from physics); but both employed science as another manifestation of nature (the *natural* sciences as forces of nature): physics and mechanics, divested of the applied sciences. Brecht, in fact, was to reject this scientistic aspect of his work almost immediately. See Liz Kotz, "Post-Cagean Aesthetics and the 'Event Score'," *October* 95 (Winter 2001): 55-89; Julia Robinson, *George Brecht: Events, A Heterospective*, ed. Alfred Fischer (Köln: Walther König, 2006); and my "Research and Development: Robert Watts and George Brecht's *Yam Lecture*," in *Concept Action Language* (Vienna: Museum Moderner Kunst Stiftung Ludwig Wien and Cologne: Walther König, 2010), 69-85. In Brecht's *Chance Imagery*, printed in 1966 but formulated in 1960, he cites numerous avocations of life merging into Nature, such as that of Jean Arp, whom he quotes as saying, "'Reason has cut man off from nature.'" George Brecht, *Chance Imagery* (New York: Something Else Press, 1966).

[68] John Cage, "Experimental Music," *Silence*, 10. In Susan Sontag's essay "The Aesthetics of Silence," published in the journal *Aspen* in 1967, she reiterates the mystical aspects of Cage in terms of the history of art production as a series of myths: "The newer myth, derived from a post-psychological conception of consciousness, installs within the activity of art many of the paradoxes involved in attaining an absolute state of being described by the great religious mystics. As the activity of the mystic must end in a negative, a theology of God's absence, a craving for the cloud of unknowingness beyond knowledge and for the silence beyond speech, so art must tend toward anti-art, the elimination of the 'subject' (the 'object,' the 'image'), the substitution of chance for intention, and the pursuit of silence." Susan Sontag, "The Aesthetics of Silence," *Aspen* 5+6 (Fall/Winter 1967): Item 3.

paradoxically verged on the romantic and revelatory.[69] Cage and Rauschenberg's early grounding of chance in what Konrad Boehmer has called a "cult of unmediated nature" cannot be mapped onto the technologically mediated *Silver Clouds*.[70]

All that an organic, aleatory mode of reception seemed to offer—differentiated and individuated experience, no privileged anthropomorphic point of view—emerged in *Silver Clouds* as always already inscribed in a fully technocratic space of automation and consumption.[71] Instead of the liberating dynamism of nature, many viewers felt only tedium: as *New York Times* critic John Canaday wrote, "Inflated with a gas, [the pillows]

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[69] This contradiction in terms is not unlike the experience called forth by the Rorschach test, whose "neutral," "chance," or "unintentional" visual forms were intended to solicit individual instances of perception, only to subsume them into schemes of psychoanalytic classification (an experience Warhol recalled much later in his deadpan *Rorschach Paintings* of 1984). "Rorschach believed that only a maximally objective stimulus, one that appeared utterly removed from human intentionality, could reveal the purely subjective nature of the response," albeit for the purpose of classifying these responses under broad, structural characteristics of an individual and group's perception. Peter Galison, "Image of Self," *Things That Talk*, ed. Lorraine Daston (Cambridge: MIT Press, 2004), 258.

[70] Konrad Boehmer, "Chance as Ideology" (1967), trans. Ian Pepper, *October* 82 (Fall 1997): 70. Rauschenberg's first conception of the *White Paintings* was explicitly religious, as was Cage's description of a work similar to *4'33"* in 1948. Branden Joseph has shown that the shift from the work as manifestation of the divine to a ground for ambient, temporal events occurred around 1951-52, after Rauschenberg and Cage became acquainted. But the subsequent use of *the I-Ching* by Cage as well as Brecht, Maciunas, and Young in 1962-63 continued to tie nature and chance together with quasi-mystical language: "'Nature…is calm and still…it tolerates all creatures equally…therefore it attains what is right for all without artifice or special intentions. Man achieves the height of wisdom when all that he does is as self-evident as what nature does.'" Brecht, "Paragraphs, Quotations, and Lists," Spring 1961, in *An Anthology of Chance Operations*, ed. George Brecht, LaMonte Young et al (New York: George Maciunas and Jackson MacLow, 1962), n.p. Nam June Paik echoed these sentiments in his contribution to *Anthology*: "…while looking out of the window of the moving train, I realized for the first time the old Zen-Cage thesis: 'It is beautiful, not simply because it changes beautifully, but—simply—because it changes.' If nature is more beautiful than art is, it is not so because of its intensity or complexity but because of its variability, abundant abundancy, endless quantity." Paik, "Essays," ibid.

[71] The *Clouds* thus also held implications for indeterminacy different from of Hans Haacke's early work, with which it otherwise shares many obvious characteristics. As Haacke stated as late as 1965, he wanted "To make something indeterminate…which reacts to light and temperature changes, is subject to air currents and…gravity…something which the 'spectator' handles…To articulate something Natural." Haacke, untitled leaflet, Cologne, 1965, cited in Benjamin H.D. Buchloh, "Hans Haacke: Memory and Instrumental Reason," *Neo-Avantgarde and Culture Industry: Essays on European and American Art fom 1955 to 1975* (Cambridge: MIT Press, 2000), 240. On Haacke's early position (expressed in his well-known interview with Jack Burnham) of attempting to push a positivist rationality so far until it became "something very poetical, weightless and irrational," a kind of transcendence, see ibid., 214.

float around and can be stimulated to movement—by a yawn of boredom."[72] This ennui matched Warhol's own mottos of automated monotony, self as servomechanism: "I like boring things," "I like everything to be the same over and over again."[73] The *Clouds* squared the indeterminacy of an organic atmosphere with self-regulating system in a strangely repetitive, kinetic, *and* specular mode.

This specularity is seldom remarked upon—but it is worth exploring why Warhol would have chosen such highly reflective surfaces for the inflatables. Rather than resting as an absorptive field for nature's raw matter, they actively ricocheted back a speculum of their institutional surround. And these changing reflections were distorted, mobile, and multiple, exceeding the kind of self-reflexivity or tautology seen in the Minimalist cube's mimicry of its architectural parameters.[74] The *Clouds'* warped and puckered mirror effects highlighted their commercial conditions of display as well as their means of production: visitors made the connection to both film stock and the silver interior of The Factory [Fig. 1.27].[75] Like the wrinkled Factory walls, first covered in silver paint and foil in 1964, the *Clouds* were all brilliant figure at one moment, dissolved ground at

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[72] John Canaday, "What's in a Name, Like Warhol or Vanderbilt?," *The New York Times*, April 9, 1966, 13.

[73] Andy Warhol, n.d., as cited in Kynaston McShine, ed., *Andy Warhol: A Retrospective* (New York: Museum of Modern Art, 1989), 457.

[74] On the correspondence between linguistic tautology and the deployment of the cube and square in Minimal and proto-Conceptual art (for example, Robert Morris' *Mirrored Cubes* [1965] or Larry Bell's *Mineral Coated Glass Cubes* [1965]), see Benjamin H.D. Buchloh, "A Tale of Many Squares," in "Conceptual Art 1962-1969: From the Aesthetic of Administration to the Critique of Institutions," *October* 55 (Winter 1990): 130-135. Indeed, the torqued and liquefied reflections of the *Clouds* may have more to do with Warhol's strange projection drawings from the late 1970s, such as the "Space Fruit" series, which Buchloh has recently described: "Their curvatures bleed into space to defy their presence as volumetric illusions, as much as their plenitude of natural objects is inaccessible to the touch. It is impossible to distinguish their blending with space from the bleeding of form into its surroundings, which seem to devour the contours of the illusion of fruit voraciously." Benjamin H.D. Buchloh, "Drawing Blanks: Notes on Andy Warhol's Late Works," *October* 127 (Winter 2009): 10-11.

[75] In his 1966 interview with Alan Solomon, Warhol himself declared that he liked silver "because it made things disappear." See Crone, 30.

the next. They oscillated between light-emitting body and warped projection screen, between kinesthetic and mediated observation. What ensued was a fundamental disruption of the opposition between *object* and *image,* the material world versus the projected. The entropic, simulacral mirroring that Rosalind Krauss found in Roger Caillois's imitative praying mantis or in Robert Smithson's *Enantiomorphic Chambers* was here knocked further off balance, never settling into a dedifferentiated equanimity.[76] Such conditions persisted across boundaries normally drawn between Warhol's "high art" and his multimedia endeavors—for example, his Exploding Plastic Inevitable (1966) [Fig. 1.28], a nightly spectacle that confused filmic images with real bodies, spectra and spectators, and whose two-week run coincided with the Castelli exhibition of *Clouds/Wallpaper*.[77] Both works tapped into the experiential, rather than merely iconographic, dimensions of mass culture and technology.[78]

After the Castelli show, *Clouds* were mass-produced in an unlimited edition of multiples at Warhol's Factory. Unlike Warhol's pictorial works, the number and sales of individual balloons were never recorded, remaining undetermined in the artist's catalogue raisonné.[79] Many have been discarded, destroyed, or lost. Castelli himself inventoried the *Clouds* with a single entry, neglecting to note either quantity or measurements. The

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[76] Rosalind Krauss, "Entropy," *Formless: A User's Guide* (New York: Zone Books, 1997), 73-78.

[77] On relations of "figure" and "ground" in *Silver Clouds* and the EPI, see: David Joselit, "Yippie Pop: Abbie Hoffman, Andy Warhol, and Sixties Media Politics," *Grey Room* 8 (Summer 2002): 62-79. Joselit reads the *Silver Clouds* as "all figure," in contrast to the cow wallpaper's "all ground"; but I would argue that the *Clouds* were, more precisely, both figure and ground, endlessly vacillating between the two.

[78] Indeed, their ephemeral mirrorings seemed to indicate the fleeting obsolescence of the reflected subjects themselves.

[79] *The Andy Warhol Catalogue Raisonne*, v. 2, 205-211. It is interesting to note the affinity between Warhol's titles for the "Exploding Plastic Inevitable" and *Silver Clouds*, in their parallel evocation of combustion, pneumatics, and plastics.

individual *Clouds* were for sale at fifty dollars each, yet few were sold; Castelli kept no record.[80] Similarly, the shapes and sizes of the balloons were variable over time, throughout numerous subsequent exhibition venues.[81] In just the first ten months, the *Clouds* seemed to be everywhere: they wafted to the Institute of Contemporary Art Boston (where twelve appeared), the Ferus Gallery in L.A. (this time, one hundred), the Cincinnati Contemporary Arts Center, and Galerie Rudolf Zwirner in Cologne. These changes in scale produced markedly different effects, ranging from the relative freedom of isolated movement to a claustrophobic crowding in which *Clouds* would fill the ceiling. Subject to deflation and disrepair, the *Clouds* were probably restocked at Cincinnati and Cologne. At Ferus, deflated *Clouds* could be purchased in a plastic bag stamped with Warhol's signature [Fig. 1.29].

This dispersal of the work as limitless in supply, replaceable, and prone to market speculation exemplified the contemporary experience of mass consumption as always verging on the arbitrary, an endless flow of over-production and planned obsolescence which does not seem to obey laws of supply or demand.[82] And the *Clouds'* proliferation, their logic of serial production and replay, contrasted with Cage's opposition to the *mechanical reproduction* of music, its reification in the commodity form of the record.[83]

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[80] Leo Castelli, interview with Paul Cummings, May 14, 1969, Tape 1, Archives of American Art, Smithsonian Institution.

[81] *The Andy Warhol Catalogue Raisonne*, v. 2, 209.

[82] Warhol himself related the *Clouds* to his acquisition of dozens of inflatable "Baby Ruth" candy bar replicas, each almost the same 3x4 foot size as the *Clouds*, in November 1966. This act also seems to reference the accidental and arbitrary selection of the readymade. Yet the *Clouds* go *beyond* the singular Duchampian readymade, both in the work's quantity and multiplication and its sharp foregrounding of a technologically mediated space.

[83] Warhol, in contrast, listened to the same LPs ad nauseum. On Warhol and Cage's differing notions of repetition, see Branden W. Joseph, "The Play of Repetition: Andy Warhol's *Sleep,*" *Grey Room* 19 (Spring 2005): 22-53.

Different types of chance, in other words, also proposed different types of deskilling. Warhol and Klüver's mode of production acknowledged the threat of automation and repetition, even (or perhaps most acutely) in a situation of infinite differentiation; Cage, however, attempted to circumvent this tendency.

An unfixed and expanding set that infiltrated the world around it: the *Clouds* thus also violated a condition of the "open work" that Rauschenberg, Cage, and Umberto Eco took for granted circa 1960—its boundedness, its frame. "A work of art can be open only insofar as it remains a work; beyond a certain boundary, it becomes mere noise," Eco wrote.[84] Any Zen contemplation of "the drifting of clouds" had to be bracketed to be understood, much like *4'33"*'s context in the concert hall or the *White Paintings'* gallery wall.[85] But the decentered *Clouds* confounded an observer's ability to *receive* uncertainty, to interpret signal against noise.

These competing views of chance and its form remained in dialogue with each other in subsequent years, not least in Cage and Rauschenberg's own increasing involvement with technology (and, of course, with Klüver).[86] An errant *Cloud* appeared at Rauschenberg's studio in October 1967, at a press conference for the founding of

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[84] Umberto Eco, *The Open Work* (1962) trans. Anna Cancogni (Cambridge: Harvard University Press, 1989), 100. On the introduction of concepts of entropy and information theory via Georges Bataille and Umberto Eco in postwar art, see Yve-Alain Bois's seminal reading of Ed Ruscha's word paintings: Yve-Alain Bois, "The Use-Value of 'Formless'" and "Liquid Words," *Formless: A User's Guide* (New York: Zone Books, 1997), 34-40, 124-129; Yve-Alain Bois, "Thermometers Last Forever," *Edward Ruscha: Romance With Liquids* (New York: Gagosian Gallery, 1993).

[85] On the inscription of *4'33"* inside the concert hall, and Cage's split between theory and practice, see: Lydia Goehr, *The Imaginary Museum of Musical Works: An Essay in the Philosophy of Music* (Oxford: Oxford University Press, 1992), 261-264.

[86] Cage, for example, was by no means wholly opposed to technology; indeed, by the mid-1960s, he was to turn from his earlier explorations of chance operations toward unbounded processes dependent on electrical components. See James Pritchett, *The Music of John Cage* (Cambridge: Cambridge University Press, 1993), 158.

Experiments in Art and Technology (E.A.T.) [Fig. 1.30]. (The speaker is John Pierce of Bell, who was to serve on E.A.T.'s Board of Directors.) In 1968, the *Clouds* became the set for Merce Cunningham's performance *RainForest* [Fig. 1.31]. The *Clouds* were too unruly for Cunningham, who tethered them, complaining they disturbed the dancers.[87] Klüver manufactured the most recent group for the Warhol Museum in 1994 [Fig. 1.32]. As an ever-increasing series of contingent events, *Silver Clouds* was entropic: rather than evading instrumentality, the work's spatial and temporal distribution mimed deterritorialized flows of capital and information.

Chance was a condition of the technologically mediated world, never a pure nature. And it was the will to disorganization figured by the *Clouds* that Shannon's theory of information sought to control and predict through the use of feedback—defined by Shannon as the use of current information to dynamically predict and control a future state.[88] In 1960, Klüver had invoked Shannon's notion of autopoeitic behavior to argue that the self-destruction of Tinguely's *Homage to New York* was not a form of negation, but of "good machine behavior":

> "The self-destruction…of the machine is the ideal… For anyone concerned with the relations between machines and human beings, this is an obvious truth. This idea has already been expressed by Claude Shannon in the 'Little Black Box,' in which, when you pull a switch, a lid opens and a hand emerges that throws the switch in the off position, whereupon the lid closes again over the hand."[89]

Shannon's autopoeitic box might better describe *Silver Clouds*: a recursive operation that continued indefinitely. But unlike the thought experiment's black box, which oscillated

[87] In a seldom-quoted passage, Warhol refers to the *Clouds* as "Silver Space Pillows." Andy Warhol, *The Philosophy of Andy Warhol (From A to B and Back Again)* (New York: Harcourt Brace, 1975), 150.

[88] Shannon, *The Mathematical Theory of Communication*, 91-93.

[89] Klüver, "The Garden Party," 171.

between a limited number of states ("open" or "closed", "on" or "off"), the *Clouds* inevitably increased in disorder with every additional instance of production and display. If Shannon's general theory predicted the amount of entropy in an electrical signal, attempting to correct errors in transmission through feedback, the *Clouds* were a kind of recursive feedback system gone awry. [90] (Here, I must acknowledge the complexity of the term *feedback*, its meaning in different discourses: there is a distinct difference between its usage in Shannon's information theory and in Norbert Wiener's definition of cybernetics or in Alan Turing's theory of universal machines. For Shannon, feedback is a strictly mathematical entity and does not have semantic content; in Wiener's cybernetics, on which more will be said in the following chapter, feedback is much more broadly employed as a concept, encompassing linguistic and referential entities as well as homeostatic systems such as the body, climate, and so forth.)[91]

Cage himself was all too aware of the tension between chance, systems, and scientistic discourse. Writing of his aleatoric composition *Indices* in *Silence*, Cage expressed deep uneasiness about probability, which he opposed to pure chance:

> "The sounds of *Indices* are just sounds. Had bias not been introduced in the use of the tables of random numbers, the sounds would have not been sounds but

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[90] Indeed, Luhmann has argued that if *form* was previously conceptualized in terms of a Gestalt, then *chance* was the counter-concept to form, "in the sense that the simultaneous appearance of elements not bound by form was believed to be random. *Earlier versions of information theory and cybernetics were still working from within this traditional understanding of form when searching for ways to quantitatively compute improbability in terms of a link between redundancy and information*…A difference-theoretical reconstruction of the concept of form shifts the emphasis from the (ordered) content of form to the difference it makes. It extends and places on the 'other side' of form the realm of what used to be considered chance and thereby subsumes under the concept of form any difference that marks a unity." Niklas Luhmann, *Art as a Social System*, trans. Eva M. Knodt (Stanford: Stanford University Press, 2000), 27. Emphasis added.

[91] In one of the choice excerpts from his popular book *Cybernetics*, Wiener asserts that feedback is essential for homesostasis, which includes the regulation of the osmotic pressure of the blood, heart rate, even the way in which "our sex cycle must conform to the racial needs of reproduction. [!]" Norbert Wiener, *Cybernetics: or Control and Communication in the Animal and the Machine* (1948), (Cambridge: MIT Press, 1994), 114-115.

> elements acting according to scientific theories of probability, elements acting in relationship due to the equal distribution of each one of those present—elements, that is to say, under the control of man."[92]

Paradoxically, Cage's chance operation needed rules or boundaries in order to "free" chance from probability. It was precisely the false opposition between "just sounds" and "the [scientific] control of man" that *Silver Clouds* cast in relief. Indeed, the *Clouds* showed that the very execution or figuration of chance (how to convey chance?) was unavoidably tied to its reification. This was the problem of modernist abstraction—the heightening of form versus the hardening of the signifier, its lapse into commodity.[93]

Silver Clouds likewise stood in contrast to Gyorgy Kepes' understanding of chance and probability. For Kepes—who, like Cage, had studied with László Moholy-Nagy at the Chicago Bauhaus—the management of risk and error through the regulation of feedback was aimed at an *organicist* union of man and nature. This coalition would ostensibly guard against dangers of nuclear and environmental destruction.[94] And although Kepes was to serve on the board of directors of E.A.T., he and Klüver nevertheless continued to define themselves (and their respective programs, since Kepes was the founder and director of the Center for Advanced Visual Studies [C.A.V.S.] at the Massachusetts Institute of Technology) against one another.[95] Kepes' essay for the

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[92] Cage, *Silence*, 37.

[93] For another view of this dilemma in terms of the work of Robert Morris—in particular, the artist's early engagement with Foucauldian notions of disciplinary control versus his interest in the work of John Cage, and their implications for the politicization of form—see Branden W. Joseph, "The Tower and the Line: Toward a Genealogy of Minimalism," *Grey Room* 27 (Spring 2007): 58-81.

[94] Reinhold Martin, *The Organizational Complex* (Cambridge: MIT Press, 2004), 131.

[95] For a different assessment of the relationship between Kepes and Klüver, see Anne Collins Goodyear, "Gyorgy Kepes, Billy Klüver, and American Art of the 1960s: Defining Attitudes Toward Science and Technology," *Science in Context* 17 (2004): 611-635. For Goodyear, Kepes may be equated with "science" and Klüver with "engineering," a distinction I find helpful but ultimately reductive.

catalogue of the 1970 exhibition "Explorations," which actually featured the *Silver Clouds*, continued Kepes' longstanding and grave concerns about technological accident:

> "An engineer…must learn to synchronize error and correction of error in order to avoid 'hunting'—excessive oscillation about his target point caused by inaccuracy of aim… We have not found, in our exploded, explosive age, the right method of self-regulation."[96]

Despite the work's inclusion in the show, I would argue that the very aimlessness of the *Clouds* perturbed this obsession with technological control over technological risk: not only by the *Clouds'* chaotic and changing positions within the gallery space, but by their excessive motion through and *outside* of the institutionalized spaces of art and automatic systems of production.[97] On one hand, then, the *Clouds'* emphasis on positive feedback, its propensity toward undifferentiated noise, foretells the kind of critical resistance that Friedrich Kittler argued was necessary in the face of Kepes's espoused "self-regulation":

> "If 'control,' or, as engineers say, negative feedback, is the key to power in this century, then fighting that power requires positive feedback. Create endless feedback loops until VHF or stereo, tape deck or scrambler, the whole array of world war army equipment[,] produces wild oscillations."[98]

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[96] Gyorgy Kepes, "Toward Civic Art," *Explorations*, exh. cat. (Washington, D.C.: Smithsonian Press, 1970), n.p.

[97] On the origins of feedback in the field of cybernetics—and in the development of systems for the targeting of enemy aircraft in World War II and their relationship to disorder and entropy—see Peter Galison, "The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision," *Critical Inquiry* 21 (Autumn 1994): 228-266. More recently, historian of technology David A. Mindell has greatly deepened and complicated accounts of the development of feedback applications and cybernetics—tracing them to disparate engineering cultures even *before* World War II at Bell Laboratories, Vannevar Bush's laboratory at MIT, the naval research laboratories, and the Sperry Gyroscope Company. The central role of Bell Labs in the development of control systems and the practical and theoretical bases for cybernetics will be discussed further in the following chapters. See David A. Mindell, *Between Human and Machine: Feedback, Control, and Computing before Cybernetics* (Cambridge: MIT Press, 2002).

[98] Friedrich Kittler, *Gramophone, Film, Typewriter*, trans. Geoffrey Winthrop-Young and Michael Wutz (Stanford: Stanford University Press, 1999), 110.

Yet the *Clouds* might have more closely anticipated Luhmann's later conception of social systems as a "recursive universe" in which such wild oscillations were the norm, in which "disorder, non-linear complexity, and unpredictability are the rule."[99]

After the *Clouds'* debut, a profusion of cloudlike work drifted between an organic conception of chance and its denaturalization: Willougby Sharp's 1968 exhibition "Air Art," where the *Clouds* met Robert Morris' *Steam* (1967-68), produced by city pipelines; the Utopie architectural group's "Inflatable Moment" exhibition of 1968, which paired the *Clouds* with Mylar meteorological balloons [Fig. 1.33]; or E.A.T.'s pavilion at the Osaka World's Fair in 1970, a 90-foot-diameter inflated Mylar dome surrounded by an ever-shifting, mechanically generated fog, which will be one focus of the following chapter.[100] Such works continued to pit signal against noise, natural against artificial, control against calamity.[101] For *Silver Clouds* had shown "uncertainty" and its incarnations to be enmeshed in new kinds of technocratic regulation and restraint—irrevocably changing ventures in chance.

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[99] Niklas Luhmann, *Social Systems*, trans. John Bednarz Jr. (Stanford: Stanford University Press, 1995), xii. Luhmann's revamping of "first-order," functionalist systems theory also stands in contrast to Kepes and Moholy's organicist view of systems, because it asserts that "correction" or intervention itself creates disturbances that may exceed the regulatory capacities of any given system.

[100] The dome was, in fact, explicitly modeled on pneumatic mylar satellites such as Echo I and Echo II. See, for example, letter from Klüver to Dewey Clemmens, NASA Langley Research Center, May 22, 1969, Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 48, Folder 1.

[101] Indeed, Sharp sketched a virtual genealogy of "air art" in his catalogue, including Piero Manzoni's balloons (*Corpo d'aria* [Body of Air], 1959-60, and *Sculpture in Space*, 1960, both a kind of prepackaged take on Duchamp's *Paris Air*); Yves Klein's *Les Immateriaux*, 1,001 balloons unleashed over Paris in 1957; David Medalla's *Cloud Canyon* (1964); and Marcel Duchamp's cloud formations on the *Large Glass*. Yet none of these works' structures matched the sustained production, duration, and proliferation of the *Silver Clouds* series. See Willoughby Sharp, *Air Art* (New York: Kineticism Press, 1968).

CHAPTER 2

REMOTE CONTROL:

ORACLE AND *9 EVENINGS*

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I. Divinations

In January 1962, Klüver, Hodges, and Rauschenberg began concerted work on what was to become *Oracle*—a process that culminated in the multi-part sculpture's completion and exhibition at the Castelli Gallery in May 1965. *Oracle*'s window of construction predates *Silver Clouds* by one year, but I would like to go back to this slightly earlier piece in order to chart major shifts occurring in Rauschenberg's own work in the mid-1960s, changes parallel to the experimentation with *Silver Clouds* and equally divergent from the moment of Rauschenberg's *White Paintings* in 1951-53. For, after the artist met Klüver in 1960 during the engineer's collaboration with Jean Tinguely, Rauschenberg's continuing relationship with Klüver was to redefine his practice through the deployment of collaboration. In *Oracle*, the contact between engineers and artists made possible an investigation of densely hybrid configurations of media and subjective experience, a foray into what could be called the "cybernetic" conditions of forecasting and prediction.[1]

[1] This onset of Rauschenberg's so-called "technological" work should not be seen as a negative caesura, the demise of the artist's aspirations toward difference and hybridity into works that promoted a naïve, switch-like determinacy of participation—thereby inscribing the very spectacularity and instrumentality in the aesthetic experience that the *White Paintings* and Combines had worked so hard to escape. Ironically, Rauschenberg's "technological" work is simultaneously accused of not being spectacular *enough*, of being too technically simplistic and thus disappointing. But the paradoxical double bind of such an account misses the hybrid nature and complex set of responses elicited by the work, its production, and its engagement with media and control systems. For an assessment of Rauschenberg's late work in terms of this devolution toward regressive experience see Branden W. Joseph, "Rauschenberg's Refusal," in *Robert Rauschenberg: Combines*, ed. Paul Schimmel (Los Angeles: Museum of Contemporary Art, 2005), 274-275. Joseph sees *Black Market* (1961), for example, as the "*Last* time" when the problematic of writing and its deconstruction is found; such concerns drop away in Rauschenberg's "work with technology,"

When shown at Castelli in 1965 (as a photograph of the original installation shows), *Oracle* consisted of five assembled scrap-metal elements, each comprised of objects that Rauschenberg had found in the streets: a car door mounted on a typewriter table; a curved, elephantine exhaust pipe sitting on two wheels; a cement-mixing tub with an air conditioning duct through which water gushed noisily, attached by a chain to a wire basket; a constructed aluminum staircase housing batteries and a control unit; and a window frame on casters with a smaller ventilation duct protruding from one side [Fig. 2.1].[2] The disconnected parts were meticulously stripped of all paint and rested on the floor. A wireless control panel and five radios and transmitters were housed in the staircase, sending signals to the four other pieces—each of which contained a Comrex-brand receiver, a 10-watt amplifier, and a speaker.[3] This network converted *Oracle's* sculptural components into an acoustic environment through which the audience could freely move. The audience could, in fact, alter the sounds themselves: through ten black dials on the control unit in the staircase, they were able to manually vary the volume and

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according to Joseph, and Rauschenberg abandons a former theorization of media that would have countered a unitary, seamless, and McLuhanite "holistic global village." On the infantilization of the participatory aesthetic and its increasing similarity to repressive administration, see Benjamin H.D. Buchloh, "Conceptual Art 1962-1969: From the Aesthetic of Administration to the Critique of Institutions," *October* 55 (Winter 1990): 130-135.

[2] Curatorial file, *Oracle,* Musée National d'Art Moderne, Centre Georges Pompidou, Paris. Additional descriptions of the components appear in Billy Klüver with Julie Martin, "Four Difficult Pieces," *Art in America* 79, no. 7 (July 1991): 82-99, 138; and Anon., "Technology and the Arts," *Bell Telephone Laboratories Reporter* 15, no. 2 (March/April 1966): 16-19.

[3] Klüver with Martin, "Four Difficult Pieces," 83; Billy Klüver with Julie Martin, "Working with Rauschenberg," in Walter Hopps and Susan Davidson, *Robert Rauschenberg: A Retrospective* (New York: Solomon R. Guggenheim Museum, 1997), 312-313.

rate at which the AM band of each radio was being scanned. Yet one could not directly control the system; it was impossible to stop and "tune in" to any single station.[4]

Rauschenberg stipulated that no wires appear between the various parts of *Oracle*. "I wanted to do something that was remote control, that could be separate in the room," he said in 1965.[5] Klüver, too, understood that "the presence of wires would destroy the idea that the five elements…are completely independent units that can be moved to different positions and placed in different configurations."[6] This attempt to construct elements that were variable with each installation of *Oracle* seemed to stem from Rauschenberg's desire, throughout the 1960s, of realizing an all-encompassing environment that could react flexibly to stimuli such as bodily movement. *Broadcast,* in 1959, is the first overt manifestation of this desire: two knobs on the work's surface allowed the viewer to manipulate both volume and station selection of three radios behind the panels [Fig. 2.2]. At the time, as Branden Joseph has argued, Rauschenberg saw *Broadcast* as an attempt to bring together different media under their shared qualities of duration and difference, so as to stave off the reification or stillness of the work.[7] Describing *Broadcast* in 1963, the artist stated, "Listening happened in time. Looking

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[4] Billy Klüver, "Oracle," in *Robert Rauschenberg, Haywire: Major Technological Works of the 1960s*, ed. Cornelia Faist, exh. cat. (Ostfildern-Ruit: Hatje, 1997), 62-64.

[5] Rauschenberg, interview with Dorothy Gees Seckler, December 21, 1965, Tape 2, Archives of American Art, Smithsonian Institution.

[6] Klüver with Martin, "Four Difficult Pieces," 83.

[7] Joseph, "Rauschenberg's Refusal," 266. See also Joseph, *Random Order*, 186-187. Joseph insightfully places *Broadcast* and *Ace* (1962) at the beginning of a shift toward Rauschenberg's deconstruction of a televisual mode of apprehension, or scanning—what Brian O'Doherty described as Rauschenberg's "vernacular glance." See Brian O'Doherty, "Rauschenberg and the Vernacular Glance," *Art in America* 60, no. 5 (September/October 1973): 85; and O'Doherty, "Robert Rauschenberg I" (April 1963), in O'Doherty, *Object and Idea: An Art Critic's Journal 1961-1967* (New York: Simon and Schuster, 1967), 112.

also had to happen in time."[8] Yet in the production of *Oracle,* Rauschenberg, Klüver, and Hodges were to fundamentally alter this quest for an experience of lived duration and change.

In fact, Rauschenberg had expressed a certain dissatisfaction with *Broadcast*: "I objected to the fact that one had to be standing so close to the picture that the sound didn't seem to be using the space and the way the images were reacting to each other."[9] This frustration with the spatial characteristics of *Broadcast* actually surfaced one year after the work's realization when, in March 1960, Klüver encountered Rauschenberg at the Martha Jackson Gallery. Rauschenberg asked Klüver if it was possible to make an "interactive environment where the temperature, sound, smell, lights, etc., could be affected by the person who moved through it."[10] This was an extraordinary request, encompassing not only vision (the sole focus of most artistic pretensions to the immersive) but visceral olfactory and thermal sensations.

Over the next year and half, Klüver and his colleagues at Bell Laboratories explored this possibility in their spare time, bringing Rauschenberg into Bell for periodic discussions on the project.[11] "It proved impossible to achieve [Rauschenberg's] original

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[8] G.R. Swenson, "Rauschenberg Paints a Picture," *Art News* 62, no. 2 (April 1963): 45.

[9] Rauschenberg, interview with Seckler, 1965, Tape 1.

[10] Billy Klüver with Julie Martin, "Working with Rauschenberg," 312. See also Klüver, "Artists, Engineers, and Collaboration," 208; Klüver, "Oracle," *Robert Rauschenberg, Haywire: Major Technological Works of the 1960s,* 62.

[11] As Klüver remembers, "I began thinking about some possibilities [in 1960], but nothing really happened until 1961 after the 'Art in Motion' show. To make him more familiar with what was going on, I brought Rauschenberg to Bell Laboratories." Klüver, "Oracle," *Robert Rauschenberg, Haywire: Major Technological Works of the 1960s,* 62. Klüver's characterization of the engineers' "free time" for pursuing the external project with Rauschenberg is of particular interest in terms of the working patterns of Bell: "We would only work on it in our 'free' time, which really meant that we took the time for it whenever we chose. Bell Laboratories, like any good research laboratory, left us alone to carry on our own experimental

ideas for a multi-responsive environment," Klüver stated; having hit this dead end, Rauschenberg returned his focus to the manipulation of sound and radio.[12] Klüver and Hodges began work on designing a sound environment with five radios for which the volume and tuning control would be housed in a separate unit—thereby rupturing the audience's intimate interaction with *Broadcast* into a new relationship of remote control.

In January 1962, Rauschenberg, Klüver, and Hodges attempted to implant a system of radio receivers, amplifiers, and speakers into five canvas panels, which would be operated remotely from a central cabinet.[13] These panels would actually be diverted into use for the silent *Ace* (1962). But the notion of creating a sound environment persisted—albeit in a different form. Rauschenberg related,

> "I had some canvases stretched, but it took so long I needed help with the radios. And it took so long for me to find the help that I used the paintings for something else. Then later I decided that was a good idea because once I started seeing what was involved I saw that with the weight problem, and the depth the painting would have to be to house the equipment, that painting was the wrong form for that to take. So I started on a sculpture."[14]

Visiting Bell Labs was integral in the reconceptualization and realization of this project. As the critic Gene Swenson recounted during a studio visit later that January,

> "There had been several large metal objects in the corner of his studio the day he returned from the electronics laboratory [at Bell]. They began to occupy more and more of his interest, and over a period of time they were moved to his central working area. There were five pieces and he planned to put a radio into each of

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or theoretical research. During this time, I brought Rauschenberg to Bell Labs to see what my colleagues and I were working on." Klüver with Martin, "Working with Rauschenberg," 312.

[12] Klüver, "Oracle," *Robert Rauschenberg, Haywire: Major Technological Works of the 1960s,* 62.

[13] Gene Swenson described this arrangement during his studio visit in January 1961. See Swenson, "Rauschenberg Paints a Picture," 45-46.

[14] Rauschenberg, interview with Seckler, 1965, Tape 1.

> them; he also played with the idea of using running water, and eventually one of the pieces of the 'concert project' became a fountain."[15]

Rauschenberg began work with Klüver and Hodges on a design using five AM transistor radios – the artist insisted on using the AM band, because at the time FM only broadcasted "'cultural programs'—classical music, etc." as Klüver put it.[16] Rauschenberg's request for a completely wireless system made the process much more complex and difficult.[17] After encountering a "nightmare of noise" with homemade AM transmitters, which operated on too broad a frequency band, Klüver and Hodges attempted to re-engineer a wireless radio transmitter they purchased for $3.50.[18] Hodges devised a unique drive mechanism, via a small, variable-speed, DC motor that continually rotated the tuner for the radios back and forth across the frequency band.[19] Varying the voltage on the motors would alter the scanning speed—but any modulation

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[15] Swenson, "Rauschenberg Paints a Picture," 46. In autumn 1962, Rauschenberg used several of these sculptural elements (without radio) in the "Dylaby" (Dynamic Labyrinth) exhibition at the Stedelijk Museum, Amsterdam, occasioned by the museum's outgoing director Willem Sandberg (who also presided over "Art in Motion"). Pontus Hultén had organized the show, bringing Jean Tinguely, Niki de Saint Phalle, Martial Raysse, Per Ultvedt, and Daniel Spoerri to the museum, where each artist generated a site-specific installation. See Rauschenberg, interview with Seckler, 1965, Tape 1.

[16] Klüver with Martin, "Working with Rauschenberg," 312; Klüver with Martin, "Four Difficult Pieces," 83.

[17] Klüver explained, "Of course, if he [Rauschenberg] had allowed us to use wires to connect the control console with the other units, the solution would have been simple." Klüver with Martin, "Four Difficult Pieces," 83.

[18] Interestingly, the prefabricated parts obtained by Klüver and Hodges were devised to create a kind of domestic ambient sound system: the "Cordover FM Wireless Phono Transmitter" was originally marketed for the transmission of phonograph sound in the home. As Klüver related, "according to the manufacturer, '[it] contains complete solid state electronic circuitry ready for immediate use as an efficient means of wireless transmission of music from the tone arm magnetic cartridge of a phonograph into any FM radio in the home.'" Klüver with Martin, "Four Difficult Pieces," 83.

[19] Klüver with Martin, "Four Difficult Pieces," 83.

of the speed would be continually altered by feedback: the motor constantly self–adjusted so that one could never directly control the scan or settle on one station.[20]

Further problems with interference and the transmitters stalled Klüver and Hodges until the summer of 1964, when, as Klüver said, "technology caught up with us."[21] They purchased one of the first fully transistorized wireless microphone systems, which included a much more powerful set of transmitters and receivers, and connected it to Hodges' motor system [Figs. 2.3, 2.4]. (Transistorized, portable equipment like radios and amplifiers had just barely come onto the market by the early 1960s.) At this point, Klüver and Hodges were helping to shape crucial features in the work—even formal aspects that were arbitrary from an engineering standpoint. If Rauschenberg decided on the size and shape of the control knobs and the size of speakers, Klüver and Hodges worked with the artist on where to put the components and the layout of the receiving antennas. And when Klüver could no longer make "midnight requisitions" of Bell Labs telephone batteries to repurpose for *Oracle's* radios, he bought the only substitute he could find—bright red RCA batteries.[22] The red batteries became the only instance of visible color in the work until, like their predecessors, they were discontinued by their manufacturer.[23] These components were not simply akin to found objects but were interchangeable parts that could be replaced over time.

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[20] "Rauschenberg didn't want the viewer to be able to 'tune in' one given station, and Harold's scanning system made this virtually impossible," Klüver wrote. Klüver with Martin, "Four Difficult Pieces," 83.

[21] Klüver with Martin, "Working with Rauschenberg," 312; Klüver with Martin, "Four Difficult Pieces," 83.

[22] Klüver, "Oracle," in *Robert Rauschenberg, Haywire: Major Technological Works of the 1960s*, 65. See also Billy Klüver, "Teknologi för livet," *Konstrevy* 42, no. 2 (1966): 56-61.

[23] Klüver with Martin, "Four Difficult Pieces," 84; Klüver with Martin, "Working with Rauschenberg," 313.

On the level of the network itself, *Oracle* made use of an actual control mechanism, also known as a *servomechanism*. This is a type of device that uses a feedback loop, acting continuously on the basis of incoming information to attain a specified goal in the face of changes.[24] The system of motors that Hodges devised was one such control mechanism: it constantly adjusted to dynamically changing input from the audience's manipulation of the dials on *Oracle's* control unit. If the speed of the motors increased or decreased beyond a certain point, the system would self-correct toward an average speed—and thereby modulate the rate at which the radios were changing frequencies.

Oracle's motor system thus approximated a simple model of contemporary cybernetics, the theory of control mechanisms developed over several decades beginning in the 1920s and named by mathematician Norbert Wiener in the mid-1940s. The growth of the field of cybernetics is popularly associated with Wiener's World War II research in anti-aircraft missile technology—how to aim at a target whose velocity, acceleration, and direction is constantly changing by making a dynamic series of statistical estimates about the future positions of the target. (The term cybernetics stems from the Greek *kubernétes* (κυβερνητης), an etymology shared by the words "steersman" and "governor".) Wiener's famous book, *Cybernetics: Or Control and Communication in the Animal and the Machine*, was published in 1948; it was followed by another version in 1950, *The Human Use of Human Beings: Cybernetics and Society*, which was aimed at lay

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[24] For one of the earliest and most comprehensive texts explicating the theory of the servomechanism, from the MIT Radiation Laboratory, one of the centers of control mechanism research, see: James Hubert Maxwell, *Theory of Servomechanisms*, MIT Radiation Laboratory Series 25 (New York: McGraw, 1947).

audiences and was a mainstream success.[25] The text argued for the wide application of cybernetic theorems to the life sciences, sociology, and ecology, among others.

But it bears saying that this fixation on Wiener as the fount of cybernetics, propagated by cultural historians over the last decade, is largely inaccurate (or at least disproportionate). In fact, cybernetics was also and more specifically rooted in a number of prewar engineering milieus, *prior* to Wiener's innovations. The first of these was intimately related to Klüver: the electronic control systems innovations of the engineer Harold Black, at none other than Bell Laboratories. In 1927, Black developed the negative feedback amplifier, one of the earliest uses of negative feedback and a defining moment in the field of modern electronics. As historian David Mindell has demonstrated, feedback applications and the major concepts of cybernetics were also developed in highly different contexts and discourses throughout the 1920s and '30s, not only at Bell but at Vannevar Bush's laboratory at MIT (Shannon was Bush's doctoral student at MIT), the naval research laboratories, and the Sperry Gyroscope Company.[26]

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[25] Norbert Wiener, *Cybernetics: Or Control and Communication in the Animal and the Machine* (Cambridge: MIT Press, 1948); Nortber Wiener, *The Human Use of Human Beings: Cybernetics and Society* (Boston: Houghton-Mifflin, 1950). For a detailed history of the broader development of cybernetics through the Macy Conferences on Cybernetics, 1946-1953, see Steve Joshua Heims, *The Cybernetics Group* (Cambridge: MIT Press, 1991). The conference participants—Wiener, Heinz von Foerster, John von Neumann, Margaret Mead, Gregory Bateson, Warren McCulloch, Walter Pitts, Kurt Lewin, F. S. C. Northrop, Molly Harrower, and Lawrence Kubie—met annually to discuss the interdisciplinary applications of cybernetics, game theory, information theory, and other fields.

[26] David A. Mindell, *Between Human and Machine: Feedback, Control, and Computing before Cybernetics* (Cambridge: MIT Press, 2002), 105-137; 276-306. See also Hendrik W. Bode, 'Feedback: The History of an Idea" (1960), *Selected Papers on Mathematical Trends in Control Theory*, ed. Richard Bellman (New York: Dover, 1964); and Bode, *Synergy: Technical Integration and Technological Innovation in the Bell System* (Murray Hill, NJ: Bell Laboratories, 1971); Stuart Bennett, *A History of Control Engineering, 1930-1955* (London: Peter Peregrinus, 1993). Wiener's own anti-aircraft missile work at the National Defense Research Committee (founded by Vannevar Bush) was actually conducted under the auspices of Warren Weaver, who would terminate Wiener's contract after two years (and who was simultaneously funding researchers at Bell and MIT), and subsequently penned the introduction to Shannon's *Mathematical Theory of Communication*. After Wiener's termination, his main purpose seemed to be to convert cybernetics from a military to a civilian field of inquiry. Doing so, however, entailed a denial of the military context that had spawned his own research: "For Norbert Wiener, in the midst of the technological war, cybernetics became

Moreover, cybernetics was closely related to Shannon's research on communications theory at Bell. Both fall under a broad rubric of efforts to control dynamic systems; the two were nearly simultaneously developed (Shannon's paper on information theory, we should recall, was published in 1948). Black's work, for example, was part of a nexus of research at Bell that was subsequently furthered by Harry Nyquist, whose classical work on the stability of feedback amplifiers yielded axioms pertaining to feedback control theory, bandwidth requirements, and thermal noise, each instrumental for Shannon's information theory and the understanding of feedback and dynamic systems.[27] While the broader implications of control engineering research for the development of Experiments in Art and Technology will be discussed in the next chapters, I want to note here the ways in which *Oracle* can be understood as both firmly embedded within and yet keenly troubling this discourse of cybernetics and servomechanisms—of violence, information, and control.

For if cybernetics—and the broad array of devices whose properties it defined—was predicated on the regulation and adjustment of dynamic systems, *Oracle* was a system that activated its own interruption or diversion. Indeed, the work was an uncanny, heterogeneous mix of industrial detritus, re-engineered objects, consumer devices, and a

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a civilian enterprise. Most indicative of this alienation and reconstruction is Wiener's consistent failure to acknowledge the multiple traditions of feedback engineering that preceded him. In all his writing on cybernetics he never cited Elmer Sperry, Nicholas Minorsky, Harold Black, Harry Nyquist, Hendrik Bode, or Harold Hazen. All had published on the theory of feedback before 1940; all were recognized as important to the field; all had speculated on the human role in automatic control; some had even written on the merger of communications and control or on philosophies of feedback. … The omissions are striking. … Wiener gave cybernetics an intellectual, scientific trajectory, divorced from the traditions of technical practice from which it sprang." Mindell, 286.

[27] Mindell, "Opening Black's Box: Rethinking Feedback's Myth of Origin," *Technology and Culture*, vol. 41 (July 2000): 426-429; Bennett, *A History of Control Engineering, 1930-1955*, 82-84; E. Colin Cherry, "A History of the Theory of Information," *Proceedings of the Institution of Electrical Engineers* 98 (September 1951): 386.

startling array of *flows*: actual currents of information, radio waves, water, air, sound, electricity—and of course the ventilation streams suggested by the use of air-conditioning ducts and exhaust pipes [Figs. 2.5, 2.6]. Yet these flows were not seamlessly integrated into some controlled, systematic circuit. On the contrary, they interacted in a perpetual stutter of fissures and lags, interference and dead air. Rauschenberg had chosen to use small speakers with poor sound quality, which were installed differently in each piece and to extreme acoustic effect: in the window, the speaker (now a modern-day one) is in the metal duct which gives enormous resonance to the radio's sound and makes it nearly impossible to understand any words [Fig. 2.7]; while the exhaust pipe's speaker is attached *inside* the pipe, outside facing in, so that the sound is projected through the pipe like a deeply pitched vibrating horn.[28] In the car door, the speaker is attached to the back of the door; in the tub it is in the small wire basket. In the stairs, the sound comes directly from the radio itself. Klüver described the experience " as if you were listening to someone else's radio receiver…bits of music, talk and noise—loud, soft, clear or full of static"; the choice of station was not ultimately up to you, nor the actual qualities of the sounds.[29] Persistent background noise is audible from the motors, interference from the radios is continual, and from certain vantage points the rushing sound of the water drowns out the rest of the sounds—a phenomenon related in Klüver's and critics' accounts and confirmed in my own observation of *Oracle*.[30]

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[28] Klüver with Martin, "Four Difficult Pieces," 85; Klüver, "Oracle," *Robert Rauschenberg, Haywire: Major Technological Works of the 1960s,* 65.

[29] Klüver with Martin, "Four Difficult Pieces," 85.

[30] One critic highlights "the very real sounds of the radios and the very unreal appearance of his landscape. Interferences become static and the silences are overbearingly exclusive." Neil A. Levine, "Robert Rauschenberg." *Art News* 64, no. 9 (Sept. 1965): 11.

This tense coupling of a wireless, networked environment and the inert, industrial waste or castoffs of doors and pipes and windows confirmed the *paradox* of the postwar world in the mid-1960s—a moment that Jonathan Crary has described as "a planetary data-communications network physically implanted into the decaying, digressive terrain of the automobile-based city…[into] the rotting edifices of a previous theater of modernization."[31] For Crary, drawing on Gilles Deleuze and Félix Guattari's periodization of a "cybernetic phase of capitalism," the development of cybernetics stood at the nexus of this enforced conjugation.[32] It was a shift motivated by the "obliteration of outdated territories, languages, filiations, of any boundaries or forms that impeded the installation of cybernetics as the model for the remaking of the world as pure instrumentality."[33] Indeed, cybernetics—the science of "control and communication"—had come to mythically stand for the totality and instrumentality of late capitalism and the military-industrial complex. Cybernetics marked nothing less than the emergence of a "society of control," to use Deleuze's well-known formulation.[34] Yet *Oracle* forced this

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[31] Jonathan Crary, "Eclipse of the Spectacle," in *Art After Modernism: Rethinking Representation*, ed. Brian Wallis (New York: The New Museum of Contemporary Art, 1984), 290.

[32] Ibid., 286, n. 9. Deleuze and Guattari, drawing on Lewis Mumford's notion of the "megamachine," describe an expanding cybernetic phase of capitalism that threatens to achieve a global "generalized enslavement" through digital and telecommunications networks. See Gilles Deleuze and Félix Guattari, *Milles Plateaux* (Paris: Éditions Minuit, 1980), 30.

[33] Crary, "Eclipse of the Spectacle," 292. "And it cannot be overemphasized," Crary continues, "how the development of cybernetics ('a theory of messages and their control') is intertwined with the commodification of all information and with the hegemony of what [Thomas] Pynchon calls the 'meta-cartel.'" Ibid.

[34] Gilles Deleuze, "Postscript on the Societies of Control," *October* 59 (Winter 1992): 3-7. According to Deleuze, the transition from a Foucauldian notion of disciplinary societies to "societies of control" is incarnated in the dissipation of architectural or physical structures of discipline and enclosure into dematerialized networks of control. Inherent to the control society is the rise of the computer, superseding those machines "involving energy, with the passive danger of entropy and the active danger of sabotage." This shift mirrors the various types of cybernetic systems, mechanical and digital. What *Oracle* underscores, I would argue, is the crisis entailed in the overlay of these two regimes, one supposedly fading and the other ascendant. On the role of cybernetics within the emergence of so-called "control societies,"

cybernetic system into relation with the inert objects it had supposedly left in the past. *Oracle* was not simply a way out of reification and congealment, the stasis of paintings or aesthetic objects that Rauschenberg had so often spoken fearfully of. Rather, the work *disturbed the cybernetic system*, a system already predicated on constant change itself. If cybernetics was based on futurity, on predictions and their regulation, *Oracle* seemed to foil this divinatory function.[35]

In this, *Oracle* might seem wholly allied with the investigation of telecommunications systems in the contemporaneous *Ace* [Fig. 2.8]. Joseph has demonstrated that *Ace* produces "a more consistent and quickly perceived visual field"—thereby inducing a mode of spectatorship akin to televisual scanning.[36] As Joseph argues, the work rejected the sheer quantity and variety of pictorial incident and detail (such as legible text) in *Broadcast* and other previous Combines in favor of a more homogenous

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see also Gilles Deleuze, "Control and Becoming" and "Postscript on Control Societies," *Negotiations*, trans. Martin Joughin (New York: Columbia University Press, 1995), 169-182.

[35] The sculptural components of *Oracle* directly cite the found objects (pipes, chains, wheels) in a number of previous works dating approximately from 1961 and exhibited at Castelli that year, such as *Empire II,* 1961 and *Trophy IV (For John Cage)*, 1961. I understand these works as explorations in sculptural assemblage that presage Rauschenberg's investigation of the found object, "found" telecommunication networks, and acoustic space in *Oracle*. On the Castelli exhibition, see Joan Young and Susan Davidson, "Chronology," in Walter Hopps and Susan Davidson, eds., *Robert Rauschenberg: A Retrospective*, exh. cat. (New York: Solomon R. Guggenheim Museum, 1997), 560. In a related but differently oriented reading of Rauschenberg's works of 1961-62, Joshua Shannon focuses on the contrast between the material specificity of Rauschenberg's discarded urban construction elements and "the abstraction of the built environment" in New York City (through the advent of International Style architecture and simulacral systems of advertising). Shannon, however, describes a definitive break in Rauschenberg's work in 1962, between an "end" of the artist's Combines in that year and his subsequent series of silkscreens—whereas *Oracle* and its production between 1962-1965 would seem to acutely complicate any binary division between the Combines and silkscreens (and the corollary parallel division between the physicality of the Combines and the abstraction of the silkscreens). See Joshua A. Shannon, "Black Market: Materiality, Abstraction and Built Environment in the New York Avant-Garde, 1958-1962" (Ph.D. diss., University of California, Berkeley, 2005), 201-206.

[36] Joseph, *Random Order*, 186-187.

visual field—a kind of unified screen—that could be taken in at a distance.[37] *Ace* thus inaugurated Rauschenberg's subsequent inquiry into the spatiotemporal manipulations of broadcast television, its artificial compression of the anachronistic and remote.[38] Yet, as we have seen, Rauschenberg deliberately rejected using an actual remote control system in *Ace*—choosing instead to deploy the remote control structure in the spatially dispersed, three-dimensional ensemble of *Oracle*.

Why this switch? Why, exactly, did Rauschenberg declare that "painting was the wrong form for [the radio system] to take"?[39] The answer, I think, is that *Ace* began one trajectory in Rauschenberg's work, *Oracle* another. First, *Oracle* represented an exploration of actual, dynamic *radio* networks as opposed to the transmitted images of television. Whereas *Ace* and Rauschenberg's subsequent works in silkscreen and paint effected a critique of televisual spectacle and the status of the screened image, as Joseph has shown, *Oracle* mounted a systematic interrogation of the kinetic, acoustic, and privatized space of the transistor radio. And to fully engage this dynamism of radio demanded a *sculptural* and technologically specific investigation into how radio continually shifted and organized the space of reception.

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[37] Ibid.

[38] As Joseph maintains, "*Ace* marks a departure for Rauschenberg, not only because it was flatter than most of his earlier work—a feature emphasized by the broad, rectangular areas of light blue and green paint at the right and, further, by the two cardboard boxes pressed flat against the surface of the canvas—but also, and more important, because it attained a visual homogeneity that eliminates what he has called 'changes of focus.' ... The silkscreen paintings of the next two years follow *Ace*'s lead in getting rid of the 'changes of focus' … the relative insubstantiality of the silkscreen imagery no longer rewards an in-depth, readinglike scrutiny. Instead, it calls for a scanning of the canvas from a single distance, an effect O'Doherty found characteristic of the 'vernacular glance' and, once again, likened to watching TV." Joseph, *Random Order*, 189.

[39] Rauschenberg, interview with Seckler, 1965, Tape 1.

Indeed, 1962—the year Rauschenberg began *Oracle*—has also been singled out by Rosalind Krauss as the year Rauschenberg began his breathtaking photographic essay *Random Order*, published in 1963.[40] This was, Krauss argues, the occasion upon which the artist's work began to hinge on the very opposition between the *visual* and the *aural*, vision and speech. *Random Order* became a means to negotiate the interiority of the iconic and the exteriority of noise and words—the connotative information "outside"—to explore the nexus between "delicately silent visual spaces and the brassily verbal one of the flow of words."[41] If Krauss reads this shift in Rauschenberg's work as preparing the way for his silkscreen works and their investigation of the lexical and allegorical dimension of photography, the proliferation of connotative meaning surrounding the photograph and its archive, *Oracle* seems to mark the advent of a parallel and simultaneous exploration of spatial movement *and* literal, sculptural, aurality. This would not mean a definitive abandonment of previous concerns in Combines but rather a doubling, a mutual imbrication, of pursuits. In a passage from *Random Order* cited by Krauss, Rauschenberg had reproduced close-ups of stairs and their risers, noting the three-dimensional articulation of a stairwell, "a sculptural masterpiece clearly, economically and dramatically defining space."[42] It is striking, then, that in *Oracle*, Rauschenberg chose the small staircase to house the control system; he intended for

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[40] Rosalind Krauss, "Perpetual Inventory" (1997), *Robert Rauschenberg*, ed. Branden Joseph (Cambridge: MIT Press, October Files, 2002), 93-122.

[41] Ibid., 103-106.

[42] Robert Rauschenberg, "Random Order," *Location* 1, no. 1 (Spring 1963): 28. Cited in Krauss, "Perpetual Inventory," 105.

individual viewers to actually sit atop the stairs, corporeally installing oneself into the sculptural array, changing and being changed by the surging field of noise.[43]

Again, it was not merely the physical fixity of works such as *Broadcast* and *Ace* that perturbed Rauschenberg (as he told Klüver in 1991, "I was envious of the current and endless changes of information [in radio] as opposed to fixed images").[44] It was also the relative immobility of the spectator standing in front of a flat, two-dimensional, screen-like image—a stasis that was not much changed in works such as *Trophy II (For John Cage)*, 1961, a metal assemblage sculpture that clearly prefigures *Oracle* and which would have generated sound when a boot attached to a crumpled piece of metal via a chain swung and hit the work's metal core. Rauschenberg therefore worked to insure a dislocation of sensation and movement in *Oracle*'s audience. He told Seckler, "You had a sense of distance that as often as not was distorted. You had the feeling possibly of knowing where you were but where you were was lost."[45] This disorientation of individual space in *Oracle* drew attention to the experience of radio as both public and intensely private. With the advent of the portable transistor radio, the public, intersubjective space of broadcast networks (the saturation of radio wave signals throughout lived space) necessarily coexisted with the privatized and mobile aural space of the individual (the sole embodied listener, whom the transistor radio device isolates in an intimate and delimited sonic field). It is precisely this *frisson* that characterized the bifurcation between the two major discourses on radio concurrent with *Oracle*: Cage's

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[43] Robert Rauschenberg, interview with Billy Klüver, March 1, 1991, cited in Klüver with Julie Martin, "Working with Rauschenberg," *Robert Rauschenberg: A Retrospective*, 312-313.

[44] Robert Rauschenberg, interview with Billy Klüver, March 1, 1991, cited in Klüver, "Oracle," *Robert Rauschenberg, Haywire: Major Technological Works of the 1960s,* 62.

[45] Rauschenberg, interview with Seckler, 1965, Tape 2.

view of radio as an omnipresent ether, versus Marshall McLuhan's understanding of radio as engendering a privatized auditory space.

In 1966, one year after *Oracle* made its debut, Cage told Morton Feldman in a "radio happening" on New York's WBAI, "But all that radio is, Morty, is making available to your ears what was already in the air and available to your ears, but you couldn't hear it…all it is is making audible something which you're already in. You are bathed in radio waves."[46] Cage's aim was to induce a perceptual revelation of this (ordinarily imperceptible) permeation of radio.[47] Radio thus functioned as an increasingly important element of Cagean silence. It represented a new permutation of Cage's aspiration toward a radically multiplicitous experience of the world and, with it, a liberatory evasion of the administered sameness of technocratic rationality. Such a conception was already presaged in Cage's first piece to incorporate radio, *Imaginary Landscape No. 4* (1951). Cage wrote the work for twelve radio receivers, each of which had a dial for volume control and a dial for tuning. Two performers per receiver (twenty-four in total) were to vary the volume and frequency through these dials, taking off from

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[46] John Cage, cited in "Radio Happenings: Recorded at WBAI, NYC 7/9/66-1/16/67," *Exact Change Yearbook No. 1*, ed. Peter Gizzi (Boston: Exact Change), 256. On the exchange between Cage and Feldman, see Joe Milutis, "Radiophonic Ontologies and the Avantgarde," in *Experimental Sound and Radio*, ed. Allan S. Weiss (Cambridge: MIT Press, 2001), 57-72. On the role of magnetic tape in spurring Cage's conception of sound as a "total sound-space," infinite and continuous, microscopic and macroscopic, see John Cage, "Experimental Music," 9; Branden W. Joseph, "Chance, Indeterminacy, Multiplicity," in *The Anarchy of Silence: John Cage and Experimental Art*, ed. Julia Robinson, exh. cat. (Barcelona: Museu de Arte Contemporani de Barcelona, 2009), 219. As Joseph notes, "magnetic tape allowed for the possibility not only of reproducing *any* sound but, through various means of manipulation, producing *every* possible sound." Ibid.

[47] Although Cage believed that exposure to and perceptual awareness of radio's overriding network held liberatory promise, this is not to say that his view of technology was as simplistically utopian as other critics have implied; for such a characterization see Kathleen N. Woodward, "Art and Technics: John Cage, Electronics, and World Improvement," in Kathleen N. Woodward, ed., *The Myths of Information: Technology and Postindustrial Culture* (Madison, Wis.: Coda Press, 1980), 171-192.

a score derived from the *Book of Changes*.[48] Cage described the aim of the work as a kind of smooth, infinite, and neutral field of experience:

> It is thus possible to make a musical composition the continuity of which is free of individual taste and memory (psychology) and also of the literature and "traditions" of the art. The sounds enter the time-space centered within themselves, unimpeded by the service to any abstraction, their 360 degrees of circumference free for an infinite play of interpenetration.[49]

If Cage's work in magnetic tape and radio has been read as modeling the very immanence of power, its microscopic invasion of infinitely more minute sounds, bodies, and waves, here we might more fully historicize the composer's realization—acknowledging the particularity and heterogeneity of his work as it changed during the crucial period in his oeuvre, from the 1950s into the mid-'60s.[50] Indeed, Cage did not seem to recognize a fundamental aspect of radio at the time: From the moment of *Imaginary Landscape #4* to his conversation with Feldman on WBAI, Cage's embrace of radio did not account for the degree to which that technology was already transforming from the logic of standardization toward that of asymptotic differentiation.

Despite its instrumental resemblance to *Imaginary Landscape No. 4*, *Oracle* represents a departure from that work's logic.[51] Unlike *Imaginary Landscape No. 4*,

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[48] First performed publicly near midnight in January 1952 at Columbia University's McMillin Theater, *Imaginary Landscape No. 4* lasted four minutes and thirteen seconds. Few sounds were actually heard, because the majority of the local radio stations had signed off the air by that time of the evening.

[49] John Cage, "To Describe the Process of Composition Used in Music of Changes and Imaginary Landscape No. 4" (1952), *Silence* (Middletown, CT: Wesleyan University Press, 1961), 59.

[50] For the broadest, most convincing characterization of Cage's work in terms of such a recognition of immanent systems of power and control, see Branden W. Joseph, *Beyond the Dream Syndicate: Tony Conrad and the Arts after Cage* (New York: Zone, 2008); for a specific reading of smaller shifts and discontinuities within Cage's particular view of sound technologies, see Liz Kotz, "Cagean Structures," in Robinson, ed., *The Anarchy of Silence: John Cage and Experimental Art*, 118-165.

[51] Joseph draws a direct comparison between *Broadcast* and *Imaginary Landscape No. 4*, arguing that "*Broadcast* … works to fragment the audience's attention across three asynchronous and interfering channels, creating, in effect, a miniature version of Cage's four-minute aleatory composition "Imaginary

Oracle extends the active role of the "performer" to any and all passerby.[52] It impedes the direct relationship between the body, mechanical controls, and tuning/volume output; and, most important, it embeds the radio system in resolutely heavy, lumbering, sculptural form. Building on Cage's work and yet surpassing certain of its assumptions, *Oracle* confronted the ways in which radio's plenary diversity was also a sophisticated realization of the customization of capital and the privatization of networks, spaces, and things. This was not an unimpeded ether, "free for an infinite play of interpenetration," but an uneven and irregular realm of discrete pockets and aporias.

Oracle realized seminal aspects of what McLuhan termed radio's "acoustic space"—a realm that did not posit geometrical spatial relations, that possessed neither center or periphery, since hearing occurs from all directions simultaneously.[53] With

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Landscape #4" (1951), in which twelve radios were 'played' by twenty-four performers." Joseph, *Random Order*, 185.

[52] In this sense, *Oracle* also departs from another earlier, related work, George Brecht's event score *Candle Piece for Radios* (1959), which was likely written as "homework" for John Cage's class in experimental composition at the New School and derived from the latter's *Imaginary Landscape No. 4*. Brecht's piece directs performers to manipulate the volume and tuning dials of a set number of radios according to specific directions distributed on instruction cards. When a performer drew a card, he would follow those instructions as to the precise direction and amount to turn the volume and tuning dials on a radio; the numerical values of each adjustment were determined by a table of random numbers. Even Brecht, however, admitted that this system of instructions seemed overdetermined, and that it involved too many instruction cards; this type of extensive performative instruction and controlled environment seems at odds with the parameters of *Oracle*. On *Candle Piece*, see Simon Anderson, "Living in Multiple Dimensions," in *Off Limits: Rutgers University and the Avant-Garde, 1957-1963*, ed. Joan Marter (Newark and New Brunswick, New Jersey: The Newark Museum and Rutgers University Press, 1999), 114-115; on *Candle Piece* in relation to Cage's class, see Julia Robinson, "In the Event of George Brecht," in *George Brecht: Events, A Heterospective*, ed. Alfred Fischer (Köln: Walther König, 2006), 30.

[53] McLuhan based his well-known concept of "acoustic space" on the work of the behavioral psychologist E.A. Bott, his peer at the University of Toronto. Against the linear, fragmented order of vision and the printed word, McLuhan proposed that acoustic space defined the nodal, relational, and decentered network of electronic communications. See Marshall McLuhan, *The Gutenberg Galaxy: The Making of Typographic Man* (Toronto: University of Toronto Press, 1962). The notion of an aural (and non-visual) ordering of space also developed in the discourse on film sound, most notably by Christian Metz in his seminal essay "Aural Objects". As Metz wrote, the "spatial anchoring of aural events is much more vague and uncertain than that of visual events. The two sensory orders don't have the same relationship to space, sound's relationship being much less precise, restrictive, even when it indicates a general direction (but it

radio, however, acoustic space was experienced not simply as an abstract morass (as reductive readings of McLuhan tend to portray the concept). Rather, it was a materially concrete and molecularized phenomenon. The media theorist argued that radio now possessed unprecedented power to "involve people in depth," especially with those "who carry transistor sets in order to provide a private world for themselves amidst crowds."[54] As *Oracle* enabled its audience to adjust the work's transistor radios (albeit not as handheld transistors, a portable technology that would be utilized the next year in the performance series *9 Evenings: Theatre and Engineering* as well as in the Pepsi Pavilion, constructed by E.A.T. for Expo '70 in Osaka, Japan) and choose their own listening position among both diffuse and focused channels of sound, the work bore out McLuhan's assertion that "Radio affects most people intimately, person-to-person, offering a world of unspoken communication between writer-speaker and the listener. That is the immediate aspect of radio. A private experience."[55] After the mainstreaming of television, according to McLuhan, radio had diversified into an unprecedented medium for regional and local service, becoming specialized in both "content" and physical

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rarely indicates a really precise site, which on the contrary is the rule for the visible)." Christian Metz, "Aural Objects" (1975), trans. Georgia Gurrieri, *Yale French Studies*, no. 60 (1980): 29-30.

[54] Marshall McLuhan, "Radio: The Tribal Drum," *Understanding Media: The Extensions of Man* (1964), (Cambridge: MIT Press, 1994), 298. McLuhan cites Bertolt Brecht's "Radio Poem," n.d., in this regard; Brecht was, of course, one of the most acute observers of the empathic intensity of radio and its potentially revolutionary effects: "There is a little poem by the German dramatist Berthold Brecht: 'You little box, held to me when escaping / So that your valves should not break, / Carried from house to ship from ship to train, / So that my enemies might go on talking to me / Near my bed, to my pain / The last thing at night, the first thing in the morning, / Of their victories and of my cares, / Promise me not to go silent all of a sudden.'" Ibid.

[55] Ibid., 299. It was in this sense that, for McLuhan, radio was a "hot" medium," whereas television was "cool"; moreover, the private auditory space of radio aroused an unmatched intensity of individual (and primordial) affect: "The subliminal depths of radio are charged with the resonating echoes of tribal horns and antique drums. This is inherent in the very nature of this medium, with its power to turn the psyche and society into a single echo chamber." Ibid.

location with “the multiplicity of receiving sets in bedrooms, bathrooms, kitchens, cars, and now in pockets.”[56] *Oracle* reproduced this monadic particularization of reception. At the same time, however, the work also staged the inevitable connections *between* such intimate and discrete points of listening—suffused as these points were by a surfeit of noise, the sound of water, ambient chatter.

Oracle thus dislocated the supposed fixity and determinedness of broadcast radio networks. And it did so not only on the level of reception. If radio has preoccupied the modernist imagination, from Marinetti to Khlebnikov, Brecht to Arnheim to Artaud, it is the *apparatus* of radio itself—the parceling of its mechanisms, the slicing and selling of radio airwaves—that has haunted otherwise triumphal declamations of the medium’s political potential as a participatory communication system, most notably in the well-known critiques proffered by thinkers as different as Adorno, Hans Magnus Enzensberger, and Jacques Attali.[57] It makes sense, then, to view *Oracle* in terms of these historically specific conditions of radio production and broadcasting—in contrast, again, to the artist’s engagement with television or film.[58] *Oracle* directly engaged the recent development of the portable transistor radio and its privatization (both physical, à la McLuhan, and commercial), only to operate in its gaps, its lacunae. Indeed, in 1962, Rauschenberg and Klüver were confronting severe signal interference in their

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[56] McLuhan continues, “Different programs are provided for those engaged in diverse activities. Radio, once a form of group listening that emptied churches, has reverted to private and individual uses since TV. The teenager withdraws from the TV group to his private radio.” Ibid., 306.

[57] See Hans Magnus Enzensberger, “Constituents of a Theory of the Media,” *New Left Review* 1, no. 64 (Nov./Dec. 1970): 13-36; Jacques Attali, *Noise: A Political Economy of Music* (Minneapolis: University of Minnesota Press, 1985).

[58] For a specific reading of Rauschenberg’s work of this time in terms of television and film, see Joseph, *Random Order*, 275.

configuration of radios and transmitters. So they attempted to use the "empty spots" in the existing broadcast frequencies: As Klüver remembered, "The solution to the problem of interference was to retransmit the AM signal in a different frequency band. We decided to use the empty spots in the FM band (in the early '60s there were very few FM stations)."[59] As they continued to grapple with interference problems, the project explored and occupied spaces in the spectrum that were leftover, vacant.

Oracle, in other words, was a kind of pirate radio. And it was precisely this mode of illicit "ham" operation that Adorno, writing in 1941 during his research for the Princeton Radio Project, saw as literally interfering with commercially standardized radio and its characteristics of unity, reificiation, quotation, and "atomization."[60] For Adorno, radio exhibited a major tendency toward standardization that paralleled monopolistic economic structures (what he termed "Ubiquity-Standardization"), but also countertendencies. This made for a continual push and pull between an illusion of "hereness," specialization, and authenticity in the radio experience, and a uniformity that pervaded the production of radio—a tension that could equally well describe the dynamics of *Oracle*. Adorno noted, "As the power of radio stations, and especially the large networks increases, they try more and more to maintain a diversity of programs at

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[59] Klüver with Martin, "Four Difficult Pieces," 83.

[60] Theodor Adorno, *Current of Music: Elements of a Radio Theory*, trans. Robert Hullot-Kentor (Frankfurt: Suhrkamp Verlag, 2006). As Adorno elaborates, "In other words, through radio, the individual elements of symphony acquire the character of quotation. Radio symphony appears as a medley or potpourri in so far as the musical atoms it offers up acquire the touch of having been picked up somewhere else and put together in a kind of montage." All too often, this montage gave rise to sonic simplicity and uniformity: "[I]n the symphonic field those works surrender themselves to radio most readily which are conglomerates of tunes of both sensual richness and structural poverty—tunes making unnecessary the process of thinking which is anyhow restrained by the way the phenomenon comes out of the radio set." Ibid., 263, 268.

the same time."[61] By operating in the empty spots of existing frequency channels, *Oracle* matched the localized, concrete, bodily apprehension of noise in radio with the interstices of commercial radio's broad sweep. Indeed, *Oracle* called attention to the aural deficits of radio as well—foregrounding the compression of sound waves in radio, the resolutely *monophonic* result of the device: Radio broadcasting could not produce stereo sound and, as such, fundamentally differed from normal listening experience. Despite radio's affinity to "live sound," an approximation far closer that television's similitude to "live action" (as McLuhan and others observed), radio was still marked by a distortion of sound. Moreover, Adorno noted that all radio sound was pervaded by a unifying electric current of noise, or what he called a "hear-stripe"—akin to the screen upon which filmic images were projected. By giving control of the tuning dials to the spectator, who could turn these controls at will, even if their effect on the stations was further mediated, *Oracle* uncannily enacted the one possibility of unsettling this mediation that Adorno allowed: "Perhaps if it were possible to play 'upon the electric current' of radio, in the sense that one can play on a piano or violin, the hear-stripe would disappear. Under present conditions, however, we know that such a suggestion sounds utopian."[62]

In fact, one could argue that the divinations of the normative cybernetic system were seemingly mirrored in the determined, commercial standardization of broadcast radio networks. And it becomes clear that *Oracle* seemed to adopt and disrupt each facet of such systems, upending their smooth transmissions, their bandwidths of transmission, their acoustic plenitude, their "hear-stripe." *Oracle* begins to appear as nothing less than

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[61] Ibid., 150.

[62] Ibid., 178.

a double deterritorialization of the cybernetic phase of capitalism (so harrowingly outlined by Deleuze)—and thus of the field of technological innovation and control.[63] Radio itself has been a medium continually on the verge of being outmoded, superseded first by television and now adaptively resurrected via digital technologies ("internet radio")—a perpetual condition of displacement incarnated in the evolution of *Oracle* itself.

For even as *Oracle* converted bodily and phenomenological experience of sculpture into a mediated "broadcast," like *Field Painting* it became a measure of obsolescence: the work has necessarily been updated several times with new technology as it migrated into different collections. In 1976, the collector São Schlumberger acquired *Oracle*; she then donated it to the Musée National d'Art Moderne, Paris. The work was to be shown at the *vernissage* of the Centre Georges Pompidou in 1977. Klüver and Hodges redesigned the equipment so that the AM radios and DC motors could be moved out of the control console in the staircase and into each piece, eliminating the need to retransmit the control signals from the console [Fig. 2.9].[64] They installed a "digital proportional remote radio control system" otherwise designed for use in remote-controlled hobby airplanes. Digital control signals for the volume and scanning rate were thus transmitted to servomotors (which could, in turn, transfer signals

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[63] As Deleuze argued, *music* effects a kind of sonic dematerialization of the body, a form of "becoming molecular," an entity that is never fixed into a pattern of organization or regulation: music incurs a "deterritorialization of the refrain," an open structure that disrupts the refrain or rhythmic motif that often structures "an organism's milieu, territory, or social field." See Gilles Deleuze and Felix Guattari, "Becoming-Music," in *A Thousand Plateaus: Capitalism and Schizophrenia* (1980), trans. Brian Massumi (London: Continuum, 2003), 299-309. On Deleuze's reading of music, see Ronald Bogue, *Deleuze on Music, Painting, and the Arts* (London: Routledge, 2003), 3.

[64] Klüver with Martin, "Four Difficult Pieces," 85-86.

to the individual radios) in the other four pieces.[65] Upon arrival at the Pompidou, however, Klüver and Hodges were forced to switch *Oracle* from the AM to the FM band, since the museum's metal structure acted as a "Faraday cage," blocking the interior from the AM range of frequencies. Apparently, they blew a fuse, causing a museum-wide blackout the evening of the opening.[66]

The work has since required recurrent maintenance and renovation, including regular recharging of the batteries and repair of mechanical breakdowns.[67] In 1992, the Centre Georges Pompidou asked Klüver to repair *Oracle* for the museum's fifteenth anniversary. Working with Bruno Seeman, a physicist at the oilfield technologies company Schlumberger (the collector's family corporation), Klüver updated the work for the fourth time—using electronic (as opposed to motor-powered) scanning and wireless infrared transmitters.[68] In 1997, *Oracle* was upgraded again by engineers Biorn and Ted Dillenkoffer, and displayed in October-January 2006-07 at the Centre Georges Pompidou; it has been shown most recently in a 2017 traveling survey of Rauschenberg's work.[69] Built in to the very core of the work's structure, then, was the ultimate arbitrariness of technological change. *Oracle*'s future lay precisely in its degradation.

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[65] Ibid.

[66] Ibid.

[67] Klüver, "Oracle," *Robert Rauschenberg, Haywire: Major Technological Works of the 1960s,* 69.

[68] The electro-mechanical, motor-driven scanning had been the main source of power drainage. The new infrared transmitter system was of a type normally used for wireless earphones and advantageous because not subject to interference. Billy Klüver, "Artists, Engineers, and Collaboration," 209. See also Rauschenberg, interview with Dorothy Gees Seckler, December 21, 1965, Tape 1.

[69] Curatorial file, *Oracle*, Centre Pompidou, Paris.

The repurposing of pre-existing technology for *Oracle* also stands as an *inversion* of another model of indeterminate invention, one that would start "from scratch" with no preset goal, no prior knowledge of how the invention will be used.[70] The tension between different modes of invention and experiment bespeaks the historical currency of nondeterministic models of science and its applications in the postwar period. In a kind of deferred action, the discourses of science as "epistemological rupture" (via Alexandre Koyré and Bachelard), cybernetics, and information theory each revisited the behemoth challenge to causal and mechanistic worldviews in the nineteenth century. The work of Kuhn, Wiener, and Shannon each—in very different disciplinary registers—proclaimed their fundamental indebtedness to the emergence of nondeterministic physics, and the applied research at Bell Labs would have been impossible without it. Rauschenberg pronounced his own entrenchment in the popular reception of this scientific discourse of indeterminacy, and his subsequent involvement with technology is inseparable from an investigation into causality, temporal reversibility, and irreversibility. After all, in the face of non-causal systems, of uncertainty, one resorts to fate—to oracles. As Rauschenberg later told Barbara Rose,

> "[Klüver] gave me the suggestion that the possibilities in technology were endless. Of course he was right. It was a difficult transition to make because I normally work very much by hand… Moving on to theory and its possibilities was like being handed a ghost bouquet of promises."[71]

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[70] This second model of invention—not starting from scratch, but finding new and unforeseen ways of using and changing existing technology—will be largely pursued in *9 Evenings;* it closely parallels Russian Constructivist debates on invention and technics. See Maria Gough, *The Artist as Producer: Russian Constructivism in Revolution* (Berkeley: University of California Press, 2005), 93, 99, 104-119.

[71] Rauschenberg, interviewed by Barbara Rose, in Rose, *Rauschenberg* (New York: Vintage, 1987), 87.

Klüver's early collaborations with Johns, Warhol, and Rauschenberg thus foreshadowed the possibilities and concerns made explicit in *9 Evenings*—technological invention and obsolescence, modernism and scientific positivism, mediated perception, and the work of art as subject to collective production, chance, and control systems.

II. Beginning 9 Evenings [72]

> "The artist's work is like that of a scientist. It is an investigation which may or may not yield meaningful results; in many cases we only know many years later."[73]
>
> —Billy Klüver

The concerns of collaboration, technological failure and obsolescence, and control systems were to be greatly amplified in *9 Evenings,* the major project that led to the formation of E.A.T—and that would prove central to its method. *9 Evenings* was a colossal enterprise whose ambition was matched only by its scale: the performance series lasted, appropriately, nine evenings in October 1966, as outlined in a Rauschenberg-designed poster, and was attended by over ten thousand people [Fig. 2.10]. Over thirty engineers from the Bell Labs campus in Murray Hill, New Jersey worked together with ten artists; their pathological struggles against and with one another brought the working methods of the postwar laboratory and studio into unprecedented intimacy. If these travails have been widely chronicled (witness the famous group photo in front of the Armory [Fig. 2.11]), the historical reception of the event is much more complex than its

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[72] A version of this section on *9 Evenings* appeared as Michelle Kuo, "*9 Evenings* in Reverse," *9 Evenings Reconsidered: Art, Theatre, and Engineering, 1966*, ed. Catherine Morris, exh. cat. (Cambridge: MIT List Visual Arts Center, 2006), 31-44. See also my "Inevitable Fusing of Specializations," in *Robert Rauschenberg*, eds. Leah Dickerman and Achim Borchardt-Hume, exh. cat. (New York and London: Museum of Modern Art and Tate Modern, 2016), 260-271.

[73] Billy Klüver, "The Great Northeastern Power Failure," January 28, 1966, lecture given at the College Art Association annual meeting. For manuscript, see Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 3, Folder 2.

contemporary traces indicate. Indeed, *9 Evenings* moved collaboration toward a peculiar kind of organization and production, a vital shift that fundamentally altered modes of collective action, disciplinary bounds, and the terms of performance.

This shift must be read against the specific historical moment of the late 1960s—and its penumbra, the "long '68"—that marked the simultaneous expansion of capitalism on a global scale *and* what Fredric Jameson has famously called "an immense freeing or unbinding of social energies, a prodigious release of untheorized new forces."[74] This double movement meant that new models of cultural and aesthetic engagement were just as quickly coopted by and in fact isomorphic with developments in capital. Here I refer, of course, to Guy Debord's theorization of "spectacle"; more broadly, as Jameson argues, at this moment "culture becomes coterminous with social life in general…the society of the spectacle, the image, or the simulacrum, *everything* has at length become cultural, from the superstructures down into the mechanisms of the infrastructure itself."[75]

For some, however, this understanding does not go far enough: indeed, the late 1960s may also be understood to be precisely the point at which Jameson's "every*thing*" might be extended to every *force*, every *field*, every *event*. In other words, sovereign forms of power become more mutable and flexible forces of *control*, forces that are imbricated in the very communicative, biological, and microscopic networks that would seem to elude the physical mechanics of both superstructure and infrastructure.[76] The

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[74] Fredric Jameson, "Periodizing the 60s," *Social Text* 9/10 (Spring/Summer 1984): 208.

[75] Ibid., 201. Emphasis added. See also Guy Debord, *Society of the Spectacle* (1967), trans. Donald Nicholson-Smith (New York: Zone, 1994); Jonathan Crary, "Eclipse of the Spectacle," in *Art After Modernism: Rethinking Representation*, ed. Brian Wallis (New York: The New Museum of Contemporary Art, 1984), 291-292.

[76] The signal formulation in this regard is Gilles Deleuze's "control society"; see Gilles Deleuze, "Postscript on the Societies of Control," *October* 59 (Winter 1992): 3-7.

strategies of the postwar neo-avant-gardes were concerned, to varying degrees, with precisely this penetration of control into all sectors of immaterial and material life. And technology is central to this deep transformation, both as cause and effect. What is at stake in this period and in *9 Evenings* is the scope of this proliferation of control, its enactment through and because of technological development, and the efficacy of the tactics that might anticipate or combat it.

In January 1966, Klüver and Rauschenberg assembled a group to organize a performance program for the Fylkingen Arts Festival in Stockholm. The participants included a number of members of the experimental dance and theater group Rauschenberg had been working with at Judson Church since 1962, known as "Bastard Theater": Alex Hay, Deborah Hay, Lucinda Childs, Steve Paxton, and Robert Whitman, who had all participated in pieces such as *Spring Training* in 1965 [Fig. 2.12]. The Fylkingen Festival was seemingly aligned with the interests of the group—speakers slated for the event were Buckminster Fuller, Marshall McLuhan, and Bell Labs's John Pierce.[77] On January 14, Pierce, Max Mathews (the "father" of digital music and sound synthesis, also of Bell Labs), and others gathered with Klüver's group of artists to brainstorm ideas. To this list were added Yvonne Rainer, Öyvind Fahlström, composer David Tudor, and Cage.[78]

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[77] Harriet DeLong, "Origin," unpublished manuscript on *9 Evenings*, December 1966, Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 1, Folder 3. DeLong had been hired to interview participants and assemble information for a book on *9 Evenings*, to be published by MIT Press and edited by Brian O'Doherty. The book was never published; drafts and an incomplete manuscript, however, are extant in the E.A.T. archives.

[78] All of these participants would have been in the orbit of Whitman and Rauschenberg's community of performers and composers, as well as other artists related to the circle around Klüver and Hultén. Fahlström, for example, had known Klüver and Rauschenberg through Hultén; in 1961 he had moved to New York and taken over Rauschenberg's old studio on 128 Front Street, where Johns also had a studio.

Proposals ranged from making use of Telstar, the new telecommunications satellite that came on the heels of Echo I, to Rauschenberg's "Feedback. Use of feedback through speakers and mikes carried by people to create variable sound," to Paxton's inquiry [Fig. 2.13], "Can sound 'materialize' in a space of different discrete points? Without speakers? Can the surrounding area be silent? Could images, smells, or matter be 'materialized' in this same way?"[79] At this time, preliminary collaborations ensued; Cecil Coker, for example, contributed synthetic speech technology for vocal effects in Deborah Hay's *No. 3* and Rauschenberg's *Linoleum* performances, both of which took place during curator Alice Denney's NOW festival in Washington, D.C. in April and May of 1966.[80]

Subsequently, however, extant correspondence depicts the Festival organizers as unwilling to work with the Americans' exploratory and collaborative approach. Negotiations with Fylkingen fell through in April 1966 and the project was cancelled.[81]

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[79] Steve Paxton, "Notes on ideas for first meeting," January 14, 1966, Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 1, Folder 3. As Klüver asked of Pierce, "The artists in the Stockholm Festival project have increasingly been asking about the possibility of making use of Telstar, Early Bird or some transatlantic TV communication. Cage and Fahlström have definite suggestions on how to use it. It has also been proposed that a performance could be put on in New York and thus be part of the Festival via the satellite transmission. I understand that Comsat is in charge of the satellite transmission. Do you think it would be conceivable that Bell Telephone or AT&T could sponsor a national TV program from the Festival in Stockholm with parts of it coming from New York? The artists could then make a specific theatre piece (15-20 min.) to fit this situation. The program could also include interviews with you, McLuhan, Cage and some Swede. I do not believe there would be any difficulty in getting Eurovision to relay the program in Europe." Billy Klüver, letter to John R. Pierce, April 8, 1966, *9 Evenings* Documents, The Daniel Langlois Foundation for Art, Science, and Technology, Montreal, Accession no. D 8966; C1-27.

[80] Deborah Hay, unpublished interview with Simone Forti, "*9 Evenings* Interview Transcripts," March 16, 1966, Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 3, Folder 15.

[81] DeLong, "Origin," n.p.; see also Fylkingen, "To the American Artists," letter to Klüver et al, July 22, 1966, n.p., Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 1, Folder 10.

Klüver and the group decided to find another venue for their proposed performances, eventually selecting the 69th Regiment Armory in New York, not by coincidence the site of the 1913 Armory Show. With the location secured, a fundraising scramble began. By the middle of August, the group had raised $12,000 from private donors and corporations—ranging from established art patrons such as Robert Scull, Dominique and John de Menil, and Victor and Sally Ganz, to dealers such as Virginia Dwan and Alfredo Bonino, to the Westinghouse Electric Corporation.[82] The main underwriter, however, was ultimately the Foundation for Contemporary Performance Arts, which had been founded in 1963 by Johns and Cage, having met with success in fundraising for Merce Cunningham's dance company by selling works donated by artists (the philanthropic organization continues to be active today).[83] Finally, Schweber Electronics donated much of the electronics equipment needed for the event.[84]

The artists now had to adapt their performances to the proportions of the Armory. Where they had been thinking in terms of a space approximately half the size, the Armory would provide a space approximately 150 feet long by 120 feet wide and a ceiling 160 feet high. Echo and reverberation times were as long as 5.5 seconds.

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[82] *E.A.T. News* 1, no. 3 (November 1, 1967): n.p.

[83] Letter of agreement with Foundation for Contemporary Performance Arts, 1966, Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 3, Folder 11. It should also be noted that the Foundation for Contemporary Performance Arts (currently named the Foundation for Contemporary Arts) had sponsored a lecture series earlier that year, in 1966, at the 92nd Street YMHA in New York, featuring Norman O. Brown, Peter Yates, Buckminster Fuller, Merce Cunningham, Harold Rosenberg and Marshall McLuhan—a roster of figures which would have provided a template for the original proposal to Fylkingen.

[84] *E.A.T. News* 1, no. 3 (November 1, 1967): n.p.

Working on this large scale, many artists became interested in the use of remote control for various props and effects.[85]

As meetings between the artists and engineers progressed, the need for a flexible, wireless, networked control system for the various theatrical elements became apparent. The most ambitious project undertaken was the design and development of TEEM, a "Theatre Electronic Environmental Modular System" for wireless, remote control of lights, sound, video, and other effects. It was the master network of *9 Evenings*, comprised of nearly three hundred components and used in some manner by all the artists in their pieces. Klüver described TEEM as the first electronic system built for on-stage use and a step toward the possibility when the computer could be part of an actual performance.[86] TEEM began to take shape early in 1966 and a description and engineering diagram of the "Wireless System," as it was first called, was available to the artists by March 1, 1966 [Fig. 2.14]. The system went through profound changes as the performance pieces were developing—a process that was to continue until the moment of execution of each event.[87] It was designed originally for use at the Festival in Stockholm with Fylkingen having the option to purchase it afterwards.[88]

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[85] Engineer Herbert Schneider discussed the parameters of the Armory in his document on specifications for *Open Score*. Herbert Schneider, "A Systems Approach to Bob Rauschenberg's Open Score," n.d., Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 1, Folder 8.

[86] Billy Klüver, memorandum, August 16, 1966, Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 1, Folder 3.

[87] Harriet DeLong, "Notes for *9 Evenings* manuscript," December 1966, Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 1, Folder 3.

[88] Ibid.

The majority of the electronic equipment was placed at a central control panel, thought of as a "black box" by the engineers. This allowed for the remote control of the elements on the stage (lights, loudspeakers, cameras, microphones, projectors, motors, and so forth), which were linked to the control panel either by cables or by a wireless network. A novel system was developed that involved transmitters and FM receptors: it became possible to use a variety of inputs—movement, sound, electrical signal—to trigger chains of command that could set in motion a whole range of different devices.[89] The wireless control network demonstrated that a single device did not have to function in the same way or produce the same effects. Different components could trigger different chains of command.[90] Referencing the system's application for the remote controlled sequences in Rainer's piece, Biorn compared TEEM to the first large-scale, general-purpose computer: "The idea comes from... the ENIAC... which was programmed by patching cords on a telephone switching system, that was how we intended to change the programs."[91] *9 Evenings* became less a matter of stage design than of creating an overarching electronic and informatic network, one that served as an interface between the technical apparatus and the performers and engineers.

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[89] Fred Waldhauer, memorandum, schematics, and handwritten notes, "Proportional Control System for the Festival of Art and Engineering," 1966, *9 Evenings* Documents, The Daniel Langlois Foundation for Art, Science, and Technology, Montreal, Accession no. 9 EVE 00032686.

[90] Clarisse Bardiot, "The Diagrams of *9 Evenings*," trans. Claire Grace, *9 Evenings Reconsidered: Art, Theatre, and Engineering, 1966*, ed. Catherine Morris, exh. cat. (Cambridge: MIT List Visual Arts Center, 2006), 45-51. As Bardiot writes, "engineers and artists involved in 9 Evenings utilized some of the fundamental principles and logic of computer science: programming, data storing, shifts between one media form and another, random logic, combinatorics, etc." Ibid., 51.

[91] Remarking on this potentially overly elaborate approach to the programming of the system, Biorn continued, "which would have been fine, if the performances had been going on [a long time] ... but since there were only 2 shows... we should have spent less time on that." Vincent Bonin and Eric Legendre, Interview with Per Biorn, *9 Evenings* Documents, The Daniel Langlois Foundation for Art, Science, and Technology, Montreal.

The problem of such an interface was acute. Numerous accounts of the interaction between the various participants relate an inability to communicate between artists and engineers. The engineer Herbert Schneider (a researcher on radio systems from Bell) recalled, "initially the artists were in total creative control. Then, after months of working, the whole team was having great difficulty getting things to work… there were communication problems between the artists and engineers that started to alter many of the artists' ideas."[92] The solution was to instigate an overall organization and alignment of the technical and artistic aspects as one integrated system of action. Schneider asserted himself as Systems Engineer for the project. He decided to set up an entire control area in the Armory where the wireless control network could be centralized [Fig. 2.15]. Moreover, he formulated a series of unique block diagrams to organize the effects of each piece—showing the links between the control area and the devices (such as lights) in the stage area.[93] As seen in the block diagram for the piece *Open Score,* whose main participants were Rauschenberg and engineer Bill Kaminski, these drawings were an innovation of Schneider's that both artists and engineers were able to understand [Figs. 2.16].

This organizational system and the model of an indeterminate invention—a type of invention without a stipulated objective or prior knowledge of how the invention might be utilized, as broached in the making of *Oracle*—were in fact already standard practice at Bell Labs. The open-endedness of invention had been thoroughly assimilated into

[92] Clarisse Bardiot and Catherine Morris, "Interview with Herb Schneider," *9 Evenings Reconsidered: Art, Theatre, and Engineering, 1966*, ed. Catherine Morris, exh. cat. (Cambridge: MIT List Visual Arts Center, 2006), 55-56, 57.

[93] Herbert Schneider, "The Performance Problem and a System Solution," n.d., Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 1, Folder 4.

corporate research and design and its mode of systemic organization. The mission of the Labs was stated as "free innovation," spurring untold scientific and technical discoveries that, it was presumed, would eventually result in new industrial applications—and hence new market sectors—for the company.[94]

By 1966, Klüver's own statements on failure now recognized this inscription of the unexpected into advanced research and design itself: "Most industrial firms [today] consider that a research man who fails 96 percent of the time is more valuable than one who succeeds more often, because he is involved in truly important experimentation."[95] Another *9 Evenings* participant, engineer Dick Wolff (an electronics specialist), alluded ironically to the non-productive paradigm of Bell Labs research:

> "At Bell your efforts get put on paper and filed away and no one ever sees them. …Here at Bell, guys spend months working on a beautiful idea, get it to work, write it up, and throw it away. They build this highly sophisticated equipment to produce this paper. The biggest product coming out of this place is paper. If this turns out to be so with the [9 Evenings] festival, it's good, it paves the way for future things."[96]

In this sense, the processes in *9 Evenings repurposed* the kind of free research and dehierarchized, horizontal management system increasingly practiced at Bell Labs. Artists and engineers began to assume common types of labor: a photograph tellingly documents Cage, Deborah Hay, Simone Forti and Jim McGee (a holograms engineer) preparing wires together for the system's control board [Fig. 2.17]. If the work at Bell

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[94] Prescott C. Mabon, *Mission Communications: The Story of Bell Laboratories* (Murray Hill, NJ: Bell Telephone Laboratories, 1975), 71-72.

[95] Klüver, quoted in Douglas Davis, "Billy Klüver: The Engineer as a Work of Art," *Art and the Future* (New York: Praeger, 1973), 145. Alex Hay remembers Klüver relating this idea as they were working on *9 Evenings* as well.

[96] Dick Wolff, unpublished interview with Simone Forti, "*9 Evenings* Interview Transcripts," November 11, 1966. Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 3, Folder 15.

was moving toward a diffuse, integrated network where power was irreducible to the agency of any one individual or group, in *9 Evenings* this kind of organization was not routinized but instead resulted in deeply epiphanic and traumatic experiences for its participants. Roles were muddled; artists were forced to relinquish customary control over composition and production. As Forti wrote in her journal,

> "Author's journal 10/8: One of the engineers said, 'What we need is a lot of unskilled labor.' And there were two dancers and a composer – Cindy, Yvonne, and Cage—stripping wires. It occurred to me after the second day of putting tiny-plugs on wires, at a table at which there were two to three artists at all times doing same, that the activity, the situation, was an engineer-directed one. Maybe it was that our eyes and fingers had been so concentrated on those little wires for so long that it seemed like a world of wires. Cage said about stripping wires, 'This is very mysterious because you can't see what you're doing. You can't see what's under it. It's typical of this technology.'"[97]

And in a revealing series of questions, Forti's journal continues with a passage struck out in the original manuscript:

> "[Fred Waldhauer was saying that their main problem here is in interconnecting. And that it's the same problem which is the main problem of the telephone system where the input of each phone in the world must be able to connect with the output of each phone. Is interconnection a problem basic to theatre in the broadest sense of the word? Have the engineers brought with them their world with its features and its problems? Have the artists been too passive? Or does this coincidence of interconnection being the main problem follow from these artists' interest in intermedia or in the landscape of mass media?"[98]

Finally, Forti wrote, "After opening night, Billy Klüver said, 'There are three elements fighting. The artists, the engineers, and the audience. These three will have to come to

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[97] Simone [Forti] Whitman, "A View of 9 Evenings: Theatre and Engineering," 1966, unpublished manuscript, 20, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 2, Folder 16.

[98] Ibid.

some resolution.'"[99] As we shall see, the actual performances themselves were to continue the fractious relations instigated in the production of *9 Evenings*.

III. 9 Evenings *in Reverse*

Let us start with the ending. Famously incendiary reviews of *9 Evenings: Theatre and Engineering* erupt at the close of each night's performance, declaring everything from "total boredom" to "the Decline of the West."[100] Such claims of technological and critical failure live on in histories of the event, becoming nearly inseparable from the works themselves.[101]

But what if we maneuver backward, unraveling this reception history in light of the actual form of the performances, as well as the collaborative process in which they were embedded? What if we take negative criticism at its face value—in order to understand precisely why *9 Evenings* did not match certain institutional and commercial expectations for aesthetic experience? For in refusing to provide a seamless show of both art and technology, *9 Evenings* successfully did something else: it demonstrated that

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[99] Ibid., 28.

[100] John Gruen, "Nine Evenings: First a Bore," *World Journal Tribunal*, October 14, 1966; Clive Barnes, "Happening: Ineffable Night at the Armory," *The New York Times,* Oct. 17, 1966. For other like-minded—and equally amusing—reports, see: "A good janitor becomes as important as a curator," *Life*, August 12, 1966; "Whatever it was it wasn't fun," *The Village Voice* XII, no. 1, October 20, 1966; Patrick O'Connor, "'Theater, Engineering' Less Than Pleasing," *The Jersey Journal*, October 17, 1966; Anne Jensen, "Nine Evenings of Nothing: Art as Tedium," *Manhattan East*, October 20, 1966; "Disharmony at the Armory," Glueck, *The New York Times*, October 30, 1966, 29. Glueck strung together the following opprobrium from audience reactions: "'Boring,' 'feeble,' 'dull,' 'vilely done'," while Barnes wrote, "God bless American art, but God help American science!"

[101] See, for example, Jack Burnham, "Art and Technology: The Panacea That Failed," in *The Myths of Information: Technology and Postindustrial Culture*, ed. Kathleen N. Woodward (Madison, WI: Coda Press, 1980), 200-215; Sylvie Lacerte, "9 Evenings," http://www.fondation-langlois.org/html/e/page.php?NumPage=1716, last accessed Feb. 22, 2016; Susanne Hillman, "Robert Rauschenberg, Robert Whitman and Billy Klüver: From 9 Evenings to Experiments in Art and Technology" (Ph.D. diss., Rutgers University, 2007); Pamela M. Lee, *Chronophobia: On Time in the Art of the 1960s* (Cambridge: MIT Press, 2004), 15. Lee's highly astute reading of the event takes into account the historical context of its successive receptions, from initial reviews to Burnham's postmortem, but does not depart from their assessments.

selected modes of neo-avant-garde performance and production were no longer wholly viable in 1966, having increasingly become the very spectacular effects they once sought to escape. This was the particular moment of intense historical pressure around 1966-67 when, as Jameson argues, "postmodern" conditions of spectacle, simulacrum, and the conflation of forms of high and mass culture transform into a "cultural *dominant,* with a precise socioeconomic functionality."[102] Brian O' Doherty articulated this change—and extended its implications—between the moment of Happenings in 1958-1963 and the new terrain of *9 Evenings*: "The anti-conventions then established are now conventions themselves… randomness, chance, simultaneity, lack of climax and resolution, dissociation of parts. They are now old-fashioned as modes. What matters is what they can be made to yield as conventions."[103]

And yield they did. *9 Evenings* forced signature devices of chance, participation, and abstraction to confront the fully technocratic world around them. Indeterminacy was not domesticated but translated into technological breakdown. Machine behavior trumped compositional scores. Audience and performer interaction became increasingly mediated. The structural inversion of these tactics represented not simply an end, then, but a transformation: *9 Evenings* inaugurated a shift in the meaning of key postwar aesthetic strategies—and offered a way through and beyond their technological arbitration. Such a shift was even apparent from the growing list of participants, who came not only from Cage's world (composers, but also many who attended his legendary class in experimental composition at the New School in 1957-58) but also from Judson

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[102] See Jameson, "Periodizing the Sixties," *Social Text* 9/10 (Spring/Summer 1984): 196. See also Crary, "Eclipse of the Spectacle," 291-292.

[103] Brian O'Doherty, "New York: 9 Armored Nights," *Art and Artists* 1, no. 9 (December 1966): 14-17.

dance, experimental film, theater, Pop, Happenings, Fluxus, and so on: Included were Frank Stella (a noted tennis enthusiast who became, as we shall see, the star player in Rauschenberg's piece for *9 Evenings*); Robert Morris, who would participate in Rainer's piece and fill in for her as director on the second night of her performance; Michael Kirby, critic and player in numerous Happenings, also in Rainer's piece; and Letty Lou Eisenhauer, who had been deeply entrenched in both the Happenings and Fluxus scenes. A range of participants from strikingly diverse aesthetic alignments, then, would become performers and collaborators—testifying to the as-yet unhardened categories of practice and doctrine at the time.

A primary case was Cage's ongoing experimentation in models of composition and performance. While preparing his work for *9 Evenings*, Cage penned a short series of notes, which he titled "12 Remarks re musical performance" (1966):

> *no score no parts free*
> *manipulation of available*
> *receivers 7 generators by*
> *any number of performers…*
>
> *collaboration with engineers*
> *composition socialized* [104]

Free manipulation, indeterminate execution, composition *socialized:* Cage and engineer Cecil Coker's *Variations VII* (October 15 and 16, 1966) extended the composer's recent use of chance operations in composition alone [Fig. 2.18]. Chance moved into the performance itself, so that process and reception were ineluctably fused—a shift that Cage had already begun to explore in his *Variations I* (January 1958) and subsequent

[104] John Cage, unpublished manuscript, Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 1, Folder 11.

works such as *Fontana Mix* (November 1958).[105] As James Pritchett has argued, in the pieces composed between 1958 and 1961, Cage "ceased making musical scores in any sense of the term, and began making what I refer to as 'tools': works which do not describe events in either a determinate or indeterminate way, but which instead present a procedure by which to create any number of such descriptions or scores."[106] One of Cage's assistants for the performance, composer David Behrman, noted that Cage "gave up control the most in this piece."[107] Here, the minimal "tool," consisting mainly of lists of sound sources and never published, was superseded by on-the-spot transmission of inputs, including telephone lines, transistor radios, televisions, frequency generators, a Moulinex coffee grinder and Smokey juice extractor (one such list of sound sources is reproduced here) [Fig. 2.19].[108] Recalling Cage's view of radio, the piece was, as Pritchett notes, an experiment in "making the inaudible audible."[109] Tudor had also brought a

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[105] On this shift, see Branden W. Joseph, "Robert Morris and John Cage: Reconstructing a Dialogue," *October* 81 (Summer 1997): 69. Cage's own early delineation of chance used in composition versus indeterminacy with respect to performance is explained in Cage, "Composition as Process: Indeterminacy" (1958), *Silence*, 35-40. On Cage's engagement with magnetic tape and changing conceptions of score and performance, see Liz Kotz, *Words to Be Looked At* (Cambridge, MA: MIT Press, 2007), 42-57; Kotz, "Cagean Structures," 118-135.

[106] James Pritchett, *The Music of John Cage* (Cambridge: Cambridge University Press, 1993), 126.

[107] David Behrman, interview, in *John Cage: Variations VII*, DVD, (New York: ARTPIX and Experiments in Art and Technology, 2008).

[108] John Cage, unpublished manuscript, Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 1, Folder 11. See also Anon., "Music Hath Charms—With Kitchen Overtones," *Home Furnishings Daily*, New York, Oct. 19, 1966: "[H]ousewares proved to be more with it than most noisemakers being used. Amplified sounds of the human body and the bong-bong of a tennis game proved tame next to the cacophony created by everyday sounds of the kitchen. …[Cage] piped in by telephone the sounds of kitchen machinery from all over the city, supplementing them with working models on stage. Chosen perhaps for their superior noises were: A Moulinex coffee grinder, a Waring blender, a Smokey juice extractor, a Toastmaster portable heater, a Japanese hand vac …"

[109] James Pritchett, *The Music of John Cage*, 153. A note from Cage to Tudor demarcates the scope of sources being considered: "things happening at the performance time (not prepared tapes) via TV, radio, telephone, telegraph?, mike, police … from outer space if possible… mikes; water (fountains, dripping, etc) etc. & electronic sds (non manipulated but tuned in so to speak i.e. feedback, single static frequencies, no

huge air-raid siren which he had named "George"—Cage heard it and decided to incorporate it into the piece because, he exclaimed, "It sounds like war."[110] Cage gave up durational limits (even those generated by aleatory methods, like the temporal intervals for his legendary *4'33"* [1952] or other works) to flag the beginning and end of the piece; together with Tudor, Behrman, Anthony Gnazzo (a mathematician from IBM), Lowell Cross (a student in electronic music at the University of Toronto, who had worked with Tudor previously and devised oscilloscope and video "translations" of sound), and others he scrambled to keep the live feeds continuously pumping, prey to the whims of their signal and feedback. And some things, of course, just didn't work: an unruly volume control, for instance, utterly defied Cage's attempts at modulation. As Coker—an acoustics pioneer who was to become celebrated for developing one of the first digital text-to-synthetic-speech converters, for "making computers talk"—recounted, "It wasn't a serious thing at the moment; but now I think, by God, I should have been there [on stage] when I think how untried everything was."[111]

Cage's implantation of uncertainty—both courted and inadvertent—into performance paralleled his 1960s turn toward an ever more intimate relation with technology (stemming from his profound experimentation with magnetic tape in the

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quasi melodic deals)." Note from John Cage to David Tudor, 1966, Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 1, Folder 11.

[110] Lowell Cross, interview, in *John Cage: Variations VII*, DVD, (New York: ARTPIX and Experiments in Art and Technology, 2008.

[111] "I remember there was a special mixer I worked on—a long strip with about 20 knobs and an input for each one. It came up after John Cage described his piece but he didn't understand it had linear potentiometers rather than logarithmic pots [potentiometers] so the volume wouldn't work with a twist of a knob the way he thought. I was in the control booth and I wish I had gone out and taken part in the performance and told him what was wrong… It's unfortunate he never had an opportunity to experiment with it." Cecil Coker, unpublished interview with Harriet DeLong, March 1973, Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 1, Folder 37.

1950s) and an increasingly complex use of chance.[112] Where previously a toss of the dice or the *I Ching* (*Book of Changes*) had organized his aural material in advance, now Cage embraced electronic processes for generating sound in real time.[113] Moreover, the use of transistors and transistor radio was extremely new (and the transistor, as previously noted, was one of the signal inventions of Bell Laboratories): here, they enabled both the transmission and physical movement of radio sound in real time, on the part of the *receiver*.

The shift in Cage's application of indeterminacy intensified on the second night of *Variations VII*. In fact, Cage seemed to be directly responding to the engagement with spatiality and radio that Rauschenberg had forged in *Oracle*: that evening, audience members left their seats to stroll, sit, and lie down amid the performers. Their bodies entered a field of viscerally shifting sound routes and bandwidths, privy to the strength of telecommunications signals as well as the acoustics of the Armory's cavernous shell. Indeed, a major issue in the use of the Armory was the range and strength of FM frequencies received inside the structure. As Simone Forti recalled, "[the Armory] was acting as a great antenna, bringing us all kinds of extraneous signals."[114] And the overall sound effect of the piece, as Gnazzo remarked, depended greatly on the large decay

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[112] On Cage's use of chance procedures for splicing and collaging magnetic tape for his legendary *Williams Mix* (1952), see Liz Kotz, "Cagean Structures," 131-132; John Cage, "Interview with Richard Kostelanetz" (1984) in Richard Kostelanetz, ed., *Conversing with Cage* (New York: Limelight Editions, 1988), 162.

[113] The most immediate and full-blown example would have been Cage's collaborated with Klüver and Coker the previous year for his *Variations V* (1965), where Merce Cunningham's dancers triggered sounds by movement in front of photocells; both Robert Moog (who would, simultaneously with Don Buchla, go on to invent the synthesizer) and Max Mathews of Bell developed sound synthesis equipment for the piece as well. Cage retrospectively gives a broad overview of the impact of electronic technology on musical practice and notation in Cage, *Notations* (New York: Something Else Press, 1969), n.p.

[114] Simone Whitman, "Nine Evenings: Notes of a Participant," *Artforum* 5, no. 6 (February 1967): 28.

time—a kind of filter effect—due to the echo of the Armory: sounds became soft, large, rounded (the space took off sharp edges from sounds).[115] The aleatory was therefore experienced as both phenomenological and virtual, always in contest with unstable modes of transmission and control.

Randomness also tends to breed: a positive feedback cycle, for example, will literally multiply noise (think of a microphone held too close to a speaker in the same audio amplification system). Tudor and engineer Fred Waldhauer's *Bandoneon ! (a combine)* stemmed from precisely this kind of multiplicative principle, systematically generating complexity and indeterminacy by producing, in Tudor's words, "'white noise' from scratch."[116] The vaudevillian and accordion-like bandoneon (inspired by Mauricio Kagel's use of the instrument) became the locus of a web of sonic and visual effects exponentially distending in time [Figs. 2.20, 2.21], as designated by the use of the mathematical factorial symbol "!". Indeed, Tudor was fascinated by the bandoneon precisely because it was a two-sided instrument, a rarity, and he attempted to modulate one side against the other side. Tudor began with a low drone, gradually adding more tones. Contact microphones picked up the sounds and relayed them through signal processing equipment including frequency modulators, filters, and frequency shifters. The cross-modulation of sounds produced a highly complex spectral output, assuming the function of a kind of mixer, using electronic circuits and saturated amplifiers that Tudor et al had constructed themselves. Noise cascaded through speakers in the balcony and

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[115] Anthony Gnazzo, interview, in *John Cage: Variations VII*, DVD, (New York: ARTPIX and Experiments in Art and Technology, 2008).

[116] David Tudor, "*Bandoneon !* Pre- and Post-Operative Note," 1973, unpublished manuscript, Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 1, Folder 9.

ricocheted off the walls. A specially adapted switching device (the "Vochrome") constructed by Robert Kieronski converted variances in pitch from the bandoneon into electrical signals that determined the spatial location of sounds (emitted via speakers throughout the armory) and the intensity of the lights.[117] Lowell Cross converted television receivers for graphic x-y axis display, activated by the amplified audio signals, and the resulting dynamic graphics (as well as the images of an oscilloscope connected to the audio amplifiers) were projected on large screens.[118] Carts that Tudor and his team assembled with found objects—wheeled props that recalled *Oracle*—were spontaneously moved by Behrman and others via remote control; each of these props contained speakers, using transducers that were modified by the resonant frequencies of a given cart's object (cones, boards, and so on). Feedback multiplied into a paradoxically even yet febrile field of aural and visual sensation. As Tudor stated later, "*Bandoneon !*

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[117] "The Vochrome is a device which may be termed as the inverse of a musical instrument. It accepts an audio signal input (such as sounds picked up by a microphone), spectrally analyses the signal and produces digital outputs corresponding to notes on the tempered scale. The original intent of the design was to produce a machine which could be 'sung to.' It would decode the voice into notes and the outputs corresponding to the notes could be used to drive a musical instrument such as a pipe organ. The instrument would play in real time the melody of the song being sung. Simple variations in the circuitry could be used to invert or transpose pitch. In Tudor's piece the Vochrome was used as a switching device which would control lights and the locations of sounds as determined by the pitch content of David's bandoneon playing. The relay switching circuit … consisted of 16 12-pole double throw relays wired to a programmable patchboard. Its function is determined entirely by the patchboard wiring. At one point earlier in its existence it converted teletype code into the six dot code of Braille. Later on it was a machine that played tic-tac-toe. For the festival the relay switching network was a sequential circuit which responded to combinations and patterns of signals generated by the Vochrome. The various states of this network each represented a different spatial arrangement of audio output from David's piece at the Armory." Robert Kieronski, "The Vochrome," in DeLong, "David Tudor: Bandoneon !," unpublished manuscript on *9 Evenings*, December 1966, Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 1, Folder 9. In essence, for Tudor's piece, this device was housed in a physical shell that used a loudspeaker to introduce sound into an acoustic chamber, where a series of brass reeds acted as tuning forks and sympathetically vibrated according to the fundamental frequency of the sound; and then the energy from the resonating reed, in conjunction with the transistor circuits, allowed passage of a electrical signal to the output that corresponded to the identified frequency.

[118] Lowell Cross, "The Video Images for David Tudor's Bandoneon!," in DeLong, "David Tudor: Bandoneon !".

[Bandoneon Factorial]'s sound image is a tending toward total oscillation (approaching white noise) with the differentiation discoverable therein…a performer activating interacting media will instigate an *unscannable* environment."[119] In other words, Tudor aimed to exponentially generate as many frequencies as possible: true "white noise" contains *all* audible frequencies at equal power, an allover field from which the "individual sound" becomes nearly impossible to extract. And aspects of the system that failed or were not ready on opening night only served to heighten this insurgency of acoustic effects, one's inability to take in the work as a whole. If *Bandoneon !* highlighted the impossibility of fully perceiving "randomness," it also betrayed the contingencies in its slapdash, "about-to-become available technology"—at the very moment of its engineered emergence.[120]

What differentiated Tudor's event from Cage's, moreover, was the absence of any kind of instruction, score, or Cagean "tool" (to use Pritchett's formulation) whatsoever. This was not an improvisation based on any kind of graphic rubric or transparent explanation. As Behrman has said, in contrast to Cage's use of notation or Cunningham's "Events," "notation is meaningless in this situation."[121] The situation gave rise to a staggering degree of turbulence, leading to what Behrman calls "chaotic systems… that offered a new kind of composition."[122] Feedback built on itself, essentially becoming an independent generator of sound with no original source (such as

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[119] David Tudor, "*Bandoneon !* Pre- and Post-Operative Note." Emphasis added.

[120] Ibid. In the same manuscript, Tudor pronounces that "*9 Evenings* bent the concepts of systems engineering…celebrating the arrival of technology rather than using it."

[121] David Behrman, interview with Julie Martin, Barishnykov Arts Center, New York, March 15, 2010.

[122] Ibid.

microphone, tape, or instrument). (In a subsequent performance of *Bandoneon !*, a speaker actually overheated and burst into flames.[123])

Technical and sensory breakdown thus gave an answer to the question of indeterminacy's fate. Once a liberatory escape from an administered world, chance and choice were now more than ever tools of commodification and instrumentality. On the one hand, individuated experience was being thoroughly colonized by actuarial science, advertising and niche marketing. (As Ian Hacking so bluntly wrote, "The hallmark of indeterminism is that cliché, information and control. The less the determinism, the more possibilities for constraint."[124]) On the other, technological failure was integral to the logic of planned obsolescence and the turnover rate of technical innovation. Klüver's own statements on failure recognized this inscription of the unexpected into advanced research and design: "Most industrial firms consider that a research man who fails 96 percent of the time is more valuable than one who succeeds more often, because he is involved in truly important experimentation."[125] As the experience with Warhol and *Silver Clouds* showed, the enormously generative aesthetic of indeterminacy and multiplicity that Cage, Rauschenberg, and members of Fluxus had established in the

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[123] David Tudor, interview, in *David Tudor: Bandoneon ! (a combine)*, DVD, (New York: ARTPIX and Experiments in Art and Technology, 2009).

[124] Ian Hacking, "How Should We Do the History of Statistics?" in *The Foucault Effect: Studies in Governmental Rationality*, eds. Graham Burchell, Colin Gordon, and Peter Miller (Chicago: University of Chicago Press, 1991), 194. Hacking writes, "The erosion of determinism and the taming of chance by statistics does not introduce a new liberty. The argument that indeterminism creates a place for free will is a hollow mockery. The bureaucracy of statistics imposes not just by creating administrative rulings but by determining classifications within which people must think of themselves and of the actions that are open to them." Ibid.

[125] Klüver, quoted in Douglas Davis, "Billy Klüver: The Engineer as a Work of Art," *Art and the Future* (New York: Praeger, 1973), 145. Alex Hay remembers Klüver relating this idea as they were working on *9 Evenings* as well.

1950s-early 1960s could therefore no longer be deployed to the same ends.[126] With typical aplomb, Billy Klüver suggested a way out of this dilemma in a speech given several months before *9 Evenings*. Referring to the "Great Northeastern Power Failure" of 1965, he proposed "the whole thing could have been an artist's idea—to make us aware of something."[127]

Klüver and *9 Evenings* dialectically intertwined the neo-avant-garde use of chance with its counterpart in technology and statistics—and thus with technological transmission, experimentation, and even breakdown, the limit case of probabilistic systems. *9 Evenings* thereby reframed the modeling of risk in *Silver Clouds* in the literal use of advanced communications technology. Whether in the form of a catastrophic blackout or noise surrounding an electrical signal, uncertainty was unavoidable. But it was also subject to newly developed tools of management. Each piece in *9 Evenings,* whether using oscilloscopes or the custom wireless system devised for the festival, relied upon this regulation of signals and their concomitant noise. It was an endeavor that literally staged the principles of communications theory—if only to disrupt that theory's quest for high signal-to-noise ratio and mire it in mechanical breakdown. As engineer Per Biorn remarked, "The idea that you would build something that would fall apart ...in a programmed way... turned my whole idea of engineering upside down."[128]

IV. Action at a Distance

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[126] Many of the original members of Fluxus had met in the late 1950s through Cage's course in experimental composition at the New School. Key Fluxus texts on chance include: *Anthology of Chance Operations*, ed. LaMonte Young (New York: LaMonte Young and George Maciunas, 1962); George Brecht, *Chance Imagery* (1957), (New York: Something Else Press, 1966).

[127] Klüver, "The Great Northeastern Power Failure," n.p.

[128] Per Biorn, interview with Vincent Bonin and Eric Legendre, August 24, 2004, *9 Evenings* Documents, The Daniel Langlois Foundation for Art, Science, and Technology, Montreal, video recording.

Rauschenberg's *Open Score* put another kind of competition into play. Frank Stella and Mimi Kanarek's cavalier forehands and volleys coyly recalled both the ludic, participatory objects of Fluxus and the legacy of object/subject relations in Happenings [Figs. 2.22, 2.23]. As physical movement limited by conventions of the game, the tennis match enacted the type of sportive interactions invited by Yoko Ono's *All White Chess Set* (1966), in which opposing sides were indistinguishable, or George Maciunas' mischievous *Modified Ping Pong Rackets,* first used in the Fluxus "Olympics" of 1965. And in a seesaw choreography where each contact between ball and racket set off an echoing 'ping!' and extinguished successive lights, the players' lunges became part of a level field of action amongst lights, speakers, performers.[129] This equivalence of things and beings pointed to the radical aspect of Allan Kaprow's early Happenings, where participants turned into props; the empathy and affect of traditional theater were hollowed out, routinized, mirroring the analgesic and reified qualities of everyday life.[130]

Interactivity took on an additional dimension in *Open Score*, however. The game insisted on an *adversarial* relation between its participants—between Stella and Kanarek, but also between the hotwired rackets and the engineers, who struggled to make the remote control devices for the rackets function properly. (On the first night, the paddle-activated lights did not work, so that engineers were forced to manually unplug a cord for

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[129] Rauschenberg viewed his collaboration with engineers as an extension of this logic of sameness: "I think that one works with information as though it were a material. I think that somehow it is richer if you are in a live collaboration with the material; that's our relationship to the engineers." Rauschenberg, quoted in Richard Kostelanetz, "Conversation with Robert Rauschenberg," *The Theatre of Mixed-Means* (New York: The Dial Press, 1968), 98.

[130] Judith Rodenbeck, "Madness and Method: Before Theatricality," *Grey Room* 13 (Fall 2003): 54-79. Rodenbeck links Kaprow's strategy of objectification to Cage's interpretation of Antonin Artaud's "Theater of Cruelty," among other theatrical discourses.

each light that was to go out.[131]) And when the lights did go out and a crowd of volunteers assembled in the dark, the audience's own gaze became one of enemy surveillance [Fig. 2.24]. They saw ghostlike, hazy, superimposed images of the crowd captured and projected via infrared television cameras, equipment which at the time was held as classified material for United States military research on surveillance and heat-seeking devices [Fig. 2.25].[132] (Robert Breer operated the cameras.) *Open Score* thus

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[131] L.J. Robinson, "At the Armory," unpublished manuscript, Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 1, Folder 14. Robert Breer also recounted the chaotic circumstances of the performance: "I remember about Bob's thing that nothing would work. The cameras didn't work, the projectors wouldn't light up. They were absolutely dead and it was about five minutes before opening time. There were about 2,500 people out there chafing at the bit and nothing worked. It was pretty crucial and I remember there was a lot of suppressed tearing of hair and Hartig (the man in charge of the infrared TV for Rauschenberg) went around and pulled all the plugs out of the current supplies, took some snippers and cut the ground pole off each plug servicing the projectors, turned the plug around and plugged it back in. That's all it took and everything was on. It was as dumb as that. Very complex equipment but it was just like turning around the plug on a toaster…. I also remember someone telling Rauschenberg that he had to go upstairs and start mixing his imagery. He said, 'Oh, my God!' He hadn't thought of that, hadn't done it before, and hadn't had time to rehearse or anything else. His famous quote is, 'I'll think of something,' which seemed pretty cool for a guy who was putting together such an elaborate piece. I remember another thing about Rauschenberg's piece. It seems to me we were very moved up on the balcony. I remember some tears going around. It was a very moving piece for some reason—unembarrassedly so. There was Les Levine, John Giorno, myself and Rauschenberg up on the balcony. And Hartig was there. In the first performance everybody repeated their names in the dark and they blew the tape. …Who knew that everytime they hit the tennis ball it would turn lights out. Obviously, the comment there was you could do the whole thing with switches. The technology thing is always up for grabs in things like that. How complicated it is is in the background, people lose their sense of proportion that way. The dramatic effect was the same, automatic or not. Those are those little victories and deceits. Unheralded I guess. I just remember being moved by that first time around. All those people announcing their names was a little bit like 'Our Town.' We were all so grateful that the thing finally did work…. We couldn't see what the audience was seeing. What we were seeing was in a little monitor. In the infrared it was all dark. Anybody who could see anything clearly was the two of us, [John] Giorno or Les [Levine], or whoever was running the other camera. By aiming the thing in the dark we couldn't see what we were going to see next. So scanning the crowd of people down on the floor and picking out things was very haphazard because we didn't have anything to go by. Being a trick filmmaker (animated films) I decided I had to deliver very straight imagery for Rauschenberg and not play with it at all myself because it was up to him to mix the stuff." Robert Breer, interview with Harriet DeLong, February 1973. Box 1.37.

[132] Larry Heilos, "Infrared TV," unpublished manuscript, Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 1, Folder 8. Heilos relates how he had to obtain the infrared cameras from an international distributor; none were commercially available in the United States. Breer, whose own extraordinary filmmaking skills were put to use as cameraman for the piece, said of the infrared technology, "The nice thing about the infrared is the memory of it. You can have a hold on some people and burn them in to the image and they can walk away without their skins and come back again." Robert Breer, interview with Harriet DeLong, February 1973, Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 1, Folder 37.

staged an agonistic conception of the subject, one not unlike the black box actors proposed by cybernetics and game theory.[133] Öyvind Fahlström alluded to the currency of such models (including their popularized iterations, from Eric Berne's psychoanalytical "transactional analysis," in which interpersonal interactions are seen as a kind of zero-sum game; to that of Buckminster Fuller's "World Game") for his own project with (*Silver Clouds*) engineer Harold Hodges, *Kisses Sweeter Than Wine* [Fig. 2.26]: "Games—Seen either as realistic models (not descriptions) of a life-span, of the Cold War balance, of the double-code mechanism to push the bomb button…The thrill of tension and resolution, of having both conflict and non-conflict (as opposed to "free form" where in principle everything is equal)."[134] Here was a rejoinder to the lack of dramatic tension in the alogical, non-narrative structure of Happenings or Fluxus events—one that opened onto relations of antagonism in the realm of politics and war.[135]

Wading throughout the warrens of Steve Paxton and engineer Dick Wolff's *Physical Things*, the *9 Evenings* audience also confronted ruptures in interactivity and

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[133] We should recall (as discussed in the previous chapter), for example, Norbert Wiener's cybernetics—which Peter Galison argues posited the subject as servomechanism, a self-regulating machine whose future movements could be predicted through the calculation of feedback. Galison, "The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision," *Critical Inquiry* 21 (Autumn 1994): 228-266.

[134] The text, partially read aloud during Fahlström's performance, was published in full by Dick Higgins's Something Else Press that year. Öyvind Fahlström, "Take Care of the World," *Manifestos* (New York: Something Else Press, 1966), 11.

[135] For instance, Michael Kirby's riveting experience as a participant in Yvonne Rainer's *Carriage Discreteness* revealed this antagonism in the relation between audience and performer. At the end of Rainer's first performance, the audience had grown increasingly bored and began to shout, clap, and stamp on the wooden bleachers. "Soon," Kirby related, "it seemed that all 1500 people in the audience were venting their anger at us." Rainer directed Kirby to move toward the audience: "I had the impulse to turn my back, but that seemed like a cowardly thing to do. I folded my arms and stared at the clamorous packed stands, at least trying to indicate that I believed in Yvonne and what she was trying to do. They were exceedingly uncomfortable moments for all of us. At last the noise subsided, but one could not help but feel that simplistic notions of 'audience participation' were being promulgated far too widely." Michael Kirby, "Environmental Theater," *The Art of Time* (New York: E.P. Dutton, 1968), 152.

transmission [Figs. 2.27, 2.28]. Ten industrial fans supported approximately 20,000 square feet of polyethylene. The inflated structure consisted of multiple "rooms": an entrance tunnel (150 feet long), a forest room (20' x 20' x 20'), a connecting tunnel (50'), big room (50' x 50' x 30'), exit (30'), performance room (12' x 12' x 12'), tower (160'), and performance tunnel (50'). And, in Paxton's words, "Amazing amounts of 1/2-inch Scotch tape (clear, sticky) were used to connect and seam the polyethylene."[136] Spectators palpated the tunnels' translucent plastic skin, then entered a magnetic potlatch of sound picked up on handheld receivers. Bodily sensation and receiving process overlaid each other. Like *Variations VII*, *Physical Things* mapped not only the space of the Armory but the commercial airwaves that girded it. During the first night, the work also entailed infamously long delays.[137] As L.J. Robinson recalled, "Fuses were blowing, weird flashes of sound and light would burst out into the gym, occasionally the acrid smell and smoke of a burned out resistor would fill the air."[138] The transmission to the modified transistor radios was weak, resulting in less aural incident than intended. One critic complained, "There was nothing to throb over."[139] Yet Paxton himself opposed such climactic thrills.[140] Rather, the work was to unfurl in a slow series of haptic

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[136] Steve Paxton, unpublished statement for *9 Evenings* book manuscript, Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 1, Folder 5.

[137] Robinson, "At the Armory."

[138] L.J. Robinson, cited in DeLong, "Origin," n.p.

[139] Gruen, "Nine Evenings: First a Bore." Gruen prefaced this statement with his expectations of being "shook up": "Never one to avoid getting his sensibilities all shook up, yours truly was right in there with the rest of the 'cattle' but, like them, he was soon making chit-chat rather than throbbing to a new experience."

[140] As Paxton astonishingly wrote a year later, in an article co-authored with L.J. Robinson, "It seems to me like the aesthetics tend toward a modest use of new materials and really a kind of an ambiguity of focus, let alone of use, to not make them especially spectacular. Now our presenting the stuff you guys made for us

discoveries (Lucy Lippard, for one, hailed *Physical Things* as "richly sensuous").[141] The intrusion of "dead air" and delay enhanced this halting process, as the synaesthetic turned to an awareness of mediated reception. Unlike the brassy showmanship of much kinetic art, these works inhabited a space of fissures and temporal lags. It was in this sense that Klüver explicitly positioned *9 Evenings* against the immediacy of "flashing lights and psychedelic effects."[142]

Klüver's assessment reveals the uncomfortable proximity between aesthetic reception as a post-Duchampian collaborative and performative act, and reception as a heady communion between spectator and work that all too often verged on the emergent synthesis of spectacle.[143] Indeed, a blasé audience of New York's art-goers now anticipated either interactive participation or multisensory effect or both—a "completion" of the work in their actions or sensations that often presupposed a kind of prestidigitation. "I'd expected magic," the critic David Bourdon said. "For the technical things to be astonishing…[the audience was] ready, able and willing for a lot more than they were

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in that way made it even more invisible than it was. If you do something with the wireless and it doesn't show at all except maybe to signal a dancer to move, I mean the dancer could have been signaled any other way. And I think that's a large part of the reason for the press—they just couldn't see it. Although if it had happened in some other way, it would have looked different but they would have nothing to compare it with and they never will in new art and they haven't gotten used to it…it's like we're in the process of invention, of like a social tool, and invention is a 24 hour a day job." Steve Paxton and L.J. Robinson, "Art and Technology: A Dialogue," *IKON* 1, no. 1 (February 1967): 21-22.

[141] Lucy Lippard, "Total Theatre?", *Art International* (January 20, 1967): 42.

[142] Billy Klüver, quoted in Grace Glueck, "The Sounds that Mushrooms Make," *The New York Times*, October 2, 1966.

[143] Marcel Duchamp, "The Creative Act" (1957), *The Essential Writings of Marcel Duchamp*, ed. Michel Sanouillet and Elmer Peterson (London: Thames & Hudson, 1975), 138. See also Benjamin H.D. Buchloh, "Ready-Made, Objet Trouvé, Idée Reçue," *Dissent: The Issue of Modern Art in Boston* (Boston: Institute of Contemporary Art, 1986), 106-122.

given."[144] And Lippard's review criticized *9 Evenings* as a whole for "too little professionalism in terms of the performing arts"—the lack of a good show.[145]

Robert Whitman nimbly pried apart this collusion of interface and astonishment. Television provided a surprisingly perfect tool: *Two Holes of Water - 3* actively deconstructed the governing code of televisual presentation, the split in time and place (between the place of the screen and the site of recording) that spectacularly conceals itself in a coherent image for the viewer.[146] Whitman's multilayered system of cameras and projections brought this operation of spatial and temporal collapse into full and fractured view. A bizarre derby of cars with both television and 16mm film cameras swerved in front of a panoramic series of projection screens [Figs. 2.29, 2.30]. Each car was, in turn, swathed in sheets of plastic that formed a further screen or distancing between recorder and projection.[147] Four more television cameras took additional recordings in disparate corners of the Armory, up in the balconies as well as offstage, their images projected on the screens below. Miniature lenses connected to television cameras by fiber optics took in the hand or arm of a performer; these live close-ups were juxtaposed with film footage, joining the literal presence of cameras moving in their

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[144] David Bourdon, interview with Simone Forti, October 11, 1966. Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 1, Folder 39.

[145] Lippard, "Total Theatre?", 39.

[146] Samuel Weber, "Television: Set and Screen," *Mass Mediauras: Form, Technics, Media* (Stanford: Stanford University Press, 1996), 117-118, 120.

[147] Indeed, both Paxton's and Whitman's pieces seemed to use plastic film as both screen and structure, recalling Whitman's use of plastic sheets and backdrops in his happening, *American Moon*, at the Reuben Gallery in 1960: The installation incorporated Kraft-paper tunnels which, toward the end, were obscured by an inflating enormous plastic balloon, wrestled by a man and a woman that moved around, under, and over it. The plastic balloon acted at once as a ground against which figures moved and as a growing and shifting physical mass with which the performers' bodies had to contend.

midst.[148] And as a remarkable diagram shows, Whitman explored the possibility of recording two views of an object at once with a television camera, beam splitter, and mirrors [Fig. 2.31]. By directing two mirror images—one of each side of an object—toward the camera, and keeping these distinct via a type of barrier, the camera would record two images at once, superimposed but distinct. This splintering of simultaneity shored up the distances masked over by commercial television, dismantling any reification of images into illusory wholes.[149] The movement of screens and images in Whitman's piece corresponds, then, to television's "movement of displacement," its *transmission* at a distance, which Weber likens to Benjamin's reading of allegory as an act of dispersion (*Zerstreuung*) and collection (*Sammlung*) (Benjamin's use of these terms has been translated more commonly as *distraction* and *attention*): "Like the allegorical court, television brings the most remote things together only to disperse them again, out of 'indifference to their being-there,' or rather, out of the undecidability of their being-there (*Dasein*)."[150]

In this sense *Two Holes of Water - 3* radically extended Kaprow's investigation of spreading simultaneous action over multiple locations in space. For *Self-Service* (1966), Kaprow had orchestrated multiple events to occur together over four months in New York, Boston, and Los Angeles. And in *Raining* (1965) [Fig. 2.32], a Happening he dedicated "For Olga and Billy Klüver," Kaprow presents a list of events in a present tense

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[148] The "performers" in the piece included Terry Riley, Les Levine, Toby Mussman, Robert Breer, Jane Kramer, Elaine Sturtevant, John Giorno, and Trisha Brown.

[149] As Whitman said, "Television is a great way to collect stuff." Robert Whitman, interview with Simone Forti, n.d., Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 1, Folder 39.

[150] Weber, "Television: Set and Screen," 125.

that implies their concurrency, each undone as "rain washes away."[151] Despite his closeness to Kaprow (as is well known, he was his student at Rutgers University) and the Happenings milieu, Whitman's continuing inquiry into projected images and nascent interest in telecommunications set his work on a different path—one that no longer dealt with the interpersonal and object relations of commodity culture, but with the dispersed, dematerialized networks of information and their control.[152]

Likewise, *Solo* ("a white, even clear event in space") didn't quite cohere into the nonhierarchical, allover monochrome field Deborah Hay had intended—the set of eight remote-controlled, motorized platforms she devised with Heilos and Wittnebert were a bit bumpy, the lighting somewhat irregular [Fig. 2.33].[153] Reductive structures were similarly overturned in Rainer's *Carriage Discreteness* [Fig. 2.34]. A grid of screens

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[151] Allan Kaprow, *Assemblage, Environments and Happenings* (New York: H.N. Abrams, 1966), 340-41.

[152] The intersection of television and the huge scale of the audience also cleaved *9 Evenings* from the early Fluxus projects of George Maciunas and others (the work of Nam June Paik is an important exception). Known for his curious objects approaching yet defying commodity status, George Maciunas never actually dispersed these ersatz products at mass scale. As Robert Watts explained, Maciunas was a "cottage industry of one person…[Fluxus] has a personal philosophy directed toward a mass audience, but not the get-up-and-go to do it." The event score or Fluxus object remained strongly linked to private experience. Robert Watts, quoted in interview with Larry Miller, "Robert Watts: Scientific Monk," *Experiments in the Everyday: Allan Kaprow and Robert Watts—Events, Objects, Documents,* ed. Benjamin H.D. Buchloh and Judith Rodenbeck (New York: Wallach Art Gallery, Columbia University), 92.

[153] Deborah Hay, unpublished manuscript, Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 1, Folder 7. The "conductor" for a group handling the remote controls was James Tenney; this set of "controllers" sat apart from the twenty-four performers who moved about the space in concert with the moving platforms. As Hay described the piece, "The remote controlled platforms, co-designed by Larry Heilos and Witt Wittnebert, were created to help achieve the effect of smoothness. The platforms could carry a performer absolutely still, all through the space… I decided that the platform should therefore operate similarly to the performer. The speed was equal to his walking rate, a platform would act on a performer by approaching him, stopping, and thereby signaling him to get on. There were eight square platforms, 26 x 26x 12 inches made of wood not unlike the floor." But as Wittnebert recounted, "The cars were controlled by FM radio, with a small receiver on each car feeding a decoder circuit that operated the relays built in the cars. Due to the small signal available and the characteristics of FM the cars were difficult to control." Witt Wittnebert, cited in DeLong, "Deborah Hay: Solo," unpublished manuscript on *9 Evenings*, December 1966, Experiments in Art and Technology Records 1966-1997, Getty Research Institute, Los Angeles, Accession no. 940003, Box 1, Folder 7.

literally toppled on cue, as devised and diagrammed by Per Biorn [Fig. 2.35]. Styrofoam, metal, and plywood constructions by Carl Andre (panels, pipes, parallelepipeds) were strewn across the floor, itself divided into a chalk-drawn grid of twenty parts. Rainer relayed spoken stage directions via walkie-talkie to the group of performers (which included Andre and others), who each had wireless earphone receivers and were meant to act upon hearing instructions.[154] Slides composed by Hollis Frampton—images of Zhou En Lai, African gazelles, W.C. Fields juggling—were projected at timed intervals. The choreographer's task-oriented, affectless gestures parried with a series of mishaps in the wireless system.[155] Rainer herself could not participate in key decision making processes for her own work, a step she was uncomfortable with. As Simone Forti related, "[Rainer] says working is very different from what it usually is for her. She has to get things each day like tape, tubes, etc. And make a lot of calls…Says, she's never worked in such an abstract, distant, cerebral way… That so much of the work is out of the artists' hands."[156]

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[154] Rainer's sixty-seven-step sequence of events concerning the set (directions for lights, projectors, props, etc.) is detailed in Yvonne Rainer, *Work 1961-1973* (Halifax: Nova Scotia College of Art and Design, 1974), 303-306. See also the transcription of the audio recording of spoken instructions (as performed by Robert Morris) on October 21, 1966, conducted by Vincent Bonin, *9 Evenings* Documents, The Daniel Langlois Foundation for Art, Science, and Technology, Montreal. The audio recording is stored at the Archiv Sohm, Stuttgart, Germany.

[155] On Rainer's aesthetic of negation, her refusal of the dramatic posturing of modern dance, see Carrie Lambert, "Moving Still: Mediating Yvonne Rainer's 'Trio A'," *October* 89 (Summer 1999): 87-112; Lambert, *Being Watched: Yvonne Rainer and the 1960s* (Cambridge: MIT Press, 2008).

[156] Whitman, "Nine Evenings: Notes of a Participant," 30. In a subsequent article in *Arts Magazine* (that focused on the sculpture of Robert Morris and on Warhol's *Chelsea Girls*), Rainer herself alluded to this experience and its impact on her conception of negation and withdrawal in performance: "Complicated by unique problems of production and collaboration, such an article [on *Carriage Discreteness*] would have to deal not only with what I think was seen, but with the distance (which everyone connected with the Armory shebang had to traverse) between initial fantasies (fantastic as well as modest) and the Second-Greatest-Show-On-Earth aspects in re-tracing that trajectory for myself. However, I do wish to say one thing, or rather pose a question: Have I (along with other people working in theater today) created 'theater-objects' that don't look back at the audience (therefore making 'excessive' demands on them), and if so, how is that possible where human performance is involved?" Yvonne Rainer, "Don't Give the Game Away," *Arts Magazine* 41, no. 6 (April 1967): 47.

Rainer herself recounted: "…I became Per Biorn's errand girl, going back and forth to Lafayette Street to buy motors, transistors, circuit boards, and other paraphernalia required for the programming of the remote controlled 'events' in my piece. The work went on day and night. I hardly slept."[157] Indeed, before the second performance on October 21, Rainer had fallen gravely ill with a gangrenous intestinal condition and Robert Morris took her place, relaying instructions to the performers.[158]

The aesthetic of negation thus gave way to an emergent conceptualism, where the labor of the artist was increasingly transferred to the non-aesthetic realm of the engineer. The discursive relation between artist and engineer was to form the basis of works such as Mel Bochner's 1967 *Measurements* series, a landmark investigation into communication and quantification during his residency at the Singer Company's research and development lab—facilitated through Experiments in Art and Technology—to be discussed in Chapter 4. The "dematerialized" conditions of conceptual art have a whole history (however twisted) of materials behind them that has gone largely unnoticed—one of wires and walkie-talkies as much as cool geometry or blank surfaces.

If the art of the sixties has only recently been reexamined in terms of the proliferation of "theatricality" beyond the Minimalist object, *9 Evenings* is still too often

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[157] Yvonne Rainer, *Feelings are Facts* (Cambridge: MIT Press, 2006), 275. Biorn further testified to the tumultuous runs of Rainer's piece: "I remember the first night of Yvonne Rainer's performance when the show is about to begin and everything has been plugged in and everybody is ready. We have tried out individually every one of the effects: the falling screen, the balloon, the super trouper, the slats; but we had never tried it with a switch. We have everything hooked up and the word comes, 'Okay, throw the switch!' And, I do. And nothing happens. Nothing whatsoever! I get a call back, 'Nothing happened.' I give the switch another turn and again nothing happens; and then things begin to happen in the most weird way that nobody can really understand. This is one of the things that happens when you don't have time to try everything out. The switch has been wired backwards so the whole first performance is run with me plugging in a screwdriver to shorten the contact point in the switch in the proper order. … By the second performance everything has been tried out and the whole thing is beautiful but the first night was a nightmare. After 36 hours of straight working, that it never worked—that was really a shock." Per Biorn, interview with Harriet DeLong, February 1972. Box 1.37.

[158] Ibid, 277-78.

seen as a collapse of the early aims of Cage, Happenings, and Fluxus into the realm of culture industry, into press hype and high price tags. 1966 is billed as the year of Happenings' demise into commodification through reproduction and documentation. The year has also served to mark the end of Rauschenberg's utopian project for a revolutionized subjectivity.[159] Yet *9 Evenings* does not simply represent an implosion of earlier ideals. Quite the contrary: it revealed that those ideals and strategies confronted a different world. As critic Jill Johnston wrote, in a rare positive review, "A disaster is not necessarily a disaster. Without semantics I would suggest that disasters often have beautiful side effects."[160] Jonas Mekas's review was equally laudatory: "As far as I am concerned, everything worked."[161] Failure was a peculiar kind of success.

9 Evenings led to the idea that artist-engineer collaborations could *proliferate*—and that the best way to facilitate such relationships was an organization, a group dedicated to matching artists with engineers and functioning as a kind of bureaucratic liaison. Klüver, Rauschenberg, Waldhauer, and Whitman led this effort, claiming to model their group on entities as diverse as the RAND Corporation and the League of Women Voters. The collective they assembled was dubbed Experiments in Art and

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[159] As noted previously, Rauschenberg's own works incorporating technology (contemporaneous with *9 Evenings*) have faced similar judgments of being too dull, mechanically simple, "switch-like," instrumentalizing their relation to the spectator. See for example Leo Steinberg, "Other Criteria," *Other Criteria: Confrontations with Twentieth-Century Art* (New York: Oxford University Press, 1972), 81. In fact, most of these pieces did *not* work well or function smoothly, stymieing any easy exchange between spectator and work.

[160] Johnston began, "[t]he show itself was a failure, but the idea will live on… In my view this collaboration [between artists and scientists] is essential in a crumbling democracy. And I think the future will exonerate a festival that needed more money and time to be successful." Jill Johnston, "Post-Mortem," *The Village Voice*, December 15, 1966.

[161] Jonas Mekas, "Movie Journal," *The Village Voice*, October 27, 1966.

Technology, and it was to continue *producing* relationships and works throughout the next decade.

9 Evenings, it seemed, had generated a fundamental turning point in the kinds of collaborative pursuits explored in *Silver Clouds* and *Oracle*. For the mode of collective production in *9 Evenings* was unprecedented. It emerged from the least likely place—the most advanced corporate research laboratory of the time. This way of working made possible avenues of authorship, construction, and reception that were significantly different from the neo-avant-garde tactics of the 1960s best known today. If those neo-avant-gardes had focused on resisting postwar systems of totalizing administration and industrialization that would increasingly characterize economic and political relations—Jameson's "henceforth global capitalism"—E.A.T. emerged as a catalyst for another model of action: one that literally was to come from inside the think tanks of those totalizing systems.[162] Yet the result would not simply be a reflection or mimesis of those extant structures. Other paths and prospects arose, unforeseen and in no small part unintended.

[162] Jameson, "Periodizing the 60s," 209.

CHAPTER 3

BIG SCIENCE

CHAPTER 3

BIG SCIENCE

I. Catalyst

It was supposed to be invisible. Experiments in Art and Technology was conceived as an unseen yet transformative agent—an ethereal yet active point of conversion between the artist and the industrial laboratory, an evanescent "catalyst."[1] In the aftermath of *9 Evenings*, Klüver, Rauschenberg, Waldhauer, and Whitman decided to pursue the formation of a bona fide organization that would, like some vast and imperceptible web, create mutual contact, translation, and metamorphosis between artists and engineers. This was, needless to say, a daunting task. Indeed, the lesson of *9 Evenings* seemed to be that artists and engineers were eager to collaborate, but that collaborations themselves—and the access, communication, materials, tools, and settings needed to make them possible—were enormously difficult to realize. And they were nearly impossible to *grow*.

E.A.T. nevertheless took up the gambit, deciding to go beyond the discrete, one-off interactions that had characterized so much artistic collaboration in the 1950s and early '60s. Yet the group would not lapse into traditional models of collective activity. "We are against making an institution," Klüver wrote in a November 1966 letter to the engineers who had participated in *9 Evenings*. "This means that our headquarters will not

[1] Throughout their documentation and materials, E.A.T. uses the term *catalyst* to describe their aim of being an agent—and accelerant—of change and mutual transformation. See, for example, Billy Klüver, "Establishing an Interactive Relationship between the Artist and Technology," manuscript, June 1969 (published in Italian as "*Interazioni fra arte e technologia*," in *Scienza e Technica*, *Enciclopedia della Scienza e della Tecnica*, ed. Edgardo Macorini [Milan: Mondadori, 1970]). E.A.T./GRI Box 120, Folder 23.

take the form of a workshop or a laboratory. It will only serve as a tryout place and where things can be tested."[2]

Against an institution: rather than an entity defined by visible borders, by stable enclosures and edifices, E.A.T. would be a chain of catalysts, an association of actors and events that were perpetually mutable, constantly changing each other, contaminating each other. In his letter to the engineers, Klüver continued,

> "A true collaboration between artists and engineers will only develop when both sides understand each other. Meanwhile the attitude should be that the engineer is working on the artist's initiative and on his directions. On the other hand we are not interested in artists (and there are many) who will command something (do this for me) without the interection [sic] back and forth of ideas between him and the engineer. The relationship must be constructive and inventive on both sides."[3]

While the artist was initially understood as the leader of the collaboration, it was imperative that room be made for flexible, unpredictable exchange and invention.

And such relationships were clearly in demand. The first E.A.T. meeting took place on November 30, 1966 in the smooth, corporate leisure space of the ballroom of the Central Plaza Hotel in New York [Fig. 3.1]. In answer to the open call, three hundred artists attended and the group collected eighty requests for technical help that night.[4] In less than two months, E.A.T. rented a loft at 9 East 16th St. and began matching artist requests with engineers, publishing a newsletter, *E.A.T. News*, and organizing open houses and lecture series [Fig. 3.2].

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[2] Billy Klüver, "To the engineers who participated in Nine Evenings," November 1966. E.A.T./GRI Box 3, Folder 2. This open-ended flexibility had an important practical corollary: "It also means that artists should be able to remove and work with the equipment we own." In other words, any technological tools or materials could be borrowed, circulated, distributed. Ibid.

[3] Klüver, "To the engineers who participated in Nine Evenings," November 1966. E.A.T./GRI Box 3, Folder 2.

[4] *E.A.T. News* 1, no. 1 (January 15, 1967): 3; E.A.T., "Ford Foundation Proposal, Version 2," May 19, 1969. E.A.T./GRI Box 42, Folder 15.

A “tryout place” that was “not a laboratory,” where “things could be tested,” equipment traded, agents joined: such provisional exchanges would seem to be the very antithesis of “big science,” the massive transformation of scientific and technological research at midcentury into the vastly scaled modern laboratory. Big science meant enormous budgets, sprawling laboratories, and juggernaut machines, newly buffeted by the postwar boom in government-sponsored research. It was the Manhattan Project—the ur-model of big science—writ even larger. It was Bell Labs, “the world’s greatest industrial laboratory,” whose staff numbered more than 13,000 by the early 1960s, and whose entire raison d’être was the invention of an immense, omnipresent telecommunications network.[5]

Art, on the other hand, appears in chronicles of this period as an alternative to “the huge rockets, the high-energy accelerators, the high-flux research reactors” that defined “big science” in the article in which the moniker was coined, an essay by Alvin M. Weinberg, director of the Oak Ridge National Laboratory, in *Science* in 1951.[6] Weinberg was responding, in turn, to Eisenhower’s famous pronouncement of “the military–industrial complex” that same year. Big science was everything, it seemed, that art was not: the former operated at the scale of the government, the military, the university, even the planet, and was an exemplar of the twentieth-century “management revolution,” of modern organization[7]; the latter was produced in small communities of

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[5] Francis Bello, “The World’s Greatest Industrial Laboratory,” *Fortune* 58, no. 5 (November 1958): 148-157.

[6] Alvin Weinberg, “Impact of Large-Scale Science on the United States,” *Science* 134, no. 3473 (July 21, 1961): 161-164.

[7] The classic articulation of the management revolution is Alfred D. Chandler Jr., *The Visible Hand: The Managerial Revolution in American Business* (Cambridge, MA: Harvard University Press, 1977).

highly idiosyncratic individuals, represented by comparatively tiny markets and schools and museums.

And yet in hindsight, E.A.T. begins to look less and less like art and more and more like big science. For big science was big, but it was not monolithic. A "factory" work style certainly dominated many laboratories, but at the same time, big science also constructed places where things could be tested with abandon, where the tryout overtook the routine, where huge high-energy accelerators also meant huge teams of idiosyncratic and flexible thinkers. *Big* did not simply mean rigid and closed. It began to mean adaptable and, in short, innovative. Its size only amplified its inventiveness and its ambition.[8] And Bell Labs was the most advanced instance of big science in action.

Sociologist Bruno Latour has produced landmark analyses of this colossal proliferation of science and technology: its tools, its procedures, its things. In doing so, he has re-envisioned both objects and subjects as dynamic "actors"—shifting our attention from stable states to the mediation that occurs *between* actors, between scientists, engineers, events, ideas, and objects. Latour thus upsets the traditional sociological binaries of "structure" versus "agency," external social forces versus individual action and transformation, object and subject, inside and outside. Instead of

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[8] On big science, see: Alvin Weinberg, *Reflections on Big Science* (Cambridge, MA: MIT Press, 1968); Peter Galison, "The Many Faces of Big Science," in Peter Galison and Bruce Hevly, eds., *Big Science: The Growth of Large-Scale Research* (Stanford: Stanford University Press, 1992); Robert Kargon, Stuart W. Leslie, and Erica Schoenberger, "Far Beyond Big Science: Science Regions and the Organization of Research and Development," *Big Science*, 334-354; Bruce Hevly, "Reflections on Big Science and Big History," *Big Science*, 355-363; Peter Galison, "Physics Between War and Peace," in E. Mendelsohn, M. Roe Smith, and P. Weingart, eds., *Science, Technology, and the Military* (Dordrecht: Kluwer, 1988); Lillian Hoddeson, Adrienne W. Kolb, and Catherine Westfall, *Fermilab: Physics, the Frontier, and Megascience* (Chicago: University of Chicago Press, 2009); Alfred D. Chandler Jr., *Scale and Scope: The Dynamics of Industrial Capitalism* (Cambridge, MA: Harvard University Press, 1990); Chandler, *The Visible Hand*. On the postwar think tank—in particular RAND—and game theory as related to theories of postmodernism, see: Pamela M. Lee, *New Games: Postmodernism after Contemporary Art* (New York and London: Routledge, 2013).

objects or subjects, he puts weight on relationships—the links and movements that are part of what he calls "science in action."[9] Everything is connected, and everything is changing. What matters is the relative strength (or weakness) and proximity (or distance) of a connection at a given moment.

To understand these contiguities, Latour relies on the methodological and theoretical apparatus of the *network*. This has enabled Latour to pursue a vigorous, atomistic dissection of research and laboratory practice. In fact, his model has increasingly been marshaled as a reference in the distant field of contemporary art, in order to map present-day relations of artistic exchange and reception. But far closer to home, Latour's sociological model of the network is an astonishingly apt—and precise—rubric for understanding E.A.T. Because E.A.T., of course, shares exactly the same actors and networks that are the subject of Latour's original research: scientists, engineers, and laboratories (even as it illustrates the far-reaching implications of Latour's work beyond this realm). Bell Labs built the network as we know it. And E.A.T. was its extraordinary homologue, a very strange network indeed.

There are two more important reasons for this remarkable methodological alignment. First, Latour argues that there are no real distinctions between technology, science, and society. Rather, he emphasizes their ties, their porous boundaries, in order

[9] Bruno Latour, *Science in Action: How to Follow Scientists and Engineers Through Society* (Cambridge, MA: Harvard University Press, 1987). See also Bruno Latour and Steve Woolgar, *Laboratory Life* (Beverly Hills, CA: Sage, 1979); Bruno Latour, *We Have Never Been Modern*, trans. Catherine Porter (Cambridge, MA: Harvard University Press, 1993); *Pandora's Hope* (Cambridge, MA: Harvard University Press, 1999); Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network Theory* (Oxford: Oxford University Press, 2007). On power as an effect of association—of links—rather than as a cause, see Bruno Latour, "Powers of Association," in John Law, ed., *Power, Action and Belief. A New Sociology of Knowledge?* (London: Routledge and Kegan Paul, Sociological Review Monograph, 1986), 261-277; on tools and things, see Bruno Latour, "The Berlin Key," in *Matter, Materiality and Modern Culture*, ed. Paul Graves-Brown (London: Routledge, 2000), 10-21.

to debunk "artificial" institutional divisions and the social or technological determinisms that accompany such false categorizations.[10] Latour prefers to think of these domains as *technoscience*, a combinatory term that is all too apposite with regard to E.A.T.'s interdisciplinary view of engineering, science, and art. Second, this permeability between "pure" science and instrumental technology warrants a different type of methodological lens for the historian or sociologist. Conventional histories "shy away from the disorderly mixture revealed by science in action and prefer the orderly pattern of scientific method and rationality."[11] In their myopia, however, they miss both the big and the little picture. By contrast, for Latour, we must "study the science *in action* and not ready made science or technology."[12] To pursue the "history of technoscience" is to follow "the history of all the little inventions made along the networks to accelerate the mobility of traces, or to enhance their faithfulness, combination and cohesion, so as to make action at a distance possible."[13]

Other sociologists, among them Pierre Bourdieu, have argued that Latour places too much of a premium on the competitive, internal politics of science and ignores the broader social field. They do so with good reason. But it is precisely Latour's near-microscopic attention to the networks of research, the traces and relations of knowledge, no matter how small or stretched or attenuated, that is indispensable for us here.[14] Latour

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[10] Latour, *Science in Action*, 141. Further, Latour argues that there is no knowledge independent of society or vice versa; there are only differences of scale in the distance between an observation and its reception.

[11] Latour, *Science in Action*, 15.

[12] Latour, *Science in Action*, 258.

[13] Latour, *Science in Action*, 254.

[14] See Pierre Bourdieu, *Science of Science and Reflexivity*, trans. Richard Nice (Chicago: University of Chicago Press, 2004), 26-31. Bourdieu even calls the kind of laboratory studies mounted by Latour,

addresses the way in which postwar scientists and engineers are fully engaged in an extensive field of research and development, management, inspection, production, and so on—and how little we have understood their practices. "We know that scientists are too few to account for the enormous effect they are supposed to generate and that their achievements circulate in frail, recent, costly, and rare galleries. We know that 'science and technology' is only the abstracted tip of a much larger process, and has only a very vague resemblance to it," he writes.[15]

Rather than looking at this immense spate of interactions and events as a causal sequence, as continuous steps in a linear progression, the model of "action at a distance" encourages us to examine the contingent and ceaselessly bifurcating paths of invention without end.[16] Rather than caricaturing the technological or scientific research laboratory as a monolithic in both organization and ideology, we can begin to understand its irregularity and heterogeneity, its disorder as well as its order. Rather than glossing the production of art along crude binaries of affirmation and critique, individual and group, inside and out, process and thing, we can begin to parse its multiplicity. And, indeed, the artwork or experiment or innovation can likewise be regarded in terms of its effects, its ripples, instead of any self-contained and originary objecthood or "content."[17] The model

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Woolgar, and others as akin to "old-style village monographs," rendering the laboratory a "small, closed and separate universe" that does not account for the "*structures* which orient scientific practices," the laboratory's status as a social microcosm among other laboratories, a discipline, a world, and so forth—what Bourdieu terms the scientific habitus. Ibid., 30. Latour has historically cited Bourdieu's early work—in particular *Outline of a Theory of Practice* (1972)—but has mounted a serious critique of Bourdieu's later emphasis on habitus, which Latour sees as mistakenly viewing "class" or "power" as a quasi-magical, top-down cause (rather than as a set of effects, as Latour would have it) of social relations.

[15] Latour, *Science in Action*, 252.

[16] Gough, *The Artist as Producer*, 93, 99, 104-119.

[17] For an important articulation of how we might go beyond "object-centric" exegeses with regard to twenty-first-century art, likewise drawing on Latour's actor-network theory, see David Joselit,

of the network pushes beyond art history's traditional exegetical frames of "work" or "medium" or "style." It becomes particularly salient when considering the singular *expansiveness* of E.A.T.—a burgeoning network of experiments, actors, events, times, sites, and techniques—the magnitude of which is crucial to the organization's purpose and meaning in every way.

II. Capital

To enter this growing network of things and subjects, we might begin by tracing one such nonlinear and constantly changing series of flows—and follow the money. The actual incorporation of E.A.T. as a nonprofit, tax-exempt 501(c)(3) organization took place on October 18, 1966, in New York in order to facilitate the funding and operation of *9 Evenings*.[18] This was a rapid, initial action that preceded any deliberation of the aims of the organization after *9 Evenings* and without certainty that such an entity could actually be sustained. The Foundation for Contemporary Arts, founded by Johns and Cage (formerly the Foundation for Contemporary Performing Arts, and still extant), would enter into partnership with E.A.T. to organize and administer the event; Rauschenberg agreed to personally cover any debt incurred.[19] As Whitman later

"Institutional Responsibility: The Short Life of Orchard," *Grey Room*; and David Joselit, *After Art* (Princeton and Oxford: Princeton University Press, 2012).

[18] "Certificate of Incorporation of Experiments in Art and Technology, Inc.," October 18, 1966. Foundation for Contemporary Arts Archive, New York (hereafter referred to as FCA Archive). See also "E.A.T. Brochure," 1967. Fondation Langlois, Collection E.A.T., Montreal (hereafter referred to as Langlois), accession no. d. 9024; C3-10; 53.

[19] Experiments in Art and Technology, "Agreement with Foundation for Contemporary Performance Arts, Inc.," September 27, 1966. FCA Archive.

recounted, it was Rauschenberg's accountant, Rubin Gorewitz, who prompted the name of "Experiments in Art and Technology," given its *non*-artistic sound.[20]

A mix of funding from dealers, corporations, and arts patrons was modeled on the fundraising experience from *9 Evenings*. The board of directors and "agents," who were to "use their influence in [sic] behalf of E.A.T.," reflected this panoply of supporters [Figs. 3.3, 3.4].[21] In addition to Schweber Electronics, Klüver had secured funding for *9 Evenings* from Walter K. Gutman; gallerist Alfredo Bonino; Virgina Kondratief; Samuel Kron; curator Audrey Sabol; and collector Robert Scull. Klüver had solicited a grant from the Rockefeller Foundation as well, overtly comparing the arts project to government grants for industrial research and development.[22] AT&T, Raytheon, Shell, and Xerox had all been approached, but none joined as a sponsor. Ultimately, the main underwriter was the Foundation for Contemporary Arts, which had initiated the sale of donated artworks as a revenue model.

The Foundation's financial support for the project was limited to funds the Foundation had already received, in addition to all revenue received from donors and *9 Evenings* ticket sales until the end of the performances.[23] Individual ticket prices were $3 each. "There is no indication that this agreement was ever signed by FCPA or E.A.T., but perhaps a signed copy was kept in the lawyers' offices," Julie Martin observes.[24] The

[20] Interview with Robert Whitman by the author, 9/28/2005.

[21] *E.A.T. News* 1, no. 3 (November 1, 1967).

[22] Letter to Boyd Compton, March 24, 1966. E.A.T./GRI Box 3, Folder 2.

[23] For an incisive summary of the FCA sponsorship of *9 Evenings*, see Julie Martin, "A Fifty Year Friendship," 2012, manuscript. FCA Archive.

[24] Ibid.

bank account "Nine Evenings Theatre and Engineering" was opened with Bankers Trust Company in New York, with the first transaction dating September 30 (a deposit of $2500), and continuing throughout May of 1967.[25]

FCPA's allocation of funds for the projects amounted to $20,500, "which have heretofore been contributed to FCPA plus the amount of additional contributions which FCPA may receive during the period commencing September 21, 1966 and ending at the conclusion of the public presentations after the Project, as well as all amounts received by FCPA from the sale of tickets of admission."[26] They agreed to pay for technical equipment, obtain FCC licenses to operate fifteen frequency modulation stations within the Armory, enter into a lease with the Armory, and other duties.[27] Rauschenberg took individual responsibility for any leftover deficit: "in order to induce FCPA to conduct the Project, [Rauschenberg] pledges to contribute to FCPA the amount of any deficit after the payment of all costs of the Project (including payments already made) remaining after the application of the funds which FCPA has allocated for the Project and further agrees to indemnify FCPA against any liability which it may incur in connection with the project."[28] The budget totaled $76,000 in costs.

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[25] Nine Evenings Theatre and Engineering bank statement, Bankers Trust Company, New York, 9/30 – 10/05/1966. FCA Archive.

[26] Memorandum, September 22, 1966, from meeting of representatives of Foundation for Contemporary Performance Arts, Inc. and Experiments in Art and Technology, Inc. at the offices of Paul, Weiss, Rijkind, Wharton, & Garrison, 4. FCA Archive. According to the memorandum, the FCPA representatives were John Cage, Jill Jakes, and Jasper Johns. The E.A.T. representatives were Klüver, Rauschenberg, and Alice Schwebke.

[27] Experiments in Art and Technology, Agreement with Foundation for Contemporary Performance Arts, Inc., September 27, 1966. FCA Archive.

[28] "[I]n order to induce FCPA to conduct the Project, [Rauschenberg] pledges to contribute to FCPA the amount of any deficit after the payment of all costs of the Project (including payments already made) remaining after the application of the funds which FCPA has allocated for the Project and further agrees to indemnify FCPA against any liability which it may incur in connection with the project." Memorandum,

Much has been made of the amounts of capital at stake here, which seemed staggering relative to the asceticism of performance art and theater at the time (see Chapter 2). It seemed to go against the very grain of Rauschenberg's, let alone Cage's, practice—not to mention the willfully stripped-down aesthetic of Judson, Fluxus, or Happenings. But, in fact, the funding program for E.A.T. directly reflected Rauschenberg's own extraordinary experimentation with models of funding. If Rauschenberg himself initially put up funds for the organization, this was in keeping with his exploration of unorthodox patronage structures and posing of alternatives to the commercial gallery, often financially supporting projects himself.

And if the expenditures were great, the risk incurred was greater: a deficit of $50,000 remained after the performances, surely making this a bad, or at least speculative, investment if ever there was one. Gorewitz and attorney Franklin Konigsberg attempted to fundraise to cover these remaining costs. Rauschenberg put up $100,000 worth of paintings as collateral. Again, the FCPA was ultimately responsible for the majority of debt relief.

After *9 Evenings*, Klüver and Rauschenberg launched a benefit exhibition at Castelli from December 6-10, 1966 (organized by Alex Hay and Lucinda Childs, and with artists from Arakawa to Sturtevant, Oldenburg to Brion Gysin, donating artworks for sale) to begin fundraising for E.A.T. itself. Klüver and Rauschenberg then set about applying for outside grants from the government, large nonprofit organizations such as

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September 22, 1966, from meeting of representatives of Foundation for Contemporary Performance Arts, Inc. and Experiments in Art and Technology, Inc. at the offices of Paul, Weiss, Rijkind, Wharton, & Garrison, 4. FCA Archive.

the Ford Foundation, and professional societies such as the IEEE, the Institute for Electrical and Electronics Engineers.[29]

This fundraising push coincided with nothing less than the invention of the public art trust in the postwar period. The National Endowment for the Arts had just been founded in 1964 and the National Endowment for the Humanities in 1965, for example. As a result, artists would spend almost as much time writing grant proposals as making art. But the founders of E.A.T. never intended for the organization to operate under the aegis of a governmental or academic institution. This sharply contrasted with virtually every other art and technology venture at the time. E.A.T.'s structure was markedly distinct from Zero, for example, whose practice would find its ultimate home in the university, at Kepes's and Piene's CAVS program at MIT. Nor did E.A.T. want museum exhibitions to be their primary mode of reception. This ran counter to finite museum endeavors such as LACMA's "Art and Technology" show, in which institutional display—the single exhibition—was the end result of collaborative activity.

In short, neither E.A.T.'s financial nor its structural status fit into known models for arts patronage, administration, or museological display. And this is why E.A.T. cannot entirely be defined in terms of the critique—or affirmation—of institutions. For such critique historically depended on the definition of institutions, from the museum to the very concept of modernism, as synonymous with the static, disciplinary strictures of scientific positivism. As Benjamin H. D. Buchloh has argued in his watershed reading of Conceptual art, modernist empiricism originated in nineteenth-century scientific positivism—and therefore in technological rationality, the "founding logic of capitalism";

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[29] *E.A.T. News* 1, no. 1 (January 15, 1967), n.p.

its logical outcome would be tautology.[30] It would be the mandate of artists such as Sol LeWitt to both reflexively reproduce and ultimately contest such tautologies. Yet even as it included many of these artists as members, E.A.T. departs from the Conceptual project. On the one hand, E.A.T. could be seen to have pushed the "aesthetics of administration" to its very limit—to a degree of imbrication and extension in structures of technological rationality wholly unmatched in postwar art. On the other hand, E.A.T. faced a different techno-scientific regime: a condition that could no longer be characterized by older models of administration, positivism, rationality, and bureaucracy, nor by an older logic of capitalism. Instead, E.A.T. broached new, shifting realms of reason, scientific method, technological invention, and aesthetic, organizational, and economic systems. It reflected and confronted another world.

In this, E.A.T. shares some of the affirmative character of Pop and Minimalism, not to mention that of Cage. Yet affirmation and mimesis were not the only implications of these movements. Nor was critical negation the only implication of Conceptualism. Other scenarios were posed, most significantly for their modeling of nascent fields of control—fields that differed from modernist institutions of sovereign power and positivist reason because of their flexibility, their atomization, their multiplicity.[31] So while E.A.T.

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[30] Buchloh, "Conceptual Art 1962-1969: From the Critique of Institutions to the Aesthetics of Administration," 115. On tautology and recursive temporality, see Lee, *Chronophobia*, 80-81.

[31] I would therefore argue that the stakes for the precise historical moment of E.A.T. are no longer fully congruent with those of Herbert Marcuse, whose famous diagnosis of technological rationality penetrating the subject—not only the body but further inward, to the unconscious, and outward, to all social relations, so that "domination is transfigured into administration"—in the 1960s represents a transition between earlier Frankfurt School analyses of institutional power and subsequent formulations of a "control society," but that still relies on many of the assumptions and methodologies of the former. (Ultimately, both models are problematic because they are too totalizing, as I will elaborate in the next chapters, but in different ways and with different definitions of power and control.) Marcuse, *One-Dimensional Man: Studies in the Ideology of Advanced Industrial Society* (New York: Beacon Press, 1964), 32.

has been commonly charged with naïve affirmation, apoliticism, or even collusion with the institutions of late capitalism—when it has been addressed at all—this reading argues otherwise. E.A.T. must be viewed apart from the dialectics of institutional critique. It must be framed in a history of media and technology that does not simply consign media to the role of bogeyman, avatar of alienation or subjugation or war.[32] It must be understood in terms of messy networks rather than monolithic institutions; new epistemologies and not positivism; risk and not totalizing control; multiplicitous processes, techniques, and technologies rather than signs or words alone. It must be considered at a moment when technology itself—the laboratory, the experiment, the innovation—was in the throes of massive transformation and expansion.

Historian of science Matthew Wisnioski has shown that engineers in the 1960s *did* pursue forms of radical critique, joining with leftist political organizations, and at least one group, Science for the People, founded in 1969, explicitly brought leftist politics and hard science together. E.A.T. is undoubtedly close to this milieu. And yet readings such as these and others in the domain of the social history of technology tend to consign the "cultural" component of such meetings between scientists and artists to an unbridled *humanism*: "For engineers—as it was for artists, scientists, and intellectuals—creativity was a romantic expression of human autonomy offered in opposition to criticisms that

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[32] Bernhard Siegert has written of the deep suspicion of media by those in the humanities, hermeneutics, the Frankfurt School, and continental theory in the 1990s. According to critical theorists, "media were responsible for eroding the growth of autonomous individuality and for alienation from authentic experiences"; and for those who came after, "If the telegraph, the telephone, or the radio were analyzed as mass media at all, then it was with a view toward uncovering their military origin and exposing the negative horizon of war of mass media and their alleged public status. Hence the enthusiasm with which the early work of Paul Virilio was received . . ." Siegert, *Cultural Techniques: Grids, Filters, Doors, and Other Articulations of the Real*, trans. Geoffrey Winthrop-Young (New York: Fordham University Press, 2014), 4.

technology was self-directed and that its practitioners were soulless."[33] This is the overriding explanation for E.A.T.'s own growth: "…over two thousand engineers, scientists, and technicians joined EAT [sic] in twenty-six chapters from New York to Japan with hope of making technology human."[34] In this interpretation, the critique of technology is the affirmation of humanism.

Yet such naïve humanism was precisely the *opposite* of the neo-avant-garde project—and, moreover, the opposite of the kinds of experience proffered in *9 Evenings* and in the strategies of E.A.T. Against any notion of an autonomous artwork, made by some transcendent individual via romantic subjective expression, the collaborations marshaled by Rauschenberg, Klüver, Cage, Whitman, Rainer, Paxton et al engaged a radically materialist, immanent, contamination of art and life. They pursued a multiplicitous, experimental, open-ended mode of production and reception that was intersubjective, even anarchic; that militated against notions of the unified expressive subject in favor of a contingent field of events and operations, challenging the liberal humanist subject position and traditional notions of individual artistic agency.[35]

And, as I have argued, *9 Evenings* and the early works of E.A.T. went even further—*beyond* such Cagean experiments in non-composition and radical immanence, approaching the dark side of chance or ludic détournment, engaging the inscription of such neo-avant-garde tactics, in turn, within new systems of control and management. If

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[33] Matthew Wisnioski, *Engineers for Change* (Cambridge, MA: MIT Press, 2012), 229. See also Fred Turner, "Romantic Automatism: Art, Technology, and Collaborative Labor in Cold War America," *Journal of Visual Culture* 7, no.1 (April 2008): 5-26.

[34] Wisnioski, 246.

[35] Cf. Yve-Alain Bois's watershed analysis of non-composition and the disavowal of the unified authorial subject in the twentieth century.

a certain latent humanism *did* haunt the legacy of "systems" and structuralism in the late modernism of the 1950s and early '60s, as Fredric Jameson has claimed—the autonomous, closed sphere of modernist culture redoubling and thus dialectically salvaging the closed world of the late capitalist system—such morphological and social unification would reach its apogee in Kepes's utopian revival of the Bauhaus legacy. By contrast, E.A.T. would irrevocably disrupt any such organicist harmonization.[36]

Ironically, then, this is one way in which interdisciplinary interpretation falls short: historians of technology have missed the history of art here, failing to understand crucial aesthetic and philosophical issues at stake in this work. And art historians have failed to understand the transformations of technological and scientific research that underpinned E.A.T.'s activity. Art historians have also elided the critical distinctions at work within E.A.T. itself. Again, the few studies addressing E.A.T. within the field have either focused on a few of the individual actors—turning a vast network of relationships into what is essentially a monographic study—or remained at the level of (incredibly valuable) archival research.[37] I hope to redress such blind spots here.

III. Expansion

> "Whoever makes critically and unflinchingly conscious use of the means of administration and its institutions is still in a position to realize something which would be different from merely administrated culture."[38]

[36] Jameson, "Periodizing the '60s."

[37] See Norma Loewen, "Experiments in Art and Technology: A Descriptive History of the Organization" (Ph.D. diss., New York University, 1975); Sylvie Lacerte, "9 Evenings," http://www.fondation-langlois.org/html/e/page.php?NumPage=1716, last accessed Feb. 22, 2016; Susanne Hillman, "Robert Rauschenberg, Robert Whitman and Billy Klüver: From 9 Evenings to Experiments in Art and Technology" (Ph.D. diss., Rutgers University, 2007). See also *Experiments in Art and Technology*, ed. Sabine Breitwieser, exh. cat. (Cologne: Walther König and Museum of Modern Art Salzburg, 2015).

[38] Theodor W. Adorno, "Culture and Administration," in *The Culture Industry: Selected Essays on Mass Culture*, trans. Wes Blomster (London and New York: Routledge, 2002), 131. "The tendency of every institution towards expansion—both quantitatively and qualitatively—was designated as immanent by Max

Theodor Adorno's maxim concerning the critical appropriation of the techniques of administration is well known. But it has a lesser known context: Adorno was, in fact, specifically referring to the model of *large-scale* bureaucratic organization that sociologist Max Weber had famously outlined. Even more importantly, Adorno's argument pivoted on the organization's inherent "tendency to *expand*." Expansion was the integral quality of modern organization.[39]

This drive toward expansion was directly echoed in the rhetoric of E.A.T. "There were over 8500 hours of engineering work that went into the *9 Evenings*…. During the 16 days in the Armory 19 engineers worked more than 2500 hours and three of them worked more than 250 hours each."[40] So wrote Klüver in *Artforum* in 1967— ticking off numbers, a proclamation of sheer *quantity* above all, as Branden W. Joseph has noted.[41] Klüver emphasizes both quantity of labor (man-hours) and of participants and, in doing so, implies that the magnitude of the endeavor is both central to its meaning and

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Weber in *The Theory of Social and Economic Organization* (Part III, Chapter VI) ... In Weber's view, bureaucracies, following their own law, *are destined to expand*. In the recent past the Nazi SS offers the most horrid example of this thesis. Weber finds the foundation for his thesis in the technical superiority of the organizational type of administration in contrast to traditionalist organization." Administration as bureaucratic organization is more efficient, faster, and unified than previous forms of collectivity, and the analogy Weber uses is that of the machine to the non-mechanical production of goods. Theodor Adorno, "Culture and Administration," 109 (italics my own). See also Max Weber, *The Theory of Social and Economic Organization*, trans. A. M. Henderson and Talcott Parsons (New York: The Free Press, 1947).

[39] On the tendency of modern technological systems to expand, expansion as related to complexity and diversity rather than to standardization alone, and the relationship of growth to invention in industrial laboratories after the prewar period, see Thomas P. Hughes, "The Evolution of Large Technological Systems," in *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, eds. Wiebe E. Bijker, Thomas P. Hughes, and Trevor Pinch (Cambridge, MA: MIT Press, 2012), 45-76.

[40] Billy Klüver, "Theater and Engineering—An Experiment: 2. Notes by an Engineer," *Artforum* 5, no. 6 (February 1967): 31-33.

[41] Branden W. Joseph, "Passages: Engineering Marvel: On Billy Klüver," *Artforum* 42, no. 7 (March 2004): 39, 42, 202.

potentially extensible. The numbers alone had suggested that collaboration could take place on an unprecedented scale. Yet, as we have seen, E.A.T. initially aimed to be invisible, ephemeral, without a static physical infrastructure. How could these twin aims be reconciled?

The key lies in "action at a distance": a network of relationships. Within E.A.T., the seemingly fleeting links between artists and engineers were often just as important as the material products of those relationships. A vision such as this was only possible after the heady process of *9 Evenings*, in which both people and things *changed*. As Alex Hay noted during the process:

> "We're building equipment that hasn't been built before but that's within the reach of technology. I'm asking for equipment to work in an environment that it wasn't designed to work in. …With the excitement about the concert rising, the scientists are getting more involved. [Cecil] Coker was pretty casual and apathetic in the beginning. Now I heard him say he's been working as much at night as in the day. Robbie's [Robbie Robinson] spent about $1000 of his own money. He's a ball of fire. Herb's [Herbert Schneider] developing into one too. There's nothing he won't do. It's amazing, the change from an attitude of slightly mocking, not talking seriously, and they have no idea of what's going to happen. Chances are they have very conventional ideas about art. Take a pattern where a product is dependent on their full participation. When their full participation produces the product, they're interested…"[42]

The enthusiasm of engineers—indeed, their subjective transformation—was crucial to the galvanization of the project. The redefinition of individual viewpoints and relationships becomes the main arena of action. The subjects and objects at work here are understood to be mutable—flexible, changing, open, and constantly affecting one another. As the last issue of E.A.T. News put it, in italics: "*E.A.T. is concerned with the*

[42] Alex Hay, transcript of taped interview with Simone Forti, September 17, 1966, n.p. E.A.T./GRI Box 1, Folder 6.

process of making art and not with the work of art as final product."[43] In that process, they leave behind endlessly forking and intersecting traces that, following Latour, are critical in understanding the dynamics of E.A.T. as well as the works the group produced.

Indeed, *9 Evenings* was a matter less of stage design or spectacle than of creating an underlying system unlike anything previously invented—a dynamic electronic interface between subjects, objects, and data. One can, more specifically, understand *9 Evenings* as a closed-circuit local network governed by a single master interface: the relays and signals and wires of TEEM running through one control panel—a membrane of mutual exchange between body and machine, between completely different and incommensurate domains of knowledge, carnal sensation and mechanical response, fingertip and microchip. So when, just two months after *9 Evenings*, we see the formation of E.A.T., we are seeing this concept of a local network, with a single interface, hyperbolically scaling up to a global one. E.A.T. was an attempt to build a radically expanded network across disparate disciplinary and epistemological fields—one in which fleeting likenesses among personal sensibility, interest, and expertise might be technologically automated, even algorithmically matched.

By the winter of 1966-67, and in the aftermath of the initial meeting on November 30, 1966, at the Central Plaza Hotel, matching between engineers and artists had begun. For example, work started on Carolee Schneemann's *SNOWS*, which was to be performed in January 1967 at the Martinique Theater. Schneemann and engineer Ralph Flynn would use equipment that had been constructed for *9 Evenings*, including amplifiers, speakers, photocells, "tone control units," contact microphones, "silicon

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[43] *E.A.T. News* 2, no. 1 (March 18, 1968): 1.

controlled rectifiers," and a "speaker distribution matrix," in order to deploy moving lights, objects, audio, and screenings.[44] A general list of available "E.A.T. Equipment" was circulated, which could be used by anyone who wished—from power amplifiers ("remarkably small" and low distortion, thus useful for any kind of stage sound) to the proportional control system, or TEEM, used for *9 Evenings*, which would allow remote control of sixteen audio signals, lights, or motors, all controlled by a plotting board that responded to a light source (akin to a primitive light pen), and which could be programmed in real time during a performance or pre-programmed on magnetic tape.

If I have emphasized the multiple applications of TEEM—its flexibility as a system to accommodate different programs and effects—here its status as a device with many possible inputs and outputs would become even more advantageous. More broadly, a shifting and diverse range of technology, whether high or low, short-term or long-term, conclusive or open-ended, was the goal. As the group's "Report on the Central Plaza Meeting" recounted, "Some of the projects [proposed] can be solved with a minimum of technical consultation while others appear to require long term collaborative effort with no assurance that they will be ultimately successful. Both types of projects with their different levels of technical challenge are needed to result in the rich and varied collaborative interchange possible between artist and engineer."[45]

Other applications for participation after the November 1966 meeting came from a strikingly mixed pool of artists associated with a wide range of the New York and global underground, from Cunningham, Judson Theater, happenings, USCO, and Fluxus

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[44] *E.A.T. News* 1, no. 1 (January 15, 1967).

[45] *E.A.T. News* 1, no. 1 (January 15, 1967).

to computer music: James Tenney, Tony Conrad, Michael Kirby, Marta Minujin, Hans Haacke, Mark di Suvero, Ken Dewey, David Antin, Brian O'Doherty, Phillip Corner, Gordon Mumma, Forrest Myers, Pete Seeger, and Dan Flavin; from Abraham Hyman, a technical administrator from the Electronics Operations Division of the US Atomic Energy Commission; and from art critic Irving Sandler. In this way, technical staff from the heart of military-industrial-bureaucracy joined the likes of earnest activists or experimental filmmakers.

Even amid the strange admixtures of '60s art and technology, or of '60s masscult and counterculture, rarely has a list of affiliations read in such heterogeneous fashion, so early on. In 1966—years before "The Machine" show at MoMA, or "Software" at the Brooklyn Museum (both 1968), or "Cybernetic Serendipity" at the ICA London (1968), or "Art and Technology" at LACMA (1971), and in a context altogether unlike the academic manifestos of Kepes or the gallery-bound endeavors of Zero—a group began assembling whose contours took dizzying twists. It was as if the seers of the Macy cybernetics conferences, the denizens of the New York and international neo-avant-gardes, and the technocrats and even bureaucrats of the age had suddenly converged in a warping of social and historical fabric. And this convergence was to unfold at an unprecedented scale.

The next meeting took place on December 14, 1966, and it was deemed "the first organizational meeting of E.A.T." It was on this occasion that an elaborate chart of the "Proposed Organization of E.A.T." was circulated (it was soon published in the first issue of *E.A.T. News*) [Fig. 3.5].[46] While Whitman has underscored the half-joking nature of

[46] *E.A.T. News* 1, no. 1 (January 15, 1967).

the diagram, it is nonetheless startling for its provisional mapping of the possible relations between industry, E.A.T., and artists, and its establishment of E.A.T. as, above all, a series of mediating relations. The nonlinear flow chart outlines a network of four categories and subcategories, not all commensurate: "professional groups," "industry," "E.A.T.," and "artists." The first and the last are standalone categories at the edges of the circuit; between them, the aggregator categories of industry and E.A.T. each encompass entities or activities within. Directly linked to professional groups is industry, which includes "industrial laboratories"; "available consulting eng (on their own time)"—in other words, engineers in their free time; and "information." Next to the industry sector is E.A.T., which includes a panoply of conduits: "contracts"; "board of directors / administration/ newsletter / visits to industry/ lectures / fund raising / legal protection"; 'industrial relations"' "lab. staff / small projects / equipment / performances / maintenance / space"; "information services files"; "tech. feasibility & steering (open to all eng. *& artists). This subfield of E.A.T. is directly adjacent to 'artists.'"

Among these actors and the points of communication and organization between them, a maze of arrows sketches out possible multidirectional paths of contact: from "artists" to "tech. feasibility" consultation to lab staff to contracts to industrial laboratories and back around again; or from "information" to "information services files" to "engineers' free time" to "equipment," at which point one would curiously stop or reenter the same loop, unable to jump to another path. Tellingly, artists are merely one node on the margins of this broad graphic, and the paths of possible circulation all pass through the mediation of E.A.T., which is the largest category, and the most detailed.

And circular or *dis*continuous paths are also plotted within this network, which is to say that the network shows itself to be by no means seamlessly interconnected at every point. Instead, it is marked by subroutines, interrupted and self-contained linkages: the institutional circumscriptions, informatic bottlenecks, legal hurdles, and limited windows of "free time," for example, which any kind of relation or mediation herein would have to confront. (According to Klüver's correspondence, many in the group objected to the organization, finding it far too detailed and bureaucratic; he later drew what must have been a mockingly simple diagram in its place, with just three terms/boxes, and in which the network becomes stripped to its simplest, and most open, undetermined form.[47])

The contacts mapped in the org chart would have to begin at the individual level: the meeting notes detail further exchanges between interested artists and engineers, often with a single practical query or call for expertise.[48] And so the meetings, and mediations, became more frequent and more urgent. Dean Fleming, a hard-edge abstractionist who showed at Park Place Gallery, acted as liaison for the site of the next gathering. The gallery, which had already played host to a well-known program of Minimal sculpture and music, became the setting for the January meeting as well as later E.A.T.-related projects. As the group would recount in their Ford Foundation grant application of 1969, "A subsequent meeting at the end of January 1967 at the Park Place Gallery confirmed the artists' desire to make contact with engineers and scientists."[49]

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[47] "List of questions asked at Central Plaza meeting on Nov. 30, 1966." E.A.T./GRI Box 9, Folder 25.

[48] Ibid.

[49] E.A.T., "Ford Proposal—Version 2: May 19, 1969." E.A.T./GRI Box 42, Folder 15.

E.A.T. decided to formalize such communiqués that same month, with a publication title *E.A.T. News*, styled as a kind of bulletin that would always, over its near ten-year run, include membership forms and questionnaires that could be detached and sent back to the organization. On February 18, 1967, the performance-cum-fundraiser "Homage to E.A.T.: Food for Thought" incorporated a Fluxus-inflected, tongue-in-cheek "TV Dinner" with Cage, Jack Tworkov, Merce Cunningham, Stan VanDerBeek, Len Lye, and a number of engineers—Biorn, Flynn, Waldhauer, McGee, Robinson, Wolff, and others. The event was staged at the YM/YWHA in New York, as a meal in which each diner's place setting was connected to a contact microphone and accompanied by live televisual projections hooked up to two closed-circuit TV cameras pointed at the table, light effects, and acoustic feedback. It was also aimed at engaging art patrons as possible E.A.T. supporters, with an open-mike Q-and-A session.[50]

The next month, the engineers were the target. In March 1967, Klüver gave a talk at the Institute of Electrical and Electronics Engineers (IEEE, "the world's largest technical association) to propose forming an "Engineering for Art" group, which would parallel and intersect with E.A.T., but within the domain of the engineering field's professional organization; he was met with positive responses.[51] And in April, Klüver gave the lecture "Interface: Artist/Engineer" at MIT.[52] One of his most prominent and

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[50] "Homage to E.A.T." program and proposal, February 18, 1967. E.A.T./GRI Box 41, Folder 5. Robert Creeley describes the "TV Dinner" as well as the tour that he, Klüver, Cage, VanDerBeek, Cunningham, Tworkov, and Lye took visiting universities in New York State as part of the New York State Council on the Arts program "Contemporary Voices in the Arts." See Robert Creeley, "Feedback: 'Contemporary Voices in the Arts'," *Arts Magazine* 41, no. 8 (Summer 1967): 18-20.

[51] Loewen, "Experiments in Art and Technology: A Descriptive History of the Organization," 117-118.

[52] Billy Klüver, "Interface: Artist/Engineer," reprinted in *E.A.T. Proceedings* no. 1, April 21, 1967. See also Klüver, "Interface," unpublished manuscript, March 21, 1968. E.A.T./GRI Box 120, Folder 3. All quotations until p. 30 from "Interface."

oft-cited talks, "Interface" was targeted specifically at the engineer-heavy audience of MIT; the university was already home to Kepes's Center for Advanced Visual Studies (CAVS) program, however, and the sizable crowd indicated the breadth of interest in art and technology already present. Even as it attempts to cater to an audience that might not be familiar with contemporary art, making its case to appeal to the practical aims of engineers, the lecture is bracing, highly contradictory, ranging from quantum mechanics to Susan Sontag's "On Style."

Appropriately enough, Klüver begins with *interaction*: with the exciting developments in contemporary art and its "transgression into different forms," briefly citing Happenings and *9 Evenings* as two examples of such intermedial contravention. And transgression across different boundaries is intimately linked to the topic of the future. An "artist friend" told him, he says, that people have two things on their mind when they think about the future: technology and drugs. With this quintessentially countercultural combination, then, Klüver begins a meditation on experience and sociological interaction. If Cage had said that "technology breeds agreement," drugs make it "unnecessary to have agreements." One is active, outward; the other is passive, inwardly directed. One is interactive, the other solipsistic. In this, Klüver seems to choose the path of technology as a mind-altering substance, a conduit for experience that is fundamentally social: "Few artists I know take drugs [nb: I find this hard to believe!]; but all are interested in technology. The contemporary artist's involvement or desire to be involved with technology signifies his wish to be involved with society." The future, for Klüver, would be predicated on interaction—interaction between ever-evolving and currently distant domains.

Referring to the legacy of "Aristotle, Leonardo, Van Eyck, the Futurists, the Constructivists, Schwitters, and the Bauhaus movement" as precursors of an interaction between art and technology, Klüver argues that these historical precedents relegated technology to a passive role. It is only with the modern intervention of Duchamp, Cage, and Johns, he says, that technology might be allowed agency—that the arbitrary, subjective, bourgeois, "traditional values" of art be consigned to the dustbin. "Duchamps [sic] suggested that the vector space that forms the world of the artist must never be experienced as a complete set. The artist must be conscious of the process of being an artist and hence of his own unawareness, of his not-knowing. … The meaning of art is not to communicate what we already know but what we don't know, to dislocate our vision, to make us look … Art is not a comment on or a criticism of the world." He then quotes Sontag: "'A work of art cannot advocate anything at all'"; and the legendary physicist Paul Dirac, who "insists on the measurable, observable reality rather than the validity of abstract mathematical concepts. Dirac has been to physics what Duchamps [sic] has been to art."

Above all, this is a form of *realism*: a desire to "enjoy the complexity of the world rather than be terrified by it." And this openness to complexity and contingency, obviously informed by Cage, is also a kind of *materialism* or immanence. Art is not there to "make order out of chaos"; rather, as Klüver quotes Sontag: "'Art is not only about something, it is something. A work of art is a thing in the world, not just a text or commentary on the world.'" Apart from metaphysics, knowledge, moral judgment, or "traditional values," art is "something like an excitation."

Klüver brings this sophisticated foray into materialism, into a kind of anti-transcendence or anti-metaphysics, to bear on art and engineering: The artist's approach to reality and the engineer's approach to reality are two different languages, but "in a curious way, the two areas"—analytic representation and visual and aural perception—"are coming together today." Visual access to the computer, for example, is only two years old; this *interface* between abstract code and visual/sensory perceptible input and output is new, and it is potentially life-altering. Moreover, "The contemporary artist wants the engineer. The contemporary artist sees the engineer as his collaborator, his material and his inspiration." Articulating an idea that he will repeat throughout the history of E.A.T., Klüver refers to the engineer himself as *a material*: the coming together of these vastly different spheres of experience, knowledge, perception, and representation means nothing less than an upending of subject-object distinctions.

What does this mean for actual interactions between artists and engineers? Klüver is adamant that industry be financially and logistically responsible; that new technology be prioritized (so that the artist "may catch up"). And, somewhat surprisingly, Klüver advocates for the artist and engineer to maintain their separate spheres as well—"to protect the artist from industry and the industry from art." Yet at the same time, the openness and flexibility of dialogue, the chance for surprise, is crucial: "It is for everyone working in a laboratory a trivial fact that almost any kind of chance meeting, accident or discussion can lead to new ideas." Again, two seemingly contradictory aims are juxtaposed: separation and connection.

Of course, Klüver attempts to entice his audience at MIT with the mention of possible patents, practical applications, and a wholly "new type of technology which will be involved with our senses." Indeed, citing the examples of different works—Alex Hay's acoustic amplification of real-time biofeedback in *9 Evenings*, investigating the body's sounds; Oldenburg's proposed large-scale monuments; Warhol's *Silver Clouds*—Klüver argues that altogether new kinds of perceptual experience and analytical knowledge might be attained. Klüver's most arresting example, perhaps, is his gloss on the possibilities for language and computing:

> "The tape recorder has freed the poet from his pencil. But the computer will be the poet's ultimate tool. You may ask the computer for such and such poem. The computer will give it to you visually or aurally. But, say that the poem itself in the computer is somehow dependent on you asking for it. So that whenever you want more from a certain poem at a given cue you will get more of the poem presented to you. The 'reader' will actually never know if he has read all of the material the poet programmed."

This extraordinary riff presages the explosion of literacy, reading, information, size, and the notion of a bottomless storage device for discourse and interaction: a scenario that foretells the seeming endlessness of information proffered by contemporary apparatuses, but that also outlines a strangely abstract, alternate path, one that stands apart from the discrete and certain exchanges of the iPad tablet or hypertext markup language.

What are the dangers of such interactions? Misprision—the confusion between aesthetic and technical decisions—is one. Another is "Black box syndrome": "When an artist wants a black box that can do all things and does not have time to visit the engineer, you can tell him to forget it. No matter what you do you will never be able to satisfy the artist." This prescient observation about the quixotic desire for technological possibility—expectations of magic—and the sobering reality of practical knowledge clearly harks back to the many discussions of *9 Evenings*. The lesson of one-on-one contact, emphasis on the single individuals, becomes imperative. And Klüver makes a call to arms to engineers in particular, focusing on his specific audience at MIT: "Reading articles about the two cultures on a Sunday afternoon and educating engineers in the liberal arts should not give us the same comfort anymore. … It is up to the engineer to accept the artist's offer."

What is striking in Klüver's roaming discussion is the attempt to build a real network across vastly different disciplinary and ontological fields—one in which ephemeral likenesses between personal sensibility, interest, and knowledge might be technologically automated, even algorithmically matched. This is the titular "interface": a field of mutual contact between radically different and non-isomorphic domains of knowledge, between subjects and objects. The artist-engineer relationship becomes a strange, scaled-up analogue of the man-machine interface, an essentially physiological simulation of the surface or point at which bodily sensation and mechanical response meet.[53]

But the interface is also an attempt at recognizing and eliciting what Latour calls action at a distance. Klüver seems to articulate and prescribe the kind of "actor-network" complex that Latour would retrospectively reveal in modern laboratory life—a network that operates both through and underneath traditional institutional social formations, across divergent epistemological realms, in a manner both bred by existing organizational logics and disruptive to them. A network that ties together vastly disparate disciplines, human and non-human actors. Indeed, from the remote controlled relays of *9 Evenings* to the ambitions of a global art-technology network, E.A.T. could be seen as attempting to realize action at the greatest distance possible. But rather than uniting these elements in

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[53] John Harwood, *The Interface: IBM and the Transformation of Corporate Design 1945-1975* (Minneapolis: University of Minnesota Press, 2011), 98-99.

some universalizing fusion, as traditional networks are wont to do, Klüver enhances the frisson, the heterogeneity, the differences haunting the network.[54] This explains the seeming paradox of Klüver's logic of simultaneous containment and connection: it is how and why the artist should be "protected" from industry and vice versa, even as they are brought closer together than ever before.

As Klüver concludes the lecture, he declares, "E.A.T. will act as a *transducer* between artist and industry."[55] The first elaboration of this term, which will be used throughout the group's history, it is both more specific and more ambitious than *interface*. A transducer converts one type of power into another, just as a loudspeaker converts electrical signals into sound energy. It does not obviate different states or types of energy. But it is transformative.

Due to greatly increased outreach efforts—not only talks such as "Interface" but phone calls, direct mailings, a kind of social network, in effect—engineering applications would quickly increase over the next several months, as an E.A.T. growth chart shows [Fig. 3.6].[56] The range of engineering applicants was, like the initial inquiries into membership, extremely diverse.[57] For the moment, however, E.A.T. primarily relied on

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[54] On networks and their structures, see Peter Galison, "War Against the Center," *Architecture and the Sciences*, eds. Antoine Picon, Alessandra Ponte, and Ralph Lerner (Princeton: Princeton Architectural Press, 2003), 196-227; Mark Wigley, "Network Fever," *Grey Room* 4 (Summer 2001): 82-122; Eric de Bruyn, "Topological Pathways of Post-Minimalism," *Grey Room* 25 (Fall 2006): 32-63. In 1972, several years after Klüver's lecture, Lawrence Alloway would undertake a somewhat parallel systems-theoretical approach to understanding the markets, distribution, and "connectivity" of the art world. See Lawrence Alloway, "Network: The Art World Described as a System," *Artforum* 11, no. 1 (September 1972): 28–32.

[55] Klüver, "Interface," n.p.

[56] "Growth of E.A.T. National Membership," Appendix I, "Ford Proposal—Version 2: Complete copies—May 19, 1969," n.p. E.A.T./GRI Box 42, Folder 15.

[57] E.A.T. engineering membership forms, 1967. E.A.T./GRI Box 8, Folders 1-10.

lectures such as Klüver's and personal contacts through Bell to begin to spread awareness throughout the technical community.

In April 1967, E.A.T. actually won a New York State Council of the Arts grant of $8000, their first outside grant.[58] As a result, E.A.T. secured a five-thousand-square-foot loft on East 16th St. that same month.[59] At this point, they had amassed a mailing list of about 2,000 names and received 250 applications from artists and 75 from engineers.[60] Beginning in May, the group sent information about E.A.T. to 3000 member engineers of IEEE in the New York area and began to generate articles about E.A.T. in the technical press.[61] On May 5, E.A.T. summoned a meeting for engineers at their new headquarters. The group discussed "procedures in setting up the collaboration between artists and engineers, and to begin the actual process of collaboration."[62] The engineer's role was paramount, not least because of the uncertainty of the process. As Fred Waldhauer wrote in an invitation to "engineers interested in E.A.T.": "Our experience from the 9 Evenings and the projects which have followed suggests that, in spite of the expression of great interest from the artists, the interrelation between the artist and the engineer is a fragile one, and the strength and patience of the engineers is crucial in making it work." Indeed, "The 250 requests for help received so far indicate that the approach by the artists will be

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[58] E.A.T., "Ford Proposal—Version 2: Complete copies—May 19, 1969." E.A.T./GRI Box 42, Folder 15. See also *E.A.T. News* 1, no. 2 (June 1, 1967).

[59] Ibid.

[60] Ibid.

[61] Ibid.

[62] Fred Waldhauer, "To engineers interested in E.A.T.," April 24, 1967. Langlois, d. 9024, EAT C3; 44.

imaginative, vague, and fanciful, rather than immediately realizable."[63] But if he or she stuck it out, "the process of collaboration is an endlessly fascinating one for the engineer." In fact, the engineer would actually make the ultimate decision as to whether a match would take place: an "engineering standing committee" would examine proposals, and a selected project engineer would contact the artist to discuss the project and provide information; they would then provide a technical evaluation and decide whether or not they could help the artist.[64] Finally, engineers would be responsible for two of the most important goals of the group: the level of technology—achieving a "high standard of technical innovation" would be sought, and the engineer would be the arbiter of this standard, thereby determining the fundamental structure and concept of each collaboration—and growth, via the dissemination of information and active recruitment in the industrial sector. "A successful working relationship between the artist and the engineer requires that each operate freely within his own environment"; and this freedom was dependent on the intersection and increasing magnitude of these "environments."[65]

The connection between successful collaborations and expansion would be articulated even more forcefully in June 1967, in the second issue of *E.A.T. News* (vol. 1, no. 2). On the first page of the publication, Klüver and Rauschenberg signed a statement in which the mission of the organization is posed even more broadly than before: "to catalyze the inevitable active involvement of industry, technology, and the arts."[66] In the

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[63] "Organization of Experiments in Art and Technology, Inc. / Procedure for Satisfaction of the Artist's Technical Needs," April 24, 1967. Langlois, d. 9024, EAT C3; 44.

[64] Ibid.

[65] Ibid.

[66] *E.A.T. News* 1, no. 2 (June 1, 1967).

first issue of *E.A.T. News*, this statement had been more modest: "The purpose of E.A.T. is to make materials, technology, and engineering available to any contemporary artist," with industrial laboratories to accept "full responsibility" in housing and facilitating any ensuing collaborations. Much the same division of labor had been outlined in Klüver's "Interface" lecture. But by the time of the second issue, the interaction was not to be confined to the industrial laboratory. Instead, it would be unprecedented in scope and impact: "The collaboration of artist and engineer emerges as a revolutionary contemporary sociological process. … E.A.T. will act as a 'matching agency' where an artist with a problem is matched to a member engineer whose qualifications are such that he understands what the artist is talking about."

The complete articulation of the "matching agency" strategy thus coincided with the major effort to attract member engineers, on the one hand, and serious attempts to forge relationships with industrial management. Perhaps most exciting was the announcement that the matchings had begun: 35 artists had been connected to 20 engineers. Tear-out sheets in the newsletter were to function as basic questionnaires that could be filled out and sent back as forms for matching [Figs. 3.7, 3.8].

The success of the matchings was not predicated on their stability but on their evaporation. If effective, such mediation would no longer be needed: "Once it has achieved the change in the cultural and industrial climate so that industry can assume a more direct responsibility for the sponsorship of the artist-engineer collaboration, the function of E.A.T. as a mediator may well disappear."[67] And crucial to such thorough permeation and expansive scale were the flexibility and openness E.A.T. hoped to

[67] Ibid.

engender via informal open houses and social spaces at the headquarters, detailed in the newsletter as incubators for new ideas and conversations. More pointedly than before, Klüver stressed the intimacy—but the simultaneous increase in number—of the interactions: "A one-to-one collaborative relationship will be established whenever possible."[68] Finally, these gatherings and interactions would depend upon the social involvement and integration of engineers, across various levels of power: "From the engineers we need help right now with recruiting and service on the committees. Our 'underground' of engineers is just as important as the positive attitude of top level management." In other words, the effort to reach engineers coincided with recognition of the need to build a network from the "underground" up, through all levels of management, across the industrial sector; and this de-hierarchization would be fundamental to the very definition of the organization, its plasticity. Indeed, the text continues, "The institutionalization of E.A.T. will be fought—even at the expense of risking a few loose connections."[69]

Increasing the group's reach meant increasing the spread of information: It was time to go public. That summer, Klüver, Rauschenberg, Whitman, Waldhauer, and others began preparing for the first official press conference for E.A.T., which was to take place at Rauschenberg's studio in October 1967. The purpose, as outlined in an extensive set of preparatory documents for the conference, was "To acquaint the technical and industrial community with E.A.T.'s program and objectives."[70] So the

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[68] Ibid.

[69] Ibid.

[70] E.A.T., "Preparatory documents for meeting," September 1967. E.A.T./GRI Box 11, Folder 1.

meeting was targeted at technological and industrial corporations and engineers, but the audience was far broader: They invited 50 labor union officials; 100 scientists and engineers; 100 industrial leaders; 30 artists; 175 representatives from technical press, television and radio; 25 museum curators; 30 leaders from technical institutions; and 15 politicians. Labor lawyer Theodore Kheel (who would become a pivotal figure in E.A.T., as we shall see) gave a statement, as did Ralph Gross, unionist Herman Kenin (president of the American Federation of Musicians and a leader of the American Federation of Labor), John Pierce of Bell, Warren Brodey (director of MIT's Space Camp), and the artist Robert Morris [Figs. 3.9-3.11]. Rauschenberg was named President and Chairman; Klüver the President and C.E.O.; Waldhauer the Secretary.[71] Rauschenberg and Klüver gave the initial presentations.[72] This heady mix of elite power brokers, politicians, labor leaders, corporate research heads, and artists such as Morris—who, we might remember, was by no means a household name—was likely never replicated in the postwar period.

In an undated draft statement in preparation for the October meeting, Klüver and Rauschenberg wrote:

> "E.A.T.'s purpose is to bring about the adjustment needed for industry to accept its responsibility to actively assume its role in the integration of contemporary technology and the arts. To firmly establish the artists' free access to technology, engineering and the technical processes is not only a cultural, educational or aesthetic problem but amounts in fact to ~~a serious~~ an organic social revolution. In their collaboration the artist will stimulate and enlarge technology and its means and the engineer will significantly transform the arts. This collaboration will be part of a process of accepting and exploring technology as our natural environment.
> To bring about the purpose of EAT, the following steps are necessary:
> 1. Establish a strong board and group of supporters of influential citizens

[71] "List of Participating Artists and Supporters," September 7, 1967. E.A.T./GRI Box 11, Folder 1.

[72] E.A.T., "Press conference summary," October 1967. MoMA /E.A.T. Kluver Documents #56.

capable of understanding the possibilities and the ~~idealistic~~ practical aspects of EAT.
2. Establish a group of engineers and businessmen who will translate the artists technical problems into technical projects acceptable by industry.
3. Establish a headquarters for EAT in which: A. Initiate one to one contacts between artists and engineers with the purpose of bringing about a closer understanding through direct social contact. B. Simple technical problems can be solved by engineers who contribute their time. C. Simple service of already existing ART/Technology works can be given. D. Technical information is available upon request. E. Publish newsletter.
4. Encourage A&T engineering societies to be formed within already existing institutes. Encourage and give advice to universities and educational institutions. Give technical talks, seminars, etc.

When it has achieved its purpose it should organically be absorbed by engineering institutes, universities and Industry. This is a nationwide project."[73]

I quote these notes at length because they indicate the seemingly paradoxical conjoining of "organic social revolution" and the striking out of "idealistic" in favor of "practical" aspects, to be understood by a board that would comprise members beyond the normal social and discursive formations of the neo-avant-gardes or mainstream institutions of art. Moreover, the initial idea that E.A.T. would simply disappear, be "organically absorbed," after it has achieved its goals is stated in full formation here. For the time being, this futurist rhetoric—drawing on aspects of Cage, McLuhan, Fuller, and the organicist utopianism of Kepes, while directly presaging the lexicon of Gene Youngblood and Stewart Brand—would sit side by side with resolutely pragmatic and, indeed, bureaucratic language redolent of the NGO and the postwar think tank.[74] Such uneasy and contradictory couplings bespeak the tensions between existing institutional

[73] Billy Klüver and Robert Rauschenberg, "Preparatory documents for meeting," 1967. E.A.T./GRI Box 11, Folder 1.

[74] Both Gene Youngblood's *Expanded Cinema* and the first issue of Stewart Brand's *Whole Earth Catalog* would be published in 1968. See Gene Youngblood, *Expanded Cinema* (New York: Dutton, 1970); *Whole Earth Catalog* 1010 (Fall 1968). On think tanks, see Lee, *New Games*; and Robin Kelsey, *Photography and the Art of Chance* (Cambridge, MA: Harvard University Press, 2015), TK.

and theoretical models and the kind of fluid and transient network E.A.T. was beginning to build.

Still, it is not enough to note the conjunction of utopia and pragmatics. The specific admixtures here are crucial: the museum-level board, the bureaucratic offices held (President, Vice-President, etc.), the support from corporations and government, all juxtaposed with the Cagean anarchy, the sensorial upendings of Rauschenberg and Fahlstrom and Rainer and Tudor; the business art of Warhol. And these were positioned in relation to the labor movement, academic research, art schools, and professional societies. The actual setting for the conference reflected these curious couplings: As bespectacled men in suits stood at the podium—including Senator Javits, no less, one of the most prominent politicians of the time—they were surrounded by an extremely unusual environment. Henry R. Lieberman described the scene in a *New York Times* article titled "Art and Science Proclaim Alliance in Avant-Garde Loft": "While 20 helium-filled pillows floated eerily in a two-story room called 'The Chapel,' the need for bringing artist and technologist together was stressed in speeches by Senator Jacob K. Javits, a traditionalist who sees merit in modern art…"[75]

Warhol's *Silver Clouds* drifted about the loft studio; they were accompanied by Rauschenberg's *Oracle*, which boomed static and sound, and Whitman's *Shower*, which included a projection of a woman taking a shower underneath an actual showerhead behind a Plexiglas panel. In this way, *Silver Clouds* and *Oracle*, which I have underscored as key works in the formation of E.A.T., literally surrounded the audience as emblems of the convergence of art and technology. Also on view was the so-called

[75] Henry R. Lieberman, "Art and Science Proclaim Alliance in Avant-Garde Loft," *New York Times*, October 11, 1967, 49.

"computer nude," which was generated by Bell engineers Leon Harmon and Kenneth Knowlton via the then-completely new and experimental technology of digital scanning and printing (the pair scanned a photograph and converted its brightness values into numerical values, which generated an output image composed of pixels that were actually symbols of varying density to create patterns of light and dark).[76]

Kitsch, indeed: the "computer nude" was camp, and so was the press conference. It was matched by the outsize level of publicity: the event made a media splash, with numerous articles in the mainstream, art, and technical press, including the *New York Times* and *Wall Street Journal*, chronicling the announcement. If conceptual art courted publicity as a mode of distribution and information, this inaugural press conference went further—reaching farther and wider than the press outlets and audiences touched by Seth Siegelaub or Joseph Kosuth.[77] More than a year before Siegelaub would publish the *Xerox Book* (in December 1968), E.A.T. pushed such models of informatic reproduction and communication into a truly mass level of dissemination.

But what was the message? Again, a bevy of contradictory rhetoric surfaced: the bid for publicity; the quaint, humanist language of solving "individual isolation"; the critical language of the neo-avant-gardes; the amalgamation of technoscientific and bureaucratic language with a new kind of organizational imperative.

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[76] A. Michael Noll, "Early Digital Computer Art at Bell Telephone Laboratories, Incorporated," *Leonardo* 49, No. 1 (2016): 55-65. See also Caroline Kane, "Digital Art and Experimental Color Systems at Bell Laboratories, 1965–1984: Restoring Interdisciplinary Innovations to Media History," *Leonardo* 43, No. 1 (February 2010): 53-58; Zabet Patterson, *Peripheral Vision: Bell Labs, The S-C 4020, and the Origins of Computer Art* (Cambridge, MA: MIT Press, 2015); Rebecca Rutkoff, "Painting by Numbers: The Art of Lillian Schwartz," *Artforum International* 55, no. 2 (October 2016): 238-245.

[77] On Siegelaub and conceptual art's utilization of publicity, see Alexander Alberro, *Conceptual Art and the Politics of Publicity* (Cambridge, MA: MIT Press, 2003).

It was Robert Morris, however, who made perhaps the most trenchant, searching articulation of this unforeseen combination of discourses and processes. Recounting his own experiences with technology, outsourcing, and specialized fabrication, he comes to posit a new kind of "corporate making" introduced by E.A.T.:

> "In the beginning, I merely intended to use industry to implement certain ideas I had which were fairly clear in my own mind. I knew what I wanted and it was simply a matter of finding someone to build it. This approach changed in proportion to what I found out about how things got made. It became less and less a matter of being in a studio thinking of things, making the plans and sending them off to the fabricator. More and more it became a matter of incorporating methods and materials I had found out about in the process of being related to particular fabricators. The process of working became more direct and also more complex—involving as it would not only the ever increasing acquisition of technical information but also the development of a social and executive sense which had not been necessary when I made the work myself in the studio."[78]

In other words, instead of *less* interaction with material or informational process—the artist as conceptual ideator, merely placing an order for fabrication—the artist *himself* begins to absorb the knowledge, the technical information, the skill, as well as the executive, social, and organizational habitus, bringing all of these complex processes back into his or her own orbit. Working becomes more "extended," and more open-ended:

> "Working became a very extended situation of making appointments, visiting factories and gathering information. The more I found out and the more people I met who were interested in helping, the less it seemed necessary to plan everything either precisely or completely in advance. More work got made easier by leaving certain problems open for others to work out. I began accepting solutions suggested by others which showed up in the finished work in very specific ways—*and in ways which I had not preconceived*. More possibilities occurred. In short, *less, not more, control was becoming desirable*. The process of making art began to get ever so slightly corporate."

[78] Robert Morris, "Remarks," transcript, press conference for E.A.T., October 10, 1967. MoMA/E.A.T. Klüver Documents, #56.

The statement is stunning: work becomes ever so slightly more corporate, which accompanies *less* control, not more. "Corporate" does not imply top-down administrative control; here "corporate" actually means flexibility, more possibilities, more openness, more surprise. Morris continues: "What is interesting to me about E.A.T. is that it seems to be a pretty maximum resource for a much more extended kind of corporate making…" Unlike his own previous practice and even that of *Nine Evenings*, where the individual artist still seems to possess a kind of traditional control,

> "I think this type of product control is being questioned by younger people…I think the broader awareness and more extended involvement in social, political as well as artistic action indicates a *less professionalistic, less specialist, less product-oriented tendency*. Possibly these people will be able to utilize the facilities E.A.T. offers for a more extended way of working which involves the cooperation and initiative of many. But if this is true, I do not know what is possible in these new terms. It would be boring to try to predict its nature. It would seem that getting many unlikely things tried would be more relevant than demanding particular successes.
>
> I hope E.A.T. can maintain and develop roots in many extended processes and connect to many diverse people. By being open, available and diverse, it will be a means that has not existed before. *Out of such means, things we cannot predict should develop*."[79]

Morris articulates a future one could not predict—an E.A.T. that is "open, available, and diverse." From one vantage, this openness, diversity, and unpredictability generates a vortex of contradictions: the seemingly paradoxical conjunction of "more"

[79] Ibid. Emphasis added. This testimony goes slightly against the grain of Morris's other writings at the time—specifically, his articulation of "control" in his "Notes on Sculpture" essays of 1966: "Control is necessary if the variables…are to function," Morris argued, in contrast to his fascination with a certain *lack* of control in the E.A.T. text. See Morris, "Notes on Sculpture, Part II," *Artforum* V, no. 2 (October 1966): 23; reprinted in *Minimal Art: A Critical Anthology*, ed. Gregory Battcock (New York: E.P. Dutton, 1968), 234. The discrepancy evinces a certain anxiety with regard to E.A.T. in relation to his own work and relations of power, an anxiety that lends a different inflection to the fraught overlap (or, in Foster's words, "crux") between Minimalism and Conceptual art. See also Branden Joseph, "The Tower and the Line," *Grey Room* 27 (Spring 2007): 58-81; Klüver, "The Great Northeastern Power Failure," transcript of lecture given at the College Art Association annual conference in New York, January 28, 1966. E.A.T./GRI Box 3, Folder 2.

corporatism and "less" control; organization and organicism[80]; freedom and constraint, pattern, and order; intimacy and omnipresence; all the inconsistencies brewing in Klüver's own language. But seen another way, this mise en abyme of contradictions opened onto a promise, a promise that exceeded the very terms of contemporary thought and experience. As Morris implied, E.A.T. threatened the status of the object as the teleological stage of art, just as it augured a mode of intersubjectivity, collaboration, and collectivity that went beyond even the participatory sculptures of Rauschenberg or the limited, discrete interactions of the post-Cagean event score or instruction-based Conceptual piece. It created the possibility of a new kind of actor and a new kind of network. Not product, but process; not singularity, but multiplicity; not stasis, but becoming.

IV. Matching

The press conference marked the beginning of E.A.T.'s formal organization. In November 1967, the staff grew to five people "to handle operations," and the board

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[80] Reinhold Martin has defined the historical relation between organization and organicism: "organization, as the agent of a new, horizontally equilibrated organicity, effected a conjunction where there might otherwise have been opposition: art opposed to science, technology opposed to nature, human opposed to machine. All became linkages that were themselves linked in the network of networks of the organizational complex. … Again, we are confronted here with a situation of control through feedback. Organization, as a means of control, is necessarily a function of the various nodes through which its forces flow. And architecture, as one constitutive node among many in the network, acts as both receiver and transmitter of patterned organizational codes, thereby gaining its status as one among many technologies of organization." Martin, *The Organizational Complex*, 214-215. In another register, Cage had articulated the convergence of order and disorder in a kind of transparent equilibrium—precisely through the organic: "Where there's a history of organization (art), introduce disorder. Where there's a history of disorganization (world society), introduce order. … We need for instance an utterly wireless technology. Just as Fuller domes (dome within dome, translucent, plants between) will give impression of living in no home at all (outdoors), so all technology must move toward way things were before man began changing them: identification with nature in her manner of operation, complete mystery." John Cage, "Diary: How to Improve the World (You Will Only Make Matters Worse) 1965," *A Year From Monday: New Lectures and Writings* (Middletown, CT: Wesleyan University Press, 1967), 3-21; see also *Aspen* 4 (Spring 1967). Indeed, much of the "Diary" essay stemmed from Cage's interchanges with Klüver about communication systems, wireless networks, technology, and organization. In a brief text published in *TECHNE*, Cage would also write, simply: "Introduce disorder." John Cage, "Art and Technology 1969," *TECHNE* 1, no. 1 (April 14, 1969): 11.

began a search for a full-time administrative director. They soon hired Francis Mason, a cultural affairs officer with the US Information Agency (USIA), as Acting President, and began to expand the ranks of full-time staff.[81] Thus far, financial support from industry, labor, and individuals had been generated in the form of $1000-5000 grants, in addition to the $8000 NYSCA grant. E.A.T. then obtained substantial grants from Rockefeller Brothers Fund ($25,000) and from the NEA ($50,000) in the summer of 1968.

But if E.A.T.'s beginnings were still wedded to a top-down hierarchical and bureaucratic structure—with its organizational and physical headquarters in New York, and with its board of directors, streamlined application process, press conferences, presidents, and vice-presidents—the group was also shifting its organizational logic. In order to expand, it had to change.

E.A.T. would come to adopt an increasingly horizontal structure, one that outstripped its central "management." This leveling was both cause and effect of expansion—and, specifically, it constituted the *technique* of expansion. For the fundament of E.A.T. was not, in fact, its long list of officers or leading sponsors. It was something virtual, hidden—and yet it was the tissue that held the network together, the new "connection" that Morris sensed, the ligatures of action at a distance. E.A.T.'s media was *the matching system*.

Over the course of several years, E.A.T. developed an increasingly sophisticated method of matching artists to engineers and vice versa. This growing web of connections was laconically dubbed the "Technical Services Program"— informally referred to as the "matching" system. Through it, more and more actors became involved in the

[81] "Ford Proposal, Version 2: Complete copies, May 19, 1969." E.A.T./GRI Box 42, Folder 15. Mason was appointed president of E.A.T. in March 1968.

organization, and the organization's activity became increasingly distributed across geographic space as well as the realm of information, of telecommunications, of subjects and data.

The Technical Services Program entailed coordinating interests and needs: if an artist was interested in lasers, or wanted to make a floating objects, or explore computer sound, how would the appropriate engineer-partner be found? How would the right artist be paired with the right engineer or scientist—someone who was willing and able to answer questions, consult on a project, or collaborate actively in its realization?

The very first mode of communication was a simple "Note for Artists" on the last page of *E.A.T. News* vol. 1, no. 1: " It is important for us to hear from as many artists as possible who have an interest in working with engineers and who support the purpose of E.A.T. Even though it may take some time before we can process all applications, we are able to make use of your interest in our approaches to industry and foundations."[82] Artists were requested to write to Sue Hartnett, the E.A.T. administrator, at a P.O. Box address on Canal Street. Letters immediately started arriving; among them were extensive proposals, such as Stan VanDerBeek's scheme for his "Movie-Drome," which would become one of the most effective realizations of a full environment for experimental film projection: "Concerning a project for collaboration: I am finishing off my 'Movie-Drome' theatre in Stony Point and am trying to resolve many technical problems of projection, and light and audio controls and programming. I shall not go into the problems in this note, other than these generalized ones, with the hope that I can talk

[82] "A Note for Artists," *E.A.T. News* 1, no. 1 (January 15, 1967): n.p..

to someone in more particular terms about it."[83] Most letters echoed such broad appeals for help and conversation, but in such a format, the artists' specific needs and parameters proved difficult to pinpoint.

By the summer of 1967, E.A.T. began to devise a system that would account for both artists' and engineers' input, and to streamline their information in order to make matching easier and more specialized. The group composed simple typewritten membership forms, one for artists and one for "engineer/scientists." The artist form [Fig. 3.12] asked applicants to list basic information (name, address, telephone number), and then to answer three questions:

> "What medium (media) are you working in (film, dance, music, sculpture, etc.)?
> What area(s) in science and/or engineering interest you as possible artistic resources (electronics, physics, chemistry, biology, etc.)?
> Do you have a project that requires collaboration with a technical person? If so, please describe it as clearly as possible."[84]

Concrete descriptions of media, materials, and technical interest were thereby privileged. But on the engineer/scientist form, the queries were far more general and open-ended [Fig. 3.13]. Beyond contact information, it asked:

> "What is your field?
> Company:
> Experience:
> Comments and Interests: "[85]

First, "company" assumed that the engineer/scientist worked in industry; if they were in the academy, they simply listed their university or teaching institution in the "company"

[83] Stan VanDerBeek, letter to Sue Hartnett, January 30, 1967. E.A.T./GRI Box 6, Folder 47.

[84] Artist membership form, 1967. E.A.T./GRI Box 8, Folder 7. A slightly different phrasing of these questions appears in an earlier form attached to *E.A.T. News* 1, no. 1 (June 1, 1967).

[85] Engineer/scientist membership form, 1967. E.A.T./GRI Box 8, Folder 7.

field. The "Experience" and "Comments and Interests" sections were, by and large, loquaciously filled. For one such form, Laurence Silverstein, a Senior Research Fellow in electrophysics at the Polytechnic Institute of Brooklyn, explained at length. In several long paragraphs, he writes that his field includes "laser and laser-related technology, holography, and various aspects of optics and solid-state physics, and microwave engineering"; and that he has been involved "in theoretical and experimental studies in the laser field… [and] the construction of various kinds of gas lasers, and in the production of holograms."[86] Silverstein then goes on to detail how "impressed" he was by E.A.T. at their IEEE conference booth, and after reading the March issue of *E.A.T. News*. He then goes on to suggest concrete ways in which E.A.T. could increase its "effectiveness" and "the dissemination of information," advocating increased advertising in technical publications and trade journals, appealing to graduate students as well as faculty, and attending open houses at universities and technical schools. He also suggests a shift in approach: "[E.A.T. gives] the impression that the attitude towards the technologist is essentially that he is merely a tool or technical dictionary to be made use of and manipulated by the artists…. A better approach would be to emphasize the collaborative aspects of various projects, and to attempt a greater appeal to the engineer's creative abilities."[87]

Indeed, E.A.T. took pains to stress the creative abilities of the engineer, but this form indicates that the membership drive became a kind of communicative instrument, a relay for feedback and dialogue. And Silverstein may have been appeased by the fact

[86] Laurence Silverstein, Engineer/scientist membership form, 1967. E.A.T./GRI Box 8, Folder 7.

[87] Ibid.

that the form reduced *both* artists and engineers to the same kind of information matrix: as input for data collection.

E.A.T. built a veritable database of subjects. Some even attached photos of themselves or their work. The range of early applications is astonishing, and the ambitions of artists equally so: For them, technology clearly promised limitless possibilities, and many expressed interest in new materials such as polymers, neon, resins, and Plexiglas. Among the applicants in late 1967 and early 1968 were John Chamberlain, who simply checks "sculpture" as medium of interest; Richard Serra deemed his interests in "Multi-media – sculpture—environment," "Rubber-neon," "Electronics," and the "Loft as a factory situation," underlining terms for emphasis.[88] Joseph and Trisha Brown Schlichter jointly filled out a form highlighting dance and, for Schlichter, "optical physics, holographs"; for Brown, "photography (still and motion)."[89] Illuminating her early interest in video and sound, Elaine Sturtevant aimed to "1) Develop a TV with visual memory (up to and from 24 hrs to a week)" and "2) Convert sound of spoken voice with physical manifestations of written words—as they were spoken they would be immediately transposed into a visual being."[90] (She added a note: "Sandy—would you be kind enough to see that I get the EAT notices, as I haven't been receiving them?") Sari Dienes, a colleague of Cage, Cunningham, Rauschenberg and

[88] Individual E.A.T. artist membership forms, 1967-68, E.A.T./GRI Box 6, Folder 41; Box 6, Folder 46.

[89] Joseph and Trisha Brown Schlichter, artist membership form, 1968. E.A.T./GRI Box 6, Folder 46.

[90] Elaine Sturtevant, artist membership form, 1968. E.A.T./GRI Box 6, Folder 46.

others in Stony Point, New York, writes of a project involving the artist in a wooded area with metallic, foil-wrapped freestanding forms.[91]

Not surprisingly, many applicants were working in the fields of light, electronic music, film, and environments. Tony Conrad, who had made his legendary film *Flicker* less than two years prior, underlined "film," "music," "electronics," "physics" as interests, and added, "I would be very interested in participating in committees or organizational meetings related to the project, at your earliest opportunity."[92] Ornette Coleman wrote in, only one of a number of experimental music applicants; others interested in the new possibilities for electronic and computer music included a Robert Ceely, from Boston, who notes, "I need assistance in designing equipment for 'live' performance of electronic music. My equipment includes the Moog synthesizer, and I am interested in sophisticated switching systems which will allow me to perform on this instrument in public without the (necessary) use of tape."[93] Some requests were almost farcically specific. Kaprow proposed a "Project (for a chemist): There are little gray pellets that are traditional inclusions in every fireworks kit. When lighted, they rapidly expand into coiling porous, ash 'snakes.' I'd like to find out what these pellets are made of, and have very large ones made to erupt on timers across a mountain top, from within buildings, in a subway, on a bridge… the 'snakes' would be enormous!"[94]

Forms were sent in not only from the US but from all over Europe—the Netherlands, West Germany, etc—as well as Tokyo and Ahmedabad. The same diversity

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[91] Sari Dienes, artist membership form, 1968. E.A.T./GRI Box 6, Folder 41.

[92] Tony Conrad, artist membership form, 1968. E.A.T./GRI Box 6, Folder 41.

[93] Ornette Coleman and Robert Ceely, artist membership forms, 1968. E.A.T./GRI Box 6, Folder 41.

[94] Allan Kaprow, artist membership form, 1967. E.A.T./GRI Box 6, Folder 43.

held for engineers. The majority came from Bell and IBM, but many wrote in from universities, research laboratories, military/defense contractors, and companies all over the world: a computer graphics expert at MIT's Lincoln Laboratories; a biomedical engineer and numerous others from Grumman Aircraft; researchers from NASA, Petro-Tex Chemical, Davis Controls, Allied Chemical, the US Navy Sound Lab, the Aeronautic Division of Philco-Ford, Lockheed, Martin Marietta, McDonnell Douglas, the Stanford Linear Accelerator Center, Brookhaven, Raytheon, the Institute for Advanced Study at Princeton, even the agricultural multinational corporations United Fruit and Monsanto. A large number resided in the suburbs of New Jersey—a locus of R&D at the time, from Bell to IBM to Westinghouse to Xerox—and not only younger people but career engineers applied. So did industrial design students from Cooper Union and other art schools.[95] They came from vastly different fields, from artificial intelligence to particle physics to chemistry to aviation to electronics to sound; from crystallography to oceanography, semiconductors, lasers, thermodynamics, operations research, communications theory, and computer graphics. And they came from highly disparate roles within corporations and laboratories.[96] One missive was sent from a frustrated engineer who had "always worked in the formal management end of technological companies," he complained.[97] Dick Wolff of Bell, who had participated in *9 Evenings*,

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[95] Engineering membership forms, 1967-68. E.A.T./GRI Box 8, Folders 1-8.

[96] Ibid.

[97] Engineer membership form, 1967. E.A.T./GRI Box 6, Folder 40.

described his "field" thusly: "audio, communications, fancy ckts [circuits], superconduction, music, sex; 31 yrs old."[98]

Still others professed interest in kinetic and light art; or they knew artists already; or were making their own art. One Charles K. Bruhl, a chemical engineer at Petro-Tex, perhaps unknowingly echoed Rauschenberg and others: "I am currently designing mechanical systems for a total environment room. I am working with two architects here in Houston. The goal of this project is to develop an environment in which light, sound, odors, air supply and vibration may be controlled and programmed to vary randomly over a 24-48-hr. period." Such nascent overlap of interests—or just countercultural leanings—was borne out in the reams of membership forms: The forms and curriculum vitae of engineers and artists took on a parallel structure. They started to *look* the same.

In early 1968, E.A.T. was approached by the National Science Foundation to solicit proposals for projects in art and technology, an initiative to accompany the NSF's launch of experimental programs to provide artists and art schools with technical information and material on new technical processes, glossed in NSF brochures as "Improving the Dissemination of Scientific Information." Mason, the newly initiated president of E.A.T., sent a mass letter in May calling for proposals, initially sent to some fifty artists and then expanded further that summer.[99] The E.A.T. Engineering Committee, headed by Oliver Selfridge of MIT's Lincoln Laboratories, would review all projects before they were forwarded to the NSF.

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[98] Dick Wolff, engineer membership form, 1967. E.A.T./GRI Box 8, Folder 8.

[99] Letter from Francis Mason, May 15, 1968; "NSF [National Science Foundation] List," May 1968. EAT/GRI Box 12, Folder 62. See also S. Klein, "Technology Invades the Arts," *Machine Design*, Feb. 29, 1968, 37.

So the membership forms were adumbrated to become more properly "project proposal forms" for this purpose; they were slightly simpler and more pointed than the first artist member form, asking only two questions in addition to contact information: "Does your project require collaboration with a technical person?" and
"Please describe your project and your needs as clearly as possible: …" More than one thousand were submitted from 1968 to 1973, with many, again, spiraling into lengthy descriptions.

Perhaps in response to the more detailed requirements of the project proposals, and to the growth in applications for both projects and membership in general, the forms become longer and more complex [Fig. 3.14]. In late 1968/early 1969, the artist's form now asks, "Could you circle the words below which best describe your current work"? The sample terms: "PLANAR IMAGE (e.g., painting, film, photograph)"; "RELIEF (e.g., bas-relief)"; "CONSTRUCTION (e.g., sculpture, mobile, assemblage)"; "ENVIRONMENT"; "PERFORMANCE (e.g., theatre, poetry readings, tape music, concerts)"; "PRINTED MATERIAL (e.g., letters, words, musical scores)".[100] This loose demarcation into media or genre was then accompanied by a section of more specific questions:

"Below are six subcategories:

1. Are sensory stimuli (visual, audial, olfactory, tactile, gustatory) generated in your work (i.e, does your work incorporate lights, sound sources, heat sources, etc.)?
2. Does your work contain moving mechanical parts?
3. Are you working with electronically or photographically generated images (e.g. cathode ray tubes, computer movies, film)?
4. Is your work interactive (does it involve changes induced by the presence or action of a spectator or the changes in the environment)?
5. Are people essential to your work (e.g., theatre, games)?

[100] Artist membership form template, February 1969. E.A.T./GRI Box 7, Folder 6.

6. Does your work involve replaceable equipment (e.g., tape recorders, musical instruments, projectors, TV sets)?"

Such questions gestured toward the vast array of intermedia, multimedia, kinetic, and performative work that was by then already widespread, in the wake of Happenings, Fluxus, Pop, experimental dance, theater, and music, and the post-Cagean event score, as evinced in Chip Lord (of Ant Farm)'s graphic response.[101] But it was not for everyone: One artist, a Ron Brodigan from Minneapolis, simply answered "no" to all of the above [Figs. 3.15, 3.16].[102]

And, finally, questions were posed in order to gauge the applicant's interest in and criteria for "artist placement and residence": what kind of interaction—whether "collaboration," "technical assistance," or "technical information"—they preferred; whether they would be willing to be an artist in residence "in an industrial situation," and if so, for how long, and would they be willing to travel; if they wished to work with a computer; how many others they would be willing to collaborate with; whether they would be interested in "large-scale projects demanding contributions from a variety of talents."

Indeed, it becomes apparent that both the questions about media, sensory effect, and technology and the logistical questions regarding collaboration were geared toward the making of a large-scale, multimedia project: the Pepsi Pavilion at the world's fair, Expo 70, in Osaka (which, as we will see, would consume most of E.A.T.'s energies in 1969-70). The form also pointedly asked: "Would you participate in projects, instigated

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[101] Chip Lord, E.A.T. artist membership form, 1969. E.A.T./GRI Box 9, Folder 12.

[102] Ron Brodigan, artist membership form, 1969. E.A.T./GRI Box 7, Folder 6. The one interest Brodigan circled was "sculpture."

and sponsored by industries and institutions, where the presentations are of a documentary nature and the objectives fairly tightly specified; for example, demonstrations of materials or processes in an exhibition/fair situation?"[103] And yet long-term relationships were still being cultivated: the forms were to be "recirculated every six months" to keep each member's information up to date. Actual matches were informally noted on running lists with artists on one side, engineers on the other, and notes on correspondence—whether or not communication actually took place, and what the outcome was—in between.[104] [Figs. 3.17-3.19.]

In late 1968, the scientist/engineers' forms were also updated and made far more elaborate. [Figs. 3.20, 3.21.] Three options for participation were given, and one could circle none or all: "Collaborate with artists"; "Give technical assistance"; and "Give technical information," each with varying degrees of involvement and interaction.[105] On the back of the form, a long list of technical fields and terms—"which frequently appear in artists' descriptions of their projection"— was added, and again one could circle as many or few as one liked to indicate areas of expertise. A vast range, corresponding to the range of interests expressed on the forms, was posed: electrical engineering, aerospace, biology, psychology, sociology, mathematics, chemistry physics, computers; more specific fields such as hydraulics, pneumatics, cybernetics/control theory, information systems, all manner of material sciences, from metallurgy to elastomers to fluorescents to dyes; optics, including lasers, strobes, x-rays, electro-

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[103] Artist membership form template, February 1969. E.A.T./GRI Box 7, Folder 6.

[104] E.A.T., "Matches by letter to both parties," 1968. E.A.T./GRI Box 9, Folder 3.

[105] 7.6. See Edward Arrons, Scientist/engineer membership form, 1969, E.A.T./GRI Box 7, Folder 6; Robert Moog, Scientist/engineer membership form, February 6, 1969, E.A.T./GRI Box 8, Folder 14.

luminescence, fiber optics; acoustics, ultrasonics, audio-visual conversions; communications, including television, cathode rays, video, and photography; digital systems, from "instrumentation and control systems" to remote control, integrated circuits, transistors, and microwaves; architecture, industrial design, scientific journalism; and, finally, "environmental simulation." Celebrated scientists such as Nobel laureate Richard Feynman; electronic music and audio pioneers Robert Moog, Carl Machover, and Max Mathews; and sociologist Daniel Bell all filled out forms.

As we have seen, most histories of this period tend to portray the relation between art and technology as dilettantish, technologically unambitious, and failed. But the level and kinds of expertise evinced on these forms shows that such caricatures are exactly that. Indeed, the depth of knowledge and the involvement of scientists and engineers from the highest echelons of theoretical and applied research in all of these diverse sectors were extraordinary. For example, "cybernetics/control theory" was one of most popular categories; so were brand new or rapidly burgeoning fields such as digital systems, artificial intelligence, lasers, and transistors (the latter two among the most famous inventions of Bell Labs). Mathematicians and high-energy physicists, perhaps the most revered or "high" of all high theoretical fields, were numerous. Many circled numerous fields, and wrote notes in which they expressed their desire for interaction with artists, or of their polymathic interests.

Some were already in contact with artists; others wrote of their own aesthetic endeavors. Martin Perl, a physicist at the Stanford linear accelerator (SLAC) who would go one to win the Nobel Prize for his discovery of the tau lepton in 1995, wrote rather dryly: "I have been building sculpture, bolted wood and welded iron for a number of years; also some kinetic. I am interested in more interaction with artists or engineers involved in technological art. However I am somewhat lazy about extensive or complicated problems in art. I have enough technological problems in physics."[106] Ernest Parziale, an Electrical Engineer at Bell Labs's Whippany, New Jersey, campus, had also worked at Sylvania and GM; he "paint[s] occasionally, have designed and built a contemporary lamp—painting employing electroluminescent strips of lighting. … I am completely interested and open-minded enough to work on most anything—I think this idea is really wild."[107] Norman Dolph, a researcher in switching systems, programmed control logic design, sound recording and audio systems, actually owned an independent pop record label, "STOY"; had already worked with the neon/light sculptor Stephen Antonakos; proclaimed that he was a collector, with works by Warhol and Lichtenstein; and noted that "I have operated a traveling discotheque for several years."[108] And Charles Feldman of the Worcester Polytechnic Institute, whose main work was in "Thermodynamics, statistical communications theory, biomedical engineering," was "Interested in applying statistical and probability theory to art—primarily to show varying degrees of indeterminacy in life and the world. Can program and have access to computers."[109]

Moreover, the mandate was to keep membership *free* for as many people as possible. By May 1969, a new generic (artist OR engineer) membership form

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[106] Martin Perl, scientist/engineer membership form, n.d. E.A.T./GRI Box 8, Folder 6.

[107] Ernest Parziale, scientist/engineer membership form, n.d. E.A.T./GRI Box 8, Folder 6.

[108] Norman Dolph, scientist/engineer membership form, n.d. E.A.T./GRI Box 8, Folder 2.

[109] Charles Feldman, scientist/engineer membership form, n.d. E.A.T./GRI Box 8, Folder 2.

distinguished between "sponsoring," "subscribing" and "participating" members.[110] Applicants could check a box indicating whether they would like to be considered for matching, all technical services, receive certain E.A.T. publications, and attend lectures and events, all without cost; this was the "participating" level. Subscribers were, somewhat puzzlingly, those who did not wish to participate in exchanges/collaborations but wanted to be kept informed of E.A.T. activities via all events and publications, with the bonus of receiving *E.A.T. Proceedings*, a more detailed technical publication; they would have an annual fee of $20. Sponsors would contribute an annual fee of $100 and would receive "all the privileges and publications of the Subscribing Members and, on request, additional copies of all E.A.T. publications. Special events and services connected with E.A.T. projects will be made available to Sponsoring Members."[111]

In late 1969, the matching form shifted yet again [Figs. 3.22, 3.23]. The fields on the back of the engineering form altered in order and organization; several categories were added denoting the interest in even more specialized disciplines, including ones directly linked to the military-industrial war room, such as "computers: systems simulation." Most strikingly, the list of types of participation expanded, offering more specific ways in which an engineer might interact with artists. Now one could choose "Reviewing and commenting on projects," "Assisting in writing up projects for submission to industry for sponsorship"; "Advising on matters of safety"; "Working with artists-in-residence in industry"; "Giving lectures"; "Assisting in tours through industry"; Helping to service works during exhibitions"; "Aiding in finding materials and access to

[110] Jane Abramowicz, artist membership form, May 14, 1969. E.A.T./GRI Box 7, Folder 6.

[111] Ibid.

equipment"; and "Aiding in operating equipment."[112] These additions evinced a growing sphere of situations in which artists and engineers might work together—a changing field where a critical mass of artworks that needed technological servicing or operation *already* existed, or artists had *already* been placed in residencies, or exhibitions that involved technological components had *already* been organized. The possibilities for engagement had expanded. And this increased number of options also encouraged greater flexibility and feedback, so that the engineers could shape the nature of the services themselves and help determine the kinds of interactions and collaborations that took place. They might even switch to the other side: as Neil Sheehan, a design engineer, wrote: "I think I'm an engineer who wants to be an artist."[113]

The dream of conversion was also a dream of data. E.A.T. would soon build on this system of connections, attempting to create an automated, algorithmic program for matching artists and engineers. Initially, in 1967, the "processing of artist's requests" for matching simply meant that membership forms were read but a project coordinator, a "paid administrator," who manually sorted the requests into areas of technical guidance, and would "dispose of applications obviously inappropriate to the functions of E.A.T."[114] A committee of member engineers would examine the requests and propose matches

[112] Daniel J. Donovan, scientist/engineer membership form, 1970. E.A.T./GRI Box 8, Folder 17.

[113] Neil Sheehan, design engineer for Magnet Head Corp, scientist/engineer membership form. E.A.T./GRI Box 8, Folder 17.

[114] "Matching of Engineers and Artists," *E.A.T. News* vol. 1, no. 2 (June 1, 1967).

between artists and engineers. They would then place the request with a selected member engineer, who would then contact the artist and initiate communication.[115]

When, in 1968, E.A.T. expanded its membership form to include a list of disciplines from which the user could select, this allowed the *categorization* of subjects into sortable, divisible fields of interest. But they did not yet know how to *use* these categories in any significant way, at the number and pace needed. So E.A.T. turned this categorization into information that could be *processed* at a much greater scale. The group began inputting large amounts of data, culled from the membership forms, into edge-notched cards—thereby allowing the information to be sorted, searched, and compared.[116] The notched cards were a manual data storage and manipulation system; they were kin to paper data systems such as the Jacquard loom and the player piano. And they were early relatives of the Hollerith punched card and other punched cards being adopted for computer programming at the time. Although invented nearly a century beforehand, in 1896, edge-notched cards were still being used in the 1960s for information retrieval systems at Bell, IBM, and other corporations as well as for voting, library, and government administration systems.[117]

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[115] This could result in actual collaboration or assistance, or referral back to the engineering committee. E.A.T. hoped that, eventually, they would establish "an anonymous nationwide group of scientists and engineers who will review and comment on industrial projects." *E.A.T. News* 1, no. 2 (June 1, 1967).

[116] "E.A.T. Technical Services: Description of Programs or Services," grant proposal submitted to New York State Council on the Arts, July 15, 1970. Langlois, E.A.T. C10-10; 186; 2.

[117] The cards' invention parallels the rise of actuarial administration and filing at the turn of the century: "Edge-notched cards were first developed in 1896 by Henry P. Stamford, who patented a simple device for searching one hole at a time (the holes were not notched) to locate, for instance, insurance premium due dates. Similar devices for bottom-notched cards were developed shortly thereafter, but the most successful variation was the edge-notched card system developed by Alfred Perkins in Birmingham, England, for the Dunlop Rubber Company sometime prior to 1925 (when he received a US patent). The Copeland-Chatterson Company patented Perkins' device in the UK, and the McBee Corporation bought the US rights in 1932. Both companies successfully marketed the invention and continued development through a series of patents over the next 50 years. The McBee company changed ownership several times in the last 30

E.A.T. adopted the McBee Keysort card, one popular trademarked type. The first model was yellow and slim, and slightly smaller than a business envelope at 4 x 9" [Fig. 3.24].[118] The edges of each card were marked by a row of holes—33 across the long side, for example—and each hole was bordered by lines, creating columns that denoted individual fields. These fields could be as simple as corresponding to "yes" or "no" to a question. They could also correspond to categories (say, a field of expertise, like "lasers"); or they could be numbered or lettered. The letters could allow one to search by name, for example; the numbers could be used to denote locations, or companies, or the like via a numerical coding system. These codes could become quite complex and involve multiple strings of integers. To "select" cards that fulfilled one field, one punched out the hole so that it became a "notch"—obliterating the margin between the hole and the edge of the card, and creating a curved divot in the side of the card. Then, given a stack of cards, one inserted thin metal rods—knitting needles were generally used—through the selected holes, and lifted. Voilà: the cards that remained below, and not in the "deck" held up by the needles, were the notched cards, and they represented the data set that one intended to choose. Using two or more needles produced a logical AND function; combining cards from two different selections produced a logical OR function.

years and, now owned by New England Business Services, no longer produces the edge-notched card." Robert V. Williams, "Punch Cards: A Brief Tutorial," *Annals in the History of Computing*, 2002, http://www.computer.org/web/computingnow/annals/extras/cardsvol24n2, last accessed May 5, 2015. See also Robert V. Williams, *"The Use of Punched Cards in US Libraries and Documentation Centers, 1936-1965," Annals of the History of Computing, IEEE* vol. 24, no. 2 (April-June 2002): 16-33; Steven Lubar, "'Do not fold, spindle or mutilate': A cultural history of the punch card," http://ccat.sas.upenn.edu/slubar/fsm.html, last accessed May 5, 2015.

[118] See E.A.T./GRI Box 14, which contains approximately 500 yellow engineering cards.

To ensure that all cards were oriented in the same way, one corner was diagonally cut, similar to the Hollerith punched card.[119]

It was absurdly simple—cards and knitting needles! But the edge-notched card enabled a new order of magnitude and intelligence for processing member information. One could search and retrieve engineering members according to name, state or city, company, technical fields of expertise, and preferred method of participation. Artists could be sorted by name, location, field of interest, medium, and method of collaboration. In addition, "spare" holes and fields were available to record ancillary information. E.A.T. provided these basic instructions to its administrators:

> "These cards can be used for storing and retrieving information about the technical membership. Cards can be retrieved according to the member's name, his state or city, his business address, his technical fields of competence, and the method of participation he prefers. The information can be transferred directly from the scientist/engineers membership form. The 'A, B, C, D,' holes at the bottom of the card can be used for anything. The holes 1-12 in the top right hand side are also spare. At each corner of the card there is another spare hole.

[119] Another set of documents in the E.A.T. archives details instructions for the edge-notched cards and one particular system for utilizing the cards, dubbed "The General Practitioner": "What is needed to solve the problems [in indexing and conventional filing] of both the political scientist and the art historian is a system which provides not multiple entries, but multiple paths to single entries. That economy is one of the characteristics of the system of information storing and retrieving which we call the General Practitioner… The limitations of conventional filing systems do not occur in our method of handling information. Edgenotched cards, the physical components, are not new. They have been around for forty years and are available from several companies. What is new is what we do with them. The General Practitioner is a system tailored to work in many individual and small group uses. … The investment required to start a system is small. Equipment includes only cards, stiff rods (like knitting needles), a punch or other notching device, and a list of punch codes…For [those]…with easy access to the computer and sufficient funds to use it, the General Practitioner may be of small interest. There are other sophisticated devices on the market for storing and retrieving information. The major advantages of the General Practitioner over such systems employing business machines are that it is cheap and compact… All cards have holes around the edge, differentiating them from the more commonly seen cards that are machine-punched through the body. Think of utility bills or those cards labeled Do Not Bend Spindle or Mutilate that banks and universities and companies are always handing you: those are machine-punched cards. With edgenotched cards, only the borders of the card are used for retrieval operations, while the body of the card is left for you to record information on. On the body of the card you can write, type, draw, Xerox, stamp, staple of glue small photographs, negatives or clippings." The instructions go on to enumerate salient features: Each card has a dogeared corner, so that when they are stacked, you can see at a glance the orientation of the card; a "deck" is a collection of cards that you keep together; a "subdeck" is part of a deck. Cards on diverse topics can be held together. "The General Practitioner," informational brochure, n.d. E.A.T./GRI Box 11, Folder 15.

> On the following pages the codes we will be using in New York are given. For finding people according to their technical field, only one needle is used; for selecting from the location, name, or company fields, two needles are used."[120]

These instructions were accompanied by a system for coding the different professions/areas of expertise. A long table from 1969 lists pairs of randomly generated, two-digit numbers that correspond to topics such as "optics," "circuit design," and materials like "acrylics," "fluorescence," "honeycomb hexcels" [Fig. 3.25].[121] Another table lists codes for selecting cards by company or by name, according to alphabetical four-letter intervals such as "AAAA – ADAL" (which corresponded to "22 23"): So, for example, Kaiser, Inc. would be between "JORD" and "KAND" and the code would be "3 21"; to select it, one would needle "3" and "21" simultaneously in the row of numbered holes bracketed for "company" [Fig. 3.26].[122]

In summer 1968, when E.A.T. went beyond the general artist membership form and added specific project proposal forms (introduced largely in response to the call for proposals by the National Science Foundation), these forms were sent for "technological appraisal" to qualified reviewers, such as Dr. Tom Bridges of Bell Labs, to assess the projects' "feasibility, originality and interest"; and to garner "suggestions for possible sources of equipment and materials or any alternative methods of achieving the same

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[120] "E.A.T. Technical Membership Register," 1969. E.A.T./GRI Box 11, Folder 9.

[121] "Scrambled Edge-Notch Card Punch Codes," 1969. E.A.T./GRI Box 11, Folder 9.

[122] "Instructions for E.A.T. Technical Membership Form," Dec. 4, 1969. E.A.T./GRI Box 11, Folder 9.

results."[123] Each dossier has a cover page with notes on the engineers, if any, to which the project was referred.[124]

In November 1968, after the introduction of the edge-notched card system, matching procedures were streamlined so that the artist would be sent the names, addresses, and occupations of up to three technical persons in their immediate area. In some cases only one technical person might be available, or none at all, "in which case the project will be kept on an open file and you will be notified." If, as hoped, at least one technical person was able to collaborate, the artist would contact them in their order of preference and ideally begin a working collaboration. The artist was then asked to send in the "E.A.T. Collaboration Information card," which was the only way the group could know whether or not a collaboration was taking place.[125]

At the end of 1968, the cards themselves expanded.[126] New blue McBee Keysort edge-notched cards were designed for E.A.T. [Figs. 3.27, 3.28].[127] These forms increased to full-letter size, 8.5 x 11, and featured a staggering array of fields for interests, types of collaboration, and contact information. These fields matched the newly expanded membership forms, so that a range of methods of participation on the matching card corresponded to those filled in on the membership form, from "Collaborating on a project" to "Helping to service works during exhibitions." Areas of expertise ran the

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[123] Letter from Peter Poole to Dr. T. J. Bridges, Bell Telephone Laboratories, April 4, 1969. E.A.T./GRI Box 6, Folder 1.

[124] "E.A.T. Project Proposal Forms," 1968-69, E.A.T./GRI Box 6, Folder 1.

[125] *E.A.T. Operations and Information* no. 1 (November 1, 1968), 2.

[126] A later example appears in the E.A.T. LA newsletter, *Survey* 6 (October 1970).

[127] EA.T., blue McBee Keysort edge-notched cards, 1968. E.A.T./GRI Box 11, Folder 14.

gamut from “paints/dyes” to “bio-engineering,” and these were grouped into subsets enumerated in a thin border running along the various fields: “media,” “sound,” “materials,” “computers,” light,” and “general fields.” In the central expanse of the card, one could type out name, address, and notes. So David Rosenboom, an engineer who would soon become a celebrated composer and pioneer of digital synthesizers as well as biofeedback and “brainwave music,” types in his card’s “Additional information” area: “Business: Production of computer-type environmental control equipment including modules for electronic music and multi-media and neurophysics” [Fig. 3.29].[128]

I’m still not quite sure what neurophysics is, but the card is elegant, a thing of beautiful regularity and organization. Sans-serif capitals, beveled borders, a dense grid of informatic possibility. It is readable from all sides, all orientations, a kind of Lissitzky-esque radical reversibility for the realm of information storage. And it is operable in yet another dimension, when stacked into a deck. Its horizontal orientation implied near-infinite lateral extension into millions of combinations and permutations; turned on its side and filed, the card becomes part of a field of depth, a continuum of searchable and sortable information. Each subject—each engineer—is thus mapped as a matrix of data.

In 1969, Peter Poole enumerated the benefits of the blue card and the reasons for transitioning to the new format:

> “On yellow cards’ top row of holes: Three holes at extreme indicate place. All three holes clipped means he lives in New York City. Two holes separated by one unclipped means within fifty miles of New York. One hole clipped means everywhere else.
>
> Holes 11 to 33 indicate the engineer’s specialty and are two-hole codes. That is you have to sort with two needles simultaneously. Under the glass on the black metal shelf is a list of specialties with two numbers corresponding to each.

[128] David Rosenboom, E.A.T. blue McBee Keysort edge-notched card, membership form, 1968, E.A.T./GRI Box 11, Folder 14.

Also is a list of states and countries and major cities. These are three hole codes and are located on the bottom of the cards. Turn them upside down and use three needles simultaneously. On the sides of the cards are the person's names and companies. They are difficult and we do those later. To select engineers first get all the cards together and divide them to three groups according to whether there is one, two or three clipped holes at the top right side. Then for example encephalographs at Princeton take group with two holes for fifty miles from New York. Then two needle code for bioengineering and medicine and any other associated field. There will only be a few so you can see if anyone is from Princeton, there isn't. On the yellow card system you will often get false drops because the system is overloaded. Heavily notched cards tend to drop out too often. This is a chore the blue card system is intended to avoid. ...

… About blue cards, they are made so that only one needle is necessary for specialties and two for name address. Also there are one hole codes corresponding to the 12 questions on the new membership forms. One or two should have been typed and clipped as samples. After practice with the yellow cards the blue should be clearer. I was saving the new membership forms with the 12 questions to go directly on the blue. So I was planning a new mailing to all the yellow cards members inviting them to fill out the new membership forms. The blue codes for location company and name are in the EATKIT and are adapted from the 11 to 33 codes on the top yellow card. Somewhere on the black shelf is a little green or blue card file with names of companies. For selecting a company code the first 4 letters were used regardless of whether the company is usually initialed. Thus LITT for Litton Industries and GENE for GEC or GM and EXPE for EAT. This should be changed so that familiar initials are used. On yellow cards the bottom would be notched for major city and state. The rest is experience and some things I've forgotten at the moment. But on the left yellow card side second hole from the bottom I think is a notch for good guys. But not necessarily all good guys and there are some unnotched. If you enter forms on the blue file them separately."[129]

The reverse side of the card was, in comparison to the recto, nearly blank—a large table for any ensuing matchings, with columns for the matched artist's name, location, the date of the collaboration, and the "action taken." Such business jargon was often left blank. Poole described the matching process as a straightforward procedure of selection and then sending the cards to the artist. This generated still more paperwork and filing:

[129] Letter from Peter Poole to "Manna," April 19, 1969. E.A.T./GRI Box 11, Folder 9. "Manna" refers to Mana Sarabhai, who was doing administrative work for E.A.T. at the time and was the niece of Vikram Sarabhai, the noted physicist who spearheaded India's space and nuclear programs and who worked with E.A.T. on various projects; the Sarabhai family were the main patrons of the National Institute of Design in Ahmedabad, where Tudor, Cunningham, and many other artists all visited throughout the 1960s.

> "For a matching I usually select three suitable cards and mail Xeroxes of them to the artist. Enter the name of the artists and date and on the back of the yellow card. Then make out a matching record card. These are 5 by 8 lined file cards with the name of the artist and the engineers, the date, and a brief description of the technical subject. There are lots of them in a grey metal file box on the black shelf which you can use as models. In addition there is a matching report card. They are the size of a long envelope and several are near the grey file box. Send out one to the artists for each engineer with his and the artists name on it and pre-stamp it. The artists sometimes respond with the little boxes ticked. If you can't find them don't worry. We can manage without."[130]

The cards generate a full-fledged system for information retrieval, storage, and exchange. They enable sophisticated tools for data processing: recall, random access, search terms, keywords, Boolean searching, logical 'and' / 'or' functions, and multiple sort categories at once. What's more, the cards presaged what is now called "faceted navigation." This is opposed to linear navigation, which means that one can only search for one category at a time, in a single taxonomic order: in a telephone directory book, say, one must search by city, then by name, then by number. Whereas with faceted navigation, one can search for multiple categories, or by multiple filters, simultaneously—or in any order one likes: name and number, city and profession, first name or last name. And the cards didn't have to be in a particular order in order to be searched and filtered.[131] In other words, E.A.T.'s card system pointed toward the search navigation systems that structure the Internet today. (Later, peers such as photographer Peter Moore and impresario Stewart Brand noted the usefulness of edge-notched cards

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[130] Ibid.

[131] Robert V. Williams, "The Use of Punched Cards in US Libraries and Documentation Centers, 1936-1965," *Annals of the History of Computing, IEEE* 24, no. 2 (April-June 2002): 16-33.

for cataloguing and information retrieval, in lieu of a "high-rent computer." "They're funky and functional," Brand wrote in 1971.[132])

And actual computer search was also in the air. In 1969-70, E.A.T. experimented with IBM punch cards to scale up their information retrieval system even further. One set from 1969 has 10 rows, numbered 0 to 9, of 80 columns, which was the standard punch card format.[133] Each column could relay one character, encoded as some combination of punches of the rows in that column. So, for example, punching rows 7 and 8 in one column might denote "square root," or a comma was encoded as "0-8-3."[134] There were pink cards for artists, and cream for engineers.[135] A summer 1970 grant proposal to hire a Technical Director for E.A.T. elaborated on the possibilities of a computerized database:

> "In regard to information retrieval, the Technical Director will refine the membership form for more precise initial information; and improve feedback and updating of information by developing a continuing system for recording engineers' responses to artists' requests, gathering reports on collaborations, and

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[132] "What do you have a lot of? Students, subscribers, notes, books, records, clients, projects? Once you're past 50 or 100 of whatever, it's tough to keep track, time to externalize your store and retrieve system. One handy method this side of a high-rent computer is Indecks. It's funky and functional: cards with a lot of holes in the edges, a long blunt needle, and a notcher. Run the needle through a hole in a bunch of cards, lift, and the cards notched in that hole don't rise; they fall out. So you don't have to keep the cards in order. You can sort them by feature, number, alphabetically or whatever; just poke, fan, lift and catch. Indecks is cheaper than the McBee system we used to list. We've used the McBee cards to manipulate (edit) and keep track of the 3000 or so items in this CATALOG. They've meant the difference between partial and complete insanity." Stewart Brand, *The Last Whole Earth Catalog* (January 1, 1971): 320. See also Kevin Kelly, "One Dead Media," http://kk.org/thetechnium/2008/06/one-dead-media/, last accessed May 10, 2015. Moore wrote in his E.A.T. membership form, "If you know if anyone capable of categorizing visual information, I am trying to break down photographable subject matter into categories capable of being coded into McBee or similar edge-punched cards for semi-automatic referral to my negative files before their bulk overwhelms me utterly." Peter Moore, artist membership form, n.d. E.A.T./GRI Box 6, Folder 44.

[133] Notched IBM punch cards for E.A.T. matching, 1969. E.A.T./GRI Box 11, Folder 16.

[134] See Douglas W. Jones, "Punched Card Codes," University of Iowa Computer Science Department, http://homepage.cs.uiowa.edu/~jones/cards/codes.html, last accessed May 15, 2015.

[135] Notched IBM punch cards for E.A.T. matching, 1969. E.A.T./GRI Box 11, Folder 16.

> transferring this information into the system. Use can be made of a computer for storage and retrieval of this information. Detailed information on each member and current information on his performance can be stored in the memory. By developing a simple coding system for specialties, and a qualifying code for degree of competence and interest, a systematic search of the membership can be made, resulting in the printout of any subgroup wanted with necessary feedback information to make a selection. With this system, statistics can be kept of types of requests made and this information used in recruiting specialized engineer members or in adding other information services."[136]

The system, the group determined, could be implemented using an IBM typewriter terminal connected to a central computer, an IBM 360-50, using the APL language; it could also potentially use E.A.T.'s current Telex unit and "find a compatible computer, using GE Basic language."[137] The benefits of the computer system were that it could be easily updated, and that "any E.A.T. office or other institution that wanted to provide these services could use it through remote access to the computer or by obtaining a copy of the tape and establishing their own computer operation."[138]

In other words, the system could become fully computational, and it could scale up even further. At that moment, however, the system could not actually answer the artists' technical questions; the range of these queries was "so broad that this service can't be handled by a computer-based information retrieval system."[139] Instead, the system was seen as a means of processing information in order to create direct connections between people.

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[136] "E.A.T. Technical Services: Description of Programs or Services," grant proposal submitted to New York State Council on the Arts, July 15, 1970. Langlois, EAT C10-10; 186; 2.

[137] Ibid.

[138] Ibid.

[139] Ibid., 3.

With the advent of the Keysort cards and then its nascent computerization, the matching system exceeds its initial parameters: it is now a means of *conversion*. Well before Hans Haacke began to use similar edge-notched card systems to poll exhibition-goers—most famously in his *John Weber Gallery Visitors' Profile* of 1973 [Fig. 3.30]—E.A.T. launched what may well be the first true information processing system in the sphere of art.[140] And unlike Haacke's cards—or the various administrative card formats marshaled by artists in the early '60s, from Robert Morris's *Card File* of 1962 to George Brecht's event scores to Haacke's earlier *MoMA Poll* of 1970—the information collected by E.A.T. is not merely collected and read.[141] It is *searched*; *compared* to all the other information within the set; *sorted*; and then *converted* into a third term, the titular match. Not just a medium or an interface, the matching system may be properly called a cultural technique—by which a set of data is not simply received, or exchanged, but transformed to generate something else.[142] The matching system was a transducer.

[140] On Haacke's polling at MoMA in 1970, see *Information*, ed. Kynaston McShine (New York: Museum of Modern Art, 1970). Haacke had proposed using teletype terminals for polling and a digital computer to compile and evaluate the results at the "Software" exhibition at the Jewish Museum in 1969, but because of equipment failure, the project was never realized. In June-August 1971, Haacke successfully deployed a computer system for tabulating answers to a multiple choice questionnaire for a poll taken at the group exhibition "Directions 3: Eight Artists," at the Milwaukee Art Center. On these polling pieces and Haacke's adoption of punched cards for *John Weber Gallery Visitors' Profile*, 1973, see *Hans Haacke: Unfinished Business*, ed. Brian Wallis (New York: New Museum of Contemporary Art and Cambridge, MA: MIT Press, 1986), 74-107.

[141] On the administrative format of the file in Morris and Brecht, see Benjamin H. D. Buchloh, "Fluxus," *Art Since 1900* (London: Thames and Hudson, 2004), 458-59.

[142] Here I echo Branden W. Joseph's reading—albeit ultimately a different one—of E.A.T.: "[Rauschenberg] intended nothing less than to introduce a bachelor machine into the mega-machine of late capitalism, to disarticulate the social mechanism of 'industry' by means of the bachelor machine's function of nonreproductive breaking down, to cause the social mega-machine to be incapable of reproduction (of the status quo), and thereby to make it produce something else." Joseph, *Random Order*, 279.

“Files remain below the perception threshold of the law,” media theorist Cornelia Vismann has written.[143] But as Vismann’s seminal work demonstrated, files *were* the law. The history of the law lay not in its institutions but in its files: in its media, its materiality, the very format and stuff of its practice. E.A.T.’s cards and forms have similarly gone unnoticed. Their materiality underlay the entire enterprise, yet for all intents and purposes they remained invisible. To reveal their proliferating stacks and piles and sheaves, their endlessly arranged and rearranged decks, is to turn the tables: to understand E.A.T. as a media-technological set of techniques, devices, and materials that is everywhere pervasive yet nowhere really perceived.[144] In Latour’s terms, this “paperwork” is, in fact, the hidden stuff of technoscience: “Machines, for instance, are drawn, written, argued and calculated, before being built. Going from ‘science’ to ‘technology’ is not going from a paper world to a messy, greasy, concrete world. It is going from paperwork to still more paperwork, from one centre of calculation to another … The more modern and complex they are, the more paper forms machines need so as to come into existence. There is a simple reason for this: in the very process of their construction[,] they disappear from sight because each part hides the other as they become darker and darker black boxes.”[145]

The cards and forms and files of E.A.T. have rarely been considered. But they coursed throughout E.A.T. They were printed and disseminated and sorted and

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[143] Cornelia Vismann, *Files: Law and Media Technology*, trans. Geoffrey Winthrop-Young (Stanford: Stanford University Press, 2008), 11.

[144] See Siegert, *Cultural Techniques*; Latour, *Science in Action*.

[145] Latour, *Science in Action*, 253.

manipulated, generating the information and tools and, moreover, the concepts of affinity and collaboration that defined E.A.T.

And these cards *produced subjects*. The matching system advanced a vision of the completely segmented, fungible, and disciplined human subject—the human subject as data set, with compartmentalized competencies that could be reassembled and reconfigured like so much code. Connectivity would be premised on amassing, storing, sorting, and searching fields of information. To put it another way, the individual subject does not preexist the card, only to have its information recorded on it. Rather, the collaborating subject is *produced* by the cards, by the matching system, by the device. The subject is *brought about*, as Bernhard Siegert would say, by the processing media itself.[146]

At the same time, the cards reinscribed new media into old media. Or rather, they registered the constant anachronism of media, in which new becomes old faster than it can it appear. The emerging mutability and expansion of bureaucratic administration—of life—in the fully digital database is reinscribed into a previous form of administration, one in which the lowly paper card, the proto-digital punch system, and the handwritten note all converge into layers of storage, processing, and reading techniques that are both becoming archaic and becoming the next stage of media. The future flexibility and diversification of media is transposed back into the standardization and banality of paper records and even further back into the outmoded personal script of handwriting. This

[146] Siegert, *Cultural Techniques*, 5-14. Put another way, the subject is produced by an *apparatus* (the matching system), taking up Giorgio Agamben's radical expansion of the term (from Foucault's *dispositif*). See Giorgio Agamben, "What is an Apparatus" ("*Che cosè un dispositivo?*," 2006), in Agamben, *What Is an Apparatus? And Other Essays*, trans. David Kishik and Stefan Pedatella (Stanford: Stanford University Press: 2009), 1-24.

palimpsest is no mere accident. It startlingly highlights the force of a new information world via the very media it will eliminate.[147]

V. Big data

In 1970, E.A.T. would attempt to extend the matching system into a much larger-scale information database with "EATEX." The name was a portmanteau of "E.A.T." and "index"— recalling both Telex and the "Memex," Vannevar Bush's legendary proposition for a device that could store and link all the world's books, records, and communications with extraordinary speed and dexterity, a "memory index" that predicted many features of contemporary hypertext.[148] EATEX was a database that echoed Bush's vision of radically available and manipulable information. It was also a kind of social network, as outlined in the group's proposal:

> "E.A.T. proposes to develop software for a computer-based program to compile a directory in the area of art and technology. The directory will be comprised of alphabetical listings of artists, engineers, scientists, other professionals, information resources, industries, professional conferences, equipment exhibitions, etc. and retrieval indexes. The directory will be produced in book form by offset printing directly from the computer printout.
>
> Although the development of the software for the program is in itself straightforward, gathering, correcting and assessing the effectiveness and usefulness of the information content requires considerable testing and feedback from participating individuals. The principal feature of the program is a permuted subject word index describing the technical skills, competence, interests and activities of the participating individuals listed in the directory. Another important feature is that once the initial program has been written and tested, the information printed in the directory can be easily updated and extended."[149]

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[147] Here I refer to Heidegger's reading of the difference between typewriting and handwriting in his lecture on Parmenides. See Martin Heidegger, *Parmenides*, trans. André Schuwer and Richard Rocjewicz (Bloomington, IN: Indiana University Press, 1992), 80-85. See also Kittler, *Gramophone, Film, Typewriter*, 183-263.

[148] Vannevar Bush, "As We May Think," *The Atlantic Monthly* 176, no. 1 (July 1945): 101–8.

[149] "EATEX Proposal," first draft, 1970. E.A.T./GRI Box 65, Folder 2.

EATEX, the group declared, was directly linked to the group's increasing size—and therefore the amount of information that needed to be processed in order to produce collaborations:

> "EATEX is the outgrowth of the large and increasing demand that has arisen for technical information and assistance on the part of artists and other professionals in the area of art and technology. It is offered as a service of E.A.T. to provide the artistic and technical communities with a directory of artists, scientists, engineers, researchers and other professionals; and their areas of expertise and interests in participation. EATEX is a directory, a repository of artistic and technical expertise to be shared and exchanged. By using EATEX, one person may contact another person directly for information, assistance or collaboration in the shortest time and in the most direct manner possible."[150]

The scale, rapidity, and flexibility of the system paralleled the promise of the Memex. To parse the information itself, "symbolic coding forms" compatible with the IBM 7090 computer (in use by Bell since the early 1960s) were to be filled out by members with name, interests, etc. [Fig. 3.31].[151] The forms, interestingly enough, were part of what IBM dubbed the "SHARE 7090 System," so named for the user community that developed around the 7090. The "shared" information from each form would then be coded as instructions on a punch card and entered into the system. EATEX used the (appropriately named) BELDEX system, a Bell-invented program that was one of the

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[150] "EATEX General Information," November 1970. E.A.T./GRI Box 65, Folder 1.

[151] "EATEX will be a computer printout based on the Beldex system owned by Bell Laboratories. To facilitate processing the information, we are asking you to record your data on the code form in the prescribed manner. For your reference, we are including a listing of professional fields and terms which frequently have appeared in descriptions of projects and requests for assistance. It is by no means conclusive, but merely to serve as a guide of terms which may describe your field and particular areas of interest." "EATEX General Information," November 1970. E.A.T./GRI Box 65, Folder 1. On the use of the IBM 7090 at Bell Labs, see http://research.swtch.com/bell-labs, last accessed May 1, 2015; and *A History of Engineering and Science in the Bell System: Communications Sciences, 1925-1980*, ed. Sidney Millman (Murray Hill, NJ: Bell Telephone Laboratories: 1984), 364-371. Max Mathews of Bell and E.A.T., for instance, used the 7090 to create the watershed *Music from Mathematics* recording in 1960, one of the first examples of computer-generated music.

earliest applications of computers to information systems.[152] BELDEX was already in use in the Bell internal library system, and soon, in 1972, it would be used for some of the first online "searches" within a network.[153] BELDEX could format and index large mounts of information, according to keyword or author name or other terms. In other words, it could sort the data and organize it according to one's wishes. Using BELDEX, EATEX would produce directories by location; field of expertise; preferred mode of collaboration, and the like.

The instructions for the form demonstrate how one is to enter information, in a curious hybrid of handwritten symbols and gridded compartments.[154] The form itself was a standard IBM form that was usually used for FORTRAN. It had multiple fields where one could enter a "Location," which was the name of an instruction within a program (and hence how it could be located); a machine operation; and a comments section where, in this case, the member's relevant information would be written [Fig. 3.32].[155] These would all be entered onto punch cards and then inputted into the system. The printed output from the Main Directory shows how lists of engineers, their contact information, areas of interests, were generated in one far-reaching series [Fig. 3.33].[156] A person's

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[152] "EATEX General Information," November 1970. E.A.T./GRI Box 65, Folder 1.

[153] The AT&T Bell Laboratories Library Network was the first industrial library network in the world. Donald T. Hawkins, "Case Study: The AT&T Bell Laboratories Libraries Network," in *Special Libraries*, eds. James M. Matarazzo and Toby Pearlstein (Santa Barbara: ABC-CLIO, 2013), 11-12. See also W. K. Lowry, "The Use of Computers in Information Systems," *Science* 175, no. 4024 (1972): 841-46.

[154] "EATEX Symbolic Coding Form," n.d. E.A.T./GRI Box 65, Folder 1. See also "Share 7090 System Symbolic Coding Form," January 1971. E.A.T./GRI Box 11, Folder 13.

[155] "Symbolic Card Format," in "Fortran Assembly Program (FAP) for the IBM 709/7090," in *IBM 709/7090 Data Processing System Bulletin* (1960): 2. See: http://archive.computerhistory.org/resources/text/Fortran/102663110.05.01.acc.pdf, last accessed May 1, 2015.

[156] EATEX Main Directory printout, n.d. E.A.T./GRI Box 65, Folder 1.

interests—their competencies, their subjective qualities—became a laconic string of characters: "FILM PLASTER CASTING OXY-ACET WELDING EPOX RESINS EXPANDED FORMS VACUUM FORMING SCUBA PARACHUTIST . . ."

The matching system clearly anticipates—and poses an early alternative to—the kinds of matching algorithms at work today in social networking platforms, the matches, "likes," "shares," and other positive links that both define and are generated by affinity. (Dan Graham's *Likes: A Computer-Astrological Dating Service,* 1967-69, was a remarkable parallel at the time: a brilliant and witty set of forms that participants could fill out in writing, denoting their astrological sign, dating preferences, location, etc., and then send them to Graham, who claimed to use a computer to process the information and create "matchings," although whether the artist used actual computation is not verified.) More broadly, E.A.T.'s matching system presaged "similarity search," the enormous field of research that attempts to find ever more precise ways of calculating the proximity of any two features according to a set of attributes—determining how alike two sets of features are. How can you find something else that is similar to what you have, whether it's an image, a word, a sound file, a profile? The matching system augured a new conception of information and size. It foretold the structure of so-called big data: algorithms and systems and networks (such as Facebook) that explicitly *benefit* from larger data sets. They become more powerful, more efficient, the more information they have.

And yet E.A.T.'s network did not simply map affirmative relations—like the paradigmatic networks of today, social media that are based on sharing, liking, friending. E.A.T. also produced the opposite: dead ends, negation, difference, rupture. Indeed, all too often, the matching might not result in anything at all. Even if an artist was matched and made contact with an engineer, it didn't necessarily amount to a collaboration. Or, conversely, collaborations that did happen may not have been recorded. Mel Bochner, for example, recounts that E.A.T.—unlike any other granting organization he worked with—simply didn't ask for results! They gave him money and didn't inquire as to what he did with it, in a stunning demonstration of the non-instrumentalization of E.A.T.'s program, its literal open-endedness.[157]

Sometimes engineers rejected the artist's proposal.[158] Sometimes there were problems in getting engineers to respond to artists' matching requests at all.[159] Cautionary language was even embedded in the forms and data requests themselves. The EATEX instructions contained the caveat that the information it provided was not necessarily officially recognized, and that any economically mandated work that came out of the directory should actually be excluded, deleted from the system:

> "The directory is based on the individual judgment of the participants and is not an attempt to bestow certificates of competence or sanctions by E.A.T., but indicates interest, direction, opportunities and desired areas of participation. Economic arrangements should be made among the individuals. However, if a fee is absolutely required, the person should not include himself in the directory."[160]

So, too, the symbolic coding form was emblazoned with a proviso that the person filling out the form agreed to grant permission to E.A.T. to publish their personal information.

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[157] Mel Bochner, interview with the author, April 26, 2013.

[158] Letter from Bell engineer Eric G. Rawson, responding to Allan Kaprow's E.A.T./NSF proposal "Message Units," 1968. E.A.T./GRI Box 12, Folder 51. Rawson would subsequently work with Robert Whitman on *Pond*, 1969.

[159] See artist membership forms and matching notes, 1967-1969. E.A.T./GRI Box 6, Folder 38.

[160] "EATEX General Information," November 1970. E.A.T./GRI Box 65, Folder 1.

The paperwork itself, the software program, betrayed myriad anxieties concerning privacy, the dissemination of information, and economic exploitation.

The network would also be subject to internal dissent and seemingly endless debate.[161] The engineering members were, in the end, a highly diverse group, whose perspectives on the direction and purpose of technological innovation and the humanities varied widely, and whose actual views, competencies, and actions fundamentally *changed* in the course of interaction and collaboration or conflict.[162] Nearly half the members in the network in 1970 did not actually deign to participate in collaborations: "There are 2,000 engineer members, of which 900 are Participating Members and are recorded on the edge-notched cards. The difference between these two numbers reflects the change in recording system for engineers in 1968 and the number of engineers who want to be kept informed about E.A.T. activities but not to participate."[163] On the artists' side, examining the collaboration information cards in the E.A.T. records, while several hundred said they made helpful contacts, the majority say got no response, or that their interests were incompatible, or that the engineers were not in the correct field of expertise.[164] There were also complaints of unreliability on the part of the engineers (that

[161] "Ford Proposal, Version 2: Complete copies, May 19, 1969." E.A.T./GRI Box 42, Folder 15.

[162] See engineering membership forms, 1967-1969. E.A.T./GRI Box 8, Folders 1-16. The two companies most represented were Bell and IBM, but there is a staggering range of ages, companies, areas, disciplines, and institutions from which the engineers come.

[163] Grant proposal for E.A.T. Technical Services Program, ca. 1970. E.A.T./GRI Box 42, Folder 7.

[164] See E.A.T. matching cards and "collaboration information cards" from 1968-1970, including those filled out by artists such as Donald Judd, Panamarenko (seeking assistance on "helicopter design"), Larry Rivers, Richard Serra ("alloy processing, latex, rubber"), Michael Snow (matched with engineers to consult on "machine automatically moving 16mm camera"), Mierle Laderman Ukeles ("electromagnetics, pneumatics, plastic"), Stan VanDerBeek (matched with the MIT audio pioneer Carl Machover and others for "computer projector system"), Nam June Paik (who said he was afraid to make contact—he thought he had to pay the engineers), and Bernar Venet (meteorology and physiology. A letter from Venet to Peter Poole, Oct. 22, 1968, states: "Thank you very much for the addresses that you gave me. I already got in touch with the

they were unresponsive to contacts, etc.), as a letter from a Rosalind Eichenstein to Peter Poole, October 28, 1968, declares; Eichenstein had been matched on January 10.[165]

Files, then, do not only give rise to a new kind of participant, a new collaborating subject. They also give rise to the dissenter, the disenchanted, the *non*participant. In both cases, collective action becomes a mode of "translation," of "transformation," in Latour's terms, between objects and subjects.[166]

The various elements of the matching system, from the Technical Services Program to EATEX, were inextricably linked to the global connectivity—the sensory plenitude, telecommunications, mass communications, information network, and responsive feedback system—promised by Bell. As Jonathan Crary has written of this moment, "Telecommunications is the new arterial network, analogous in part to what railroads were for capitalism in the nineteenth century. And it is this electronic substitute for geography that corporate and national entities are now carving up. Information, structured by automated data processing, becomes a new kind of raw material—one that is not depleted by use. Patterns of accumulation and consumption now shift onto new surfaces."[167]

M.D. and I think that it is going to be alright. They are interested to help me and they suggested me some fantastic possibilities. As soon as I know more I will let you know."). E.A.T./GRI Box 13.

[165] Letter from Rosalind Eichenstein to Peter Poole, October 28, 1968. E.A.T./GRI Box 9, Folder 6.

[166] See Bruno Latour, "The Powers of Association," in *Power, Action, and Belief*, ed. John Law (London: Routledge and Kegan Paul, 1986), 267; 276-77. One might also think of this tension as a manifestation of the conflicting processes of subjectification, desubjectification, and profanation in Agamben's terms: the warring processes of the production of subjects, the negation of subjects, and the fight to overturn those very apparatuses of control that produce and negate subjectivity. See Agamben, "What Is an Apparatus?," 20-21.

[167] Crary, "Eclipse of the Spectacle," 286-87. For Crary, Baudrillard's analysis of a new "flawlessly self-regulating world" is accurate, and yet, I would argue, too totalizing—ultimately complicit with the myth of the cybernetic omnipotence he means to oppose. Ibid., 290.

Bell's entire scope of invention and epistemology posed information as a raw material: the world's greatest resource. It promised mobile communication; the vast expansion of satellite transmission; vast stores of energy and their conversion through the watershed inventions of the transistor and semiconductor; vast and instantaneous communication.[168] With its channels and its files, its cards and wires, Bell would not only retrain but produce a new kind of subject.[169] So, too, would E.A.T. Yet the group's media techniques, its information processing, also posed a different model of experience and data flow: a heightening and deformation of the progressive sensory, physiological, and informatic retraining of the subject by the likes of Bell. A shadow network.

VI. Collaboration

The matching techniques—the cards, files, communications media—of the Technical Services Program produced a new collaborating subject. But how, exactly, did

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[168] Crary ties this to end of Debordian spectacle, and the advancement of a new condition: specifically the "mid-1970s," when "the transformation of television and its insertion into a wholly different set of structures begins, alongside the reorganization of world markets on a non-bipolar model. The convergence of home computer, television, and telephone lines as the nexus of a new social machinery testifies to an undoing of the spectacular consumption of the commodity. And, paradoxically, television, which had elevated the commodity to the height of spectacular space, is now implicated in the collapse of that space and the consequent evaporation of aura around the body of the commodity … we have witnessed the gradual displacement of aura from images of possessible objects to digitized flows of data." (The TV soap opera *General Hospital* is Crary's prime example.) Ibid., 287.

[169] According to Crary, rather than the "congealment" of spectacle, now there is *flux*; a retraining of the subject. And, not coincidentally, Crary's key example is the *semiconductor*—essentially an invention of Bell Labs and a product of its creation of the modern transistor: "the semiconductor, that quintessential object of 1980s capitalism. A product of 'postindustrial' industry, the semiconductor ship is a conductive solid with infinitely alterable logical properties that amplifies and codifies flows of power. Unique specifications are produced…by actually rearranging the atoms of the substances. And recently it has become clear how some semiconductor materials (e.g., gallium arsenide) are optically as well as electronically active: circuits of light and circuits of electricity are interchangeable, subject to the same digitization, dollar quantification, and maximizations of speed. According to the same axioms, television and the semiconductor operate by decomposing and remaking a field to achieve optimum patterns of circulation. Both intensify distribution flows while at the same time imposing intricate circuitries of control." Ibid., 293. Crary predicts a new highly articulated, coercive apparatus, of corporal regimentation [in the video display terminal, or VDT]; and yet this does not fully account for the mode of full interactivity and communicability that would come to pass today, or that E.A.T. modeled.

these subjects collaborate? One of the first such endeavors was Schneemann's "kinetic performance" *Snows*, which debuted in January 1967 at the Martinique Theater in New York [Figs. 3.34, 3.35].[170] In the months beforehand, Schneemann worked with engineers Robbie Robinson, Ralph Flynn, and others to develop an extraordinary range of technical effects, devices, and props for the piece, which involved live performers, an elaborate array of strobes, film, slide, and light projections, a color organ, complex sound effects and an audio collage by James Tenney, and falling "snow." And an audiovisual network ran throughout the entire environment: The engineers rigged a live feedback system so that audience members' movement would trigger light and sound effects. They placed contact microphones underneath seats in the theater, which would pick up and amplify sound in the audience via speakers arrayed around the space; some of the noise was also fed into the color organ, triggering light effects via the organ; and, in addition to the microphone input, photo cells would pick up bodily movement and trigger silicon controlled rectifiers in the overhead stage lighting, controlling the dimming and raising of certain lights.[171] Finally, Flynn devised a sound system that flexibly interchanged light and sound as inputs, so that light could produce sound and vice versa: "All audio was

[170] The performances of *Snows* took place on January 21-29 and Feb. 3-5, 1967. Program for "SNOWS: Kinetic Theater by Carolee Schneemann," 1967. E.A.T./GRI Box 41, Folder 1.

[171] "Snows…involved primarily audio and visual techniques. A color organ was used to trigger lights on Laurence Warshaw's color machine. This color organ was activated either manually or by sounds produced by the actors on stage. Silicon controlled rectifiers (SCR's) were used on most of the overhead stage lighting, and some were triggered by photo cells picking up various light changes. Several of the audience seats were wired with contact mikes which picked up random noises from the audience movement and were fed to speakers placed around the theater. Some of the noises were also fed to the color organ and SCR units. Strobes and movie projectors were used throughout the piece." Ralph Flynn, Technical Coordinator, "Technical Description, *Snows*." E.A.T./GRI Box 41, Folder 1.

controlled by a speaker distribution matrix which enabled us to distribute as many as 20 inputs into any of 20 audio inputs."[172]

Emerging before the edge-notched card system was in place, the *Snows* system was born of the basic connections made via Klüver over the past several years with Bell engineers and the systems and equipment originally produced for *9 Evenings*. After discussing the possibilities for collaboration at the initial E.A.T. meetings in November 1966, Schneemann began working with engineer Lawrence Warshaw to build light machines incorporating an electronic color organ developed by Robert Schultz.[173] Schultz, in turn, would work on floor and overhead lighting system with Schneemann and two of her assistants, dancer Phoebe Neville and technical Jack Agueros.[174] Warshaw spoke to Klüver about the use of EAT equipment "even though EAT is not yet set up for lending." Klüver put them in contact with Robbie Robinson, "who begins opening all possibilities for us."

As Schneemann writes,

> "Early in the morning, Schultz, Warshaw, Tenney and I drive station wagon out to Bell Labs. Lightly snowing. Robbie takes us to old house in Berkeley Heights which serves as storage for EAT materials and is in itself a complex environment which I would like to use. Bitterly cold. Picking and choosing like crazy in Woolworth's: these transistors, those cables, these SCR's…the stuff all looks very junky, mute and utterly unrelated to the images it will go to realize. (They tell me we've picked $4,000 worth. Libin has set entire 'Snows' budget at $400…which we exceed as it turns out.) Station wagon jammed with plastic boxes, cable, wire, power amplifiers, transceivers, photoresistors, tone controls, preamps, mikes, contact mikes, speaker matrix, huge speakers, motors, string!

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[172] Ibid.

[173] Warshaw would go on to found the "Intermedia Workshop" at the NYU School of Continuing Education. See Laurence Warshaw, "Intermedia Workshop," in "The Arts of Activism," ed. Edward Kamarck, *Arts in Society* 6, no. 3 (Fall/Winter 1969): 448-451.

[174] Flynn, "Technical Description, *Snows*."

> We can barely squeeze ourselves back in. The guys happy as monkeys surrounded by bananas; I'm brooding."[175]

The stuff—the media themselves—were all "unrelated to the images it will go to realize." In other words, Schneemann noted the opacity of these diverse things and tools, their dumbness and meaninglessness. Rather than a hermeneutically laden set of signifiers, of vessels of content, she described this assemblage as a set of black boxes. Moreover, because of their obdurate, closed quality, they were very different from the malleable materials of traditional sculpture, or even of the process-based work of the time:

> "The mechanical materials have a buried character; working parts all covered—the boxing doesn't indicate the interesting things inside. These objects have a sub-visual domination over immediate time and space. All mysterious promise. Not malleable. (Unlike taking of hunk of plastic in my hands, some living arms and legs, a cranky projector with a fine shape. A preposterous journey about to unfold and where was controlling center after all?)"[176]

As the engineer Per Biorn described it, Schneemann wanted "large colored lenses" through which to project the lights, onto two big walls. "Well, how do we do that?" Actual magnifying lenses at that scale would be an "impossible expense," as Schneemann put it.[177] So Biorn thought back to Rainer's collapsing grid for *9 Evenings*, and they decided to make a frame of two-by-fours with chicken wire on the front and back. They would then use plastic bags filled with colored water to act as the lenses, lit from behind.

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[175] Carolee Schneemann, "Aspects of E.A.T. in the Making of 'Snows,'" 1967. E.A.T./GRI Box 41, Folder 1. Schneemann also made an initial plea for assistance in an E.A.T. membership form: "Work in progress 'Snows,' to be performed early January (?), uses moving lights, moving objects (in the air) and enlargement materials for which I NEED HELP!" Carolee Schneemann, artist membership form, ca. 1967. E.A.T./GRI Box 6, Folder 46.

[176] Schneemann, "Aspects of E.A.T. in the Making of 'Snows.'"

[177] Schneemann wrote, "Magnifying lens would be impossible expense (Polymer dome!)." Ibid.

Hanging them would prove problematic, however. Schneemann detailed the thought process:

> "Discover [the bags'] size, weight of water, prohibit hanging. Spend a week learning about industrial plastic bags. We'll have to build a structure, floor to ceiling cage to support bags. Peter Watts and Karl Schenzer will build it. No longer possible to keep 'water lens' in center of performing area—three sided stage exacts compromise; lens set toward back of stage, leave several sections without bags so that we can crawl in and out."[178]

Schneemann then began working with Flynn, who, as she put it, was "a master":

> "[Flynn] came to the Martinique shortly after we had sorted EAT's equipment [from *9 Evenings*] and found much of it damaged. Watching him handle a broken pre-amp I saw we had a 'master' ('and I'm so young,' he said.) As Robbie had promised, 'Flynn will take care of everything' and he worked with us continuously. The 'everything' had to encompass an enormous range of details—mechanical, aesthetic, practical, visionary. His help was especially invaluable to me because of his own experience with theater while a student. At this point we had only two weeks until performance…the technical possibilities of the equipment we now had was generating ideas which could take months to realize. I had to insist that we concentrate on what was immediate and possible, to give up many past and new ideas. Ralph assisted me in this crucial sorting. (Light and sound systems, special machines, strobes, films, environment and action were in the relationship I wanted before performance and everyone had time to feel free, clear and aware of the over-all rhythm of 'Snows.') *Fortunately my own metaphoric, collage process with all materials—which meant many changes and variations—was a matter of course to Flynn*."[179]

Flynn enabled Schneemann to "sort"—to compose the "collage process" of actions, events, and techniques that would make up *Snows*. And it was ultimately a formal decision: "It was finally, always necessary for me to see a thing to know if it was really what was needed; since each element transformed any other once it was visible or audible, entire relationships would be shifted." Schneemann declared, to this end, that she wanted technicians to become more like performers, to make analogous decisions

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[178] Ibid.

[179] Ibid. Emphasis added.

based on spontaneity, observations, "discoveries." "technicians keep disappearing into their material, while we are emerging," she wrote; the process of their mutual realization would transform the "generative material." And she wanted to expose the technological components—but the apparatus proved resistant:

> "For 'Snows' I wanted to get all the mechanical parts sort of naked, edging the stage out of their protective boxes, jackets, casings. Not only did I discover they were unlikely to function so exposed but on the low, three sided stage they would be in continual danger from performers falling onto them, kicking them over…and they could injure performers. I wanted the piles of cable we used to line the aisles, to be walked over and around; fire laws made this prohibitive. Machines which finally did function as performer-objects were the light sculpture, the snow machine, hand held beams, two noisy hand-directed 16mm projectors, an 8mm projector, two strobe lights, and floor mikes nested in silver foil."[180]

In this way, Flynn, Biorn, Warshaw, and the devices and machines themselves were decisive: They altered and shaped Schneemann's work, and they continued to do so even during the duration of the performance. For Schneemann,

> "My problems with technology are concrete, personal; my difficulties with using technicians are mechanical. *I want to work with the gestures of machines; to expose their mechanical action as part of any total environment to which it contributes its particular effect. I would like technicians to be interchangeable with performers wherever possible*."[181]

The actual performance combined six performers—three men and three women—with the color organ and "color machine" devised by Warshaw; contact mikes that picked up audience movement and sound and triggered light effects on stage; strobes and film projectors projecting the collaged footage shot by Schneemann herself; the snow machine sprayed artificial snow amid a set of sparkling foil and chunks of foam [Fig. 3.36]. Toward the end of the performance, Scheemann's *Viet-Flakes* montage, comprising

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[180] Ibid.

[181] Ibid. Emphasis added.

documentary and newspaper photography of Vietnam, was projected. The projections were immersive; the snow and strobes and lights often blinding. The choreographic movements were a barrage of near-antagonistic actions, from pushing and dragging to covering in foil and white grease-paint, augmenting the flashing visuals, staging a blizzard of media imagery and light, as if, in Schneemann's own words, staging "the hell breaking loose" in the world at the time.[182] In this way, Schneemann explicitly staged *Snows* as a protest against the Vietnam War, during a "Week of Angry Arts" across New York.[183]

Pamela M. Lee has incisively read *Snows* as an instantiation of image overtaking the body—of the political and documentary image, namely, searing footage from Vietnam, becoming an excess of material, auditory, and tactile feedback that overwhelms the performer and viewer and marks the limit of the function of visual representation.[184] Looking into the actual process and collaboration of *Snows* reveals another dimension, one that has little do to with representation (or its limits) and more to do with media—the techniques, materials, and actualities of how the work came into being. It reveals the radical transduction of subjects and objects, technicians and performers, machines and stuff, relays and systems, in *Snows*—an interplay that paralleled the horrific equation of the same entities under the mantle of war. Automatic gestures and spontaneous

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[182] Carolee Schneemann, interview with Gene Youngblood, in *Expanded Cinema* (New York: P. Dutton & Co., Inc., 1970), 369.

[183] The Week of Angry Arts ran from January 29-February 8, 1967. See Carolee Schneemann, *More Than Meat Joy*, 128; Rasa Gustaitis, "'Angry Arts' War Protest Opens in N.Y.: Unprecedented in Scope," *The Washington Post, Times Herald* (January 30, 1967), D8.

[184] Lee, *Chronophobia*, 209-214. More recently, Erica Levin has read the piece in terms of photography, systems of control and their breakdown. Levin, "Dissent and the Aesthetics of Control: On Carolee Schneemann's *Snows*," *World Picture* 8 (Summer 2013), http://www.worldpicturejournal.com/WP_8/Levin.html, last accessed January 5, 2015.

movements, virtual effects and obdurate sensation, the remote and the proximate, were produced, leveled, in one and the same "collage."

By the end of 1967, more than sixty matchings had been made.[185] And numerous artists' proposals would, like Schneemann, suggest networks and environmental systems of all kinds. Marta Minujin's *Minuphone* (1967), for instance, directly tapped into the telecommunications network, whimsically exploring its paradoxical intertwining of mediated dispersion and individual physical effect [Fig. 3.37]. Per Biorn worked with Minujin to construct a telephone booth containing a push button telephone, which controlled nine functions in a random sequence. Only seven of the nine functions would work during any call, and the sequence would change when the phone was hung up.[186] "The circuit is activated when the phone is lifted and an audio amplifier picks up from 7 to 10 audio pulses from the push button phone and activates a stepping switch. When the first word is spoken in the phone after 7 dial tones the sequence begins."[187] A mechanically generated "wind in the face," siren sounds, live video of the caller projected on the floor of the booth (a "shadow created on a fluorescent blind TV image of the caller's face in the floor of the booth"), black and green water in the walls, a tape recording and playback of the caller's conversation; a ½ second echo; and two colored lights in the ceiling, each corresponding to a pitch of voice. The TVS in the booth were continuously on, and various circuits, recorders, and tape systems produced the audiovisual effects. Minujin invoked McLuhan, but this was no seamless microcosm of

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185 *E.A.T. News* 1, no. 4 (December 20, 1967); see also E.A.T. artists' matching forms, 1967. E.A.T./GRI Box 6, Folder 1.

186 E.A.T., "Performance projects: April 1967 to present," 1968. E.A.T./GRI Box 6, Folder 11.

187 *E.A.T. News* 1, no. 2 (June 1, 1967). See also "Partial list of Technical Assistance to Large Interactive or Environmental Pieces—1968." E.A.T./GRI Box 9, Folder 26.

the global village. Rather, the experience casually manifested both video and audio telecommunications as the heterogeneous, splintered, material and virtual, connected and isolated, all within the enclosed yet networked architecture of the telephone booth.

Between 1967 and the end of 1970, the number of received artists' matching forms grew to 2500.[188] Surveying the raft of applications reveals an increasingly staggering array of media. Tony Conrad underlined everything from "film," "music," and "electronics" to "physics" as interests; Ornette Coleman specifically asked for Ralph Flynn as a collaborator; John Chamberlain checked "Sculpture" as his medium of interest[189]; Dan Graham cited "film, holography"; "poetry; information theory—computer speech," circling the latter and noting: "both are areas of interest in my work."[190] Deborah Hay wrote: "I need an electronic engineer familiar with amplification techniques. Concert first week April, 1968. To build a large cube (possible 7 foot square) that would have a pendulum at its center inside. The materials at the base of pendulum would be used to create different sounds upon hitting the walls of the cube. Gradually the sound will grow from normal object-contact to amplification of all the possibilities within the cube i.e., string, sides of cube, pendulum, top, bottom etc."[191] And none other than Eva Hesse circled "Chemistry" as "interested possible resources," followed by: "Sculpture… (rub ber, plastic, vynil [sic], glues, (epoxy) resin, sculpmetal,)

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[188] "Artists' matching forms," 1970. E.A.T./GRI Box 6, Folder 40.

[189] Tony Conrad, Ornette Coleman, John Chamberlain E.A.T. artist matching forms. E.A.T./GRI Box 6, Folder 40.

[190] Dan Graham, artist membership form, ca. 1968. E.A.T./GRI Box 6, Folder 41.

[191] Deborah Hay, artist membership form, ca. 1968. E.A.T./GRI Box 6, Folder 42.

Chemistry."[192] From Hesse to Graham, then, artists with whom we associate new and unorthodox materials of the time were not simply emerging from some wellspring, Venus-like, with knowledge about these materials and technologies: E.A.T. was a crucial source of information that shaped these practices and future projects.

Forrest Myers explored even more sophisticated systems, making a technologically advanced riff on Richard Serra's verb list, presaging his xenon light project for the Pepsi Pavilion (and starring his high-priority ideas):

> "To experiment with weightless chambers
> *To circuit a piece for 4 outdoor searchlights
> To experiment with aluminum extruder
> *To cast a glass rectangle 6 feet high by 2 feet square
> To illuminate a gas-filled hollow glass rectangle of the same dimensions
> *To find a liquid solution that can be electrically charged to that it can be illuminated
> To get a light ray to bend in mid-space
> To build a 16 mm sky projector powerful enough to project on low cloud ceilings
> To build a 20 foot walk-through Theremin
> To build a strobe light system powerful enough to light the top 20 stories of the Empire State Building
> To discover a practical method for coloring sky-writer's smoke
> To work with a glass extruding system, also glass casting (Pittsburgh Plate Glass, etc.)
> To build paper rockets with colored smoke trails
> To build a tracking system that throws a triangular reflection on the surrounding hillside or cityscape, etc.
> *To install xenon search lamps vertically on the Staten Island ferries as well as a lamp on the Staten Island and Manhattan ferry piers."[193]

Other artists were interested in computing, such as Jackson Mac Low, whose intermedia and language work connected to Fluxus was well-suited to newer systems of audiovisual production, language programming, and automation or random generation. He could hardly contain his enthusiasm for the new organization: "The possibilities

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[192] Eva Hesse, artist membership form, ca. 1968. E.A.T./GRI Box 41, Folder 2.

[193] Forrest Myers, artist membership form, April 1, 1968. E.A.T./GRI Box 6, Folder 44.

opened by E.A.T. seem so great & so much what I've needed for so long that it is hard to stop talking about them once I begin. Maybe I've been afraid hitherto to contact you because of this."[194] In his previous work, Mac Low recounted,

> "Carefully made verbal or musical structures have been swallowed up in a sea of generalized noise—often quite interesting in itself, perhaps, but certainly not what I had in mind when composing the pieces. So the first problem I'd like engineers to help me with is the production of clear performances of my various simultaneous poems & other simultaneities. For many of them this wd involve movable mikes, pre-amps, amps, & loudspeakers—that is, each performer shd be able to be a moving sound source & able to regulate the volume & tone quality of the sound produced by amplification equipment attached to him without trailing wires, &c. Others need several tape recorders, each with its own amplification & speaker placed among the audience, along with either stationary or moving performers."[195]

In other words, Mac Low aimed to improve his signal-to-noise ratio. The artist also expressed interest in developing new uses of light in performances, such as strobes; "I have not done so hitherto because no such equipment was available to me." Inspired by the color organ / light machine used in *Snows*, Mac Low hoped to work with "various forms of light-to-sound & sound-to-light conversions involving photocells & the like…I'm especially interested in the possibilities for using computers in the mixing and modification of prerecorded materials & the use of computer-generated sounds along with recorded speech & sounds from the environment & the radio." Like Schneemann and others, then, this became a vision of conversion—not only between light and sound but language: "I'd like to be able to produce electronic poems incorporating sounds produced by photocells converting various kinds of light phenomena to acoustic ones & conversely to produce films or TV tapes including images produced by converting the

[194] Jackson Mac Low, artist membership form, n.d. (circa 1967). E.A.T./GRI Box 6, Folder 44.

[195] Ibid.

sounds of some of my poems & musical piece." And the artist was not only interested in real-time effects but in the incorporation of new technologies into production: "I want to learn much more about the kinds of equipment available, & whether any of it is available for <u>use in the process of composition itself</u>."

Finally, E.A.T. connected Mac Low with Ralph Flynn, who worked with him on an audio system for audience participation in a poetry reading at St. Marks Church, in April 1968.[196] This would lead to a matching with Herbert Bohnert, an engineer at IBM, who collaborated with Mac Low to develop computer programs to generate poetry. Extending his investigation into chance operations and systems, Mac Low explored the use of digital algorithms in combination with compositional decisions made by the poet. The following year, in 1969, he would begin a computer poetry collaboration for the LACMA "Art and Technology" exhibition. The latter is more well known, but it is clear that prior to the A&T work, Mac Low had begun extensive research into random generation and computational languages via E.A.T. Throughout his experimentation with sound, script, and systems, Mac Low saw each sensory effect and medium as a kind of signal, leveling very different phenomena into the same kind of malleable entity. As he concluded on his E.A.T. membership form: "What is your field? Potentially, all waves in the space-time continuum."[197]

That vast continuum, it seemed, was the attraction for many artists in the matching system. The most popular areas of interest denoted in the matching forms

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[196] Letter from Jackson Mac Low to Ralph Flynn, February 15, 1968. E.A.T./GRI Box 12, Folder 2. Mac Low details the aftermath of the show at St. Marks; he is grateful for Flynn's assistance and wants to work with him again; he alludes to his visit to Mt. Kisco to visit the IBM Watson Research Center at Yorktown Heights with Herbert Bohnert of IBM, organized by E.A.T.

[197] Ibid.

support precisely this allover view of media: light; sound; electronic music; sculpture; and architecture.[198] For example, a few months after *Snows,* Steve Reich worked with Robby Robinson on *Four Pianos*, presented at the Park Place Gallery on March 17, 18, and 19, 1967, as part of a three-evening program of compositions by Reich, performed by the musician with Philip Corner, Jon Gibson, Arthur Murphy, and James Tenney at Park Place Gallery, where the January 1967 E.A.T. meeting had recently taken place [Fig. 3.38]. *Four Pianos* is one of the very first pieces of live phase shifting.[199] Whereas Reich had produced phase shifting with tapes, following the work of Terry Riley, this work incorporated live performers, tape loops, and a type of early electronic keyboard, which entailed the work with Robinson.[200] As Flynn described it in his technical report:

> "The 'Four Pianos' concert consisted of four electronic pianos. Each pianist played the same 12 note progression but in a variable predetermined phase shift. A series of interesting and fascinating sounds resulted. Mr. Reich also presented some pre-recorded tapes using much the same technique as the live piano concert."[201]

Reich and Robinson linked the bodily experience of the performers to electronic synthesis in an exploration of both the mechanically accurate and involuntary variation, however slight, modulation of rhythm and time. The algorithmic compositional system

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[198] See artist matching forms, 1967-1969. E.A.T./GRI Boxes 6, 7, 8, 9.

[199] *Four Pianos* was in fact an early version of *Piano Phase* (1967), which is seen as Reich's first published live phase shifting composition. See Keith Potter, *Four Musical Minimalists: La Monte Young, Terry Riley, Steve Reich, Philip Glass* (Cambridge: Cambridge University Press, 2002), 182-83.

[200] According to Potter, the keyboard used was specifically a clavinet, an electronically amplified clavichord that had just been introduced in 1964 by the German manufacturer Hohner and was "state-of-the-art" at the time. Ibid., 195. No notes in Flynn's write-up specify clavinets, but the instrument is cited in a notice in the Village Voice: Anon., "Park Place Pianos," *Village Voice*, March 16, 1967, 11.

[201] Ralph Flynn, "*Technical write-up on 4 Pianos*," n.d. E.A.T./GRI Box 11, Folder 12.

of phasing was no longer limited to the machine. It expanded to an extraordinary combination of human subject, machine, and interface.

That same set of performances also featured Max Neuhaus's *Bi-Product* of 1966-67.[202] The artist collaborated with engineers Flynn and Ted Wolff on rigging photocells that would pick up variations in light and shadow in the performance venue; these inputs were converted into electronic signals that would trigger a printing device to generate markings on a paper tape feed, segments of which were distributed to the audience at the end of the concert.[203] Neuhaus had apparently attempted to create a similar device in a performance with Tenney and Mac Low in 1964, but it did not work; the drawings faded quickly from the paper.[204] Flynn and Wolff came up with a system that would actually function, using a newly developed thermal ink. They successfully created a series of translations between the space of the body, signal, sound, and writing—a field of conversion and notation. As Neuhaus would later muse, in a conversation with Wolff published in E.A.T.'s journal *Techne*, "The whole thing about electronics, it seems to me, is that it's the most flexible way to do anything. And it's like a super material you can do anything with. Artistically and musically."[205]

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[202] This is how the work is titled in the program for the performance; subsequently, Neuhaus would refer to the work as *By-Product*.

[203] See Flynn, "*Technical write-up on 4 Pianos*," which also discusses Neuhaus's *By-Product*; Simone [Forti] Whitman, "Interview with Max Neuhaus and Ted Wolff," *TECHNE* 1, no. 1 (April 14, 1969): 4.

[204] Theodore Strongin, "Concert is Given by Percussionist: Neuhaus Rubs, Tickles and Pats Variety of Instruments," *New York Times*, June 3, 1964.

[205] Whitman, "Interview with Max Neuhaus and Ted Wolff," 4. Wolff said of their working relationship: "One of the interesting things here is that Max doesn't just look for an immediate empirical solution to a confined problem like, 'Should #18 or #20 wire?' He asks, 'Should I use 18 or 20 and then why. And then why the why. And then the theory behind the way of the why….And this is like a big giant step rather than just saying, 'Hey! Get me out of the same bind but a little bit different.'"

By 1968, E.A.T. Technical Services had aided a wide array of artists including Donald Judd, Richard Serra, Larry Rivers, Michael Snow, and Kenneth Snelson. Yet perhaps the most striking development was the gravitation toward large-scale, responsive environments. Advances in sensors and circuits—all powered by the transistor, that landmark invention at Bell—allowed artists to pursue immersive, interactive, quasi-architectural enclosures. Extensive correspondence with the London-based design group Archigram, for example, reveals the extent to which proposals sent to E.A.T. immediately skewed toward elaborate architectural and engineering construction projects. In the fall of 1967, David Greene of Archigram wrote to Klüver to inquire about collaborating, as "we all have an insatiable interest in the feedback of technology into the built environment (or built non-environment)."[206] The group had been invited to create a construction for the Milan Triennale in May 1968, "a multi-sensory assembly in which it is hoped that the visitor to the exhibit can control and choose his programme."[207] "The design of the assembly is in a very loose state at the present," Greene wrote, "but we were wondering if there was any chance of getting the EAT Program in a cooperating role in this project? As you will know from Archigram Magazine, we have many ideas, but need the technical know-how and apparatus that can make them possible."[208]

E.A.T. began to organize successfully matched projects according to type. One main category emerged as: "Technical Assistance to Large Interactive or Environmental

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[206] Letter from David Greene of Archigram to Billy Klüver, August 28, 1967. E.A.T./GRI Box 10, Folder 1.

[207] Letter from David Greene of Archigram to Billy Klüver, October 25, 1967. E.A.T./GRI Box 10, Folder 1.

[208] Ibid.

Pieces."[209] In 1968, E.A.T. helped realize ambitious installations such as Rauschenberg's *Soundings*, with sonically triggered lights illuminating a series of panels screenprinted with the silhouettes of chairs, launched at the Stedelijk Museum in Amsterdam [Fig. 3.39]; and *Solstice*, a four-panel platform with automated sliding doors, each screenprinted with a different color from the CMYK four-color printing process, so that one walked through it as if entering a color separations system, unveiled at Documenta IV that same year [Fig. 3.40].[210] Whitman's *Solid Red Line*, a motorized red helium-neon laser projected horizontally around a room and appearing to "erase" itself, debuted at Pace Gallery [Fig. 3.41], realized with optics scientist Eric Rawson and laser specialist Larry Heilos (who had collaborated on *9 Evenings*), both of Bell Labs; an elegant diagram shows how the motor, laser, and mirror produced the effect [Fig. 3.42].[211] Whitman's *Pond*, a sound-activated mirrored "environment," as the E.A.T. documents called it, opened at the Jewish Museum in fall 1968, actualized in collaboration with Rawson and more than ten other engineers (including Flynn, Schneider, Wittnebert, and others); an elaborate block diagram maps out the input of sound, which would activate motion in a series of vibrating mylar "varifocal" mirrors [Figs. 3.43, 3.44].[212] The next

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[209] E.A.T., "Notes on matchings, 1968-69." E.A.T./GRI Box 9, Folder 26.

[210] On Rauschenberg's *Solstice*, *Soundings*, and *Mud Muse*, see Michelle Kuo, "'Inevitable fusing of specializations': Rauschenberg and Experiments in Art and Technology, 1966-70," in *Robert Rauschenberg*, eds. Leah Dickerman and Achim Borchardt-Hume, exh. cat. (New York and London: Museum of Modern Art and Tate Modern, 2016), 260-271.

[211] Robert Whitman: "Dark," text on laser construction for Pace Gallery exhibition, 1967. E.A.T./GRI Box 27, Folder 18.

[212] Eric Rawson and Robert Whitman, "Report on a Light Sculpture Using Varifocal Mirror," n.d. E.A.T./GRI Box 27, Folder 18. See also Eric Rawson, "Pond," *TECHNE* 1, no. 1 (April 14, 1969): 10. Rawson writes, "Pond is a light and sound environment that occupied a 70-foot by 40-foot gallery at the Jewish Museum in New York City. Arranged around the perimeter of the room were a variety of large electronic vibrating mirrors and rigid spherical mirrors. Automatic slide projectors, suspended above the observers' heads near the room center, projected images intermittently onto (and reflected images from

year, Whitman would then begin a long collaboration with the PhilcoFord scientist John Forkner on subsequent mirrored pieces for the LACMA "Art and Technology" exhibition, the US Pavilion at Expo 70, and the mirrored dome of the Pepsi Pavilion. Stan VanDerBeek received help on electronics for his "Geodesic Dome Projection Theatre," as it was labeled in the E.A.T. records, better known as his Movie Drome, a homespun circular projection environment built in VanDerBeek's backyard in Stony Point, New York [Fig. 3.45].[213]

One of the most ambitious and technically complex—even fantastical—proposals came from Belgian artist Panamarenko, who sent extensive blueprints and drawings for his wildly large-scale dirigible designs. One proposed a continuously accelerating spaceship powered by a nuclear reactor [Fig. 3.46]: "[T]he ship would ultimately achieve millions of miles an hour.... A thing like this can not only change the world but also time."[214] Peter Poole of E.A.T. sent letters on Panamarenko's behalf to engineers from various aerospace and defense corporations on 17 June 1969, focusing on one design in particular, a radically lightweight helicopter design that could be operated by one person.[215]

> "In a box of 16x16x18" are two motors of 200 cc, 13,000 rpm, and 18 hp. Eight knife-like propellers carefully placed and surrounded by a reservoir for fuel and

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above) the vibrating and rigid mirrors. A recorded voice spoke occasional words or phrases from loudspeakers distributed about the room." Loudspeakers were additionally installed in each varifocal mirror; when the speakers were activated with sound, "the effect is both acoustical and visual; the observer hears (or feels) the sound waves and observes his reflected image moving back and forth behind the mylar mirror as the mylar film changes curvature due to the pressure of the sound waves."

[213] Stan VanDerBeek, letter to Sue Hartnett of E.A.T., Jan 30 1967. E.A.T./GRI Box 6, Folder 47.

[214] Panamarenko, "Closed System Power Devices for Space / Portable Air Transport / Gas Turbines, 27 East 67th St., New York, April 19-May 9, 1969," proposal and statement for exhibition at John Gibson Communications, New York. E.A.T./GRI Box 6, Folder 26.

[215] Panamarenko, E.A.T. matching card, 1968. E.A.T./GRI Box 13.

> oil. There is also a seat. That is about all you need to fly around. Just start the motor, sit in it, and fly for half and hour or two hours. With fuel and motors, everything, it weighs 20 lbs. If this thing is not going to change the world, then the next proposal will. *Every detail of these projects is carefully studied and has nothing to do with science-fiction*. They are open for study and, after agreement with me, for production."[216]

The responses ranged from dismissive to supportive—evincing a surprising gulf of opinion. Niels O. Young, who ran a small firm, Block Engineering, in Cambridge, MA, and who would go on to participate in the E.A.T./MoMA competition, wrote in support—but then observed the complete lack of interest in this kind of project from the aircraft industry:

> "I am in total sympathy with Panamarenko's motives (or so I think). But I have myself dredged very far and wide searching for an engineering solution and not found one. In this search one is encouraged by the fact that practically no aircraft company (and I have canvassed Hiller, Sikorsky, Gyrodyne and Fairey) has the same motive. They spend their money to maximize profits and build better military or transport machines."[217]

Young's response reveals the utter chasm between mainstream industrial application and Panamarenko's quixotic concept. And yet Chester Sandberg, of the electrical and mechanical engineering corporation Raychem, argued: "…if what [Panamarenko] described were at all feasible under the present state of the art they would be on the market. I know of no acceptable motor with the proper power to weight ratio described. At the moment most of what Panamarenko states is just science fiction."[218] In another

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[216] Panamarenko, "Closed System Power Devices for Space / Portable Air Transport / Gas Turbines, 27 East 67th St., New York, April 19-May 9, 1969." Italics my own. For a different reading of the Panamarenko proposal and response, focusing on the Pruner and Wilson letters, see Wisnioski, *Engineers for Change*.

[217] Letter from Niels O. Young to Peter Poole, June 18, 1969. E.A.T./GRI Box 6, Folder 26.

[218] Letter from Chester Sandberg to Peter Poole, June 26, 1969. E.A.T./GRI Box 6, Folder 26.

twist, for Donna Wilson of the defense/aerospace giant McDonnell Douglas, the proposal was not "science fiction" enough:

> "The proposal is a misuse of the concept of imagination. In today's technological milieu that threatens to destroy human life and values, we desparetly [sic] need imaginative alternatives, but flying machines have existed in our collective storehouse of fantasy for centuries (e.g., see the recent exhibit The Machine by the New York Museum of Modern Art). If engineers and technicians need new grist for their mills (and I seriously believe they do) then why do artists continue to be obsessed with symbols or metaphors that are well known and explored? Their chief value to the human race has always been in their function to be the precursors of consciousness. I suggest that a proper use of imagination would be to turn to what we can hope to receive from the future—not to what we already know of the past."[219]

Finally, according to John Pruner of the major aerospace think tank Lawrence Livermore Laboratories,

> "…Mr. Panamarenko's design concept is basically feasible and is not without precedent. A similar device called the Bensen B-12 Sky-Mat was built and flown by the Bensen Aircraft Corporation. It had 10 5-ft. dia rotors, each driven by a 10 hp West Bend engine. Maximum take-off weight was 800 lbs.
>
> I believe one could construct a scaled down version of the Bensen B-12 helicopter using 8 rotors driven by two 18 hp engines to lift one man … Mr. Panamarenko's helicopter design concept is an exciting challenge not only from the stand point of design and construction but also of performance, stability, and control. To Mr. Panamarenko, I would like to express an earnest and sincere 'Good luck and many happy lift-offs.'"[220]

Pruner's flatly pragmatic acknowledgement, Wilson's disappointment, Sandberg's dismissal, Young's enthusiasm: the engineers' responses are all clearly at odds with one another. And so their critical and epistemological divides become clear: on the one hand, openness and experimental possibility; on the other, a pessimistic resignation to the utter instrumentalization of technology, consignment to a world in which the

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[219] Letter from Donna Wilson, McDonnell Douglas Advanced Research Laboratories, Huntington Beach, CA, to Libby Joyce, editor of *Techne*, July 15, 1969. E.A.T./GRI Box 6, Folder 26.

[220] Letter from John Pruner, Lawrence Livermore Laboratories, to Peter Poole, July 21, 1969. E.A.T./GRI Box 6, Folder 26.

technological resources and sophistication needed to engineer a project such as Panamarenko's was hopelessly out of reach. For Panamarenko, who had turned from proto-Conceptual assemblages in the 1960s to the dirigibles that would consume the rest of his career, the design problem of the personal flying vehicle was in and of itself an ongoing investigation that need not be fulfilled, or work. After correspondence with Poole and these engineers, Panamarenko would go on to attempt to implement some aspects of Pruner's recommendations, producing highly complex blueprints and designs; but he would never successfully produce a personal, wingless flying device of this scale.[221] His interaction with E.A.T. attested to the endlessness of his project—an openness and infinitude that could not have been more different from the scientistic positivism of Buckminster Fuller's breathlessly optimistic schemes.[222] If Fuller made engineering utopian, Panamarenko made it weird.

Engineering took another turn in Hans Haacke's *Photo-Electric Viewer-Controlled Coordinate System*, 1968 [Figs. 3.47, 3.48]. First shown at Howard Wise Galllery, the work comprised a full floor-to-ceiling grid of infrared beams; viewers' movements would trigger photo-sensors that would control incandescent light bulbs arrayed in a row at mid-level. In the beginning, in 1967, Haacke had written to E.A.T. with a membership form and proposal for a "Photo-electrically sensitized 'environment" for a solo show in January 1968 at Howard Wise Gallery [Fig. 3.49]:

> "A dark, square room, 13 feet long and 13 feet wide, with an entrance, that equally serves as exit, of approximately 2 feet, in one corner. Along the walls, at intervals of 1 ft. and 5 ft. above the floor, incandescent light bulbs, 25 Watts each,

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[221] Letter from Panamarenko to John Gibson, Aug. 1, 1969. E.A.T./GRI Box 6, Folder 26.

[222] For a succinct reading of Fuller's utopianism, see Sean Keller, "Navigating Systems," *Artforum International* 47, no. 3 (November 2008): 282-294.

> will be installed, altogether 48 bulbs. On two adjoining walls, equally at intervals of 1 ft., but slightly lower, i.e. at approximately chest level, infra-red photo-relays will be situated. On the opposite two adjoining walls will be the complimentary projectors. Twenty-four infra-red projectors and 24 relays are needed. It is important that these projectors emit only invisible light, and it is also desirable that the relays be silent in their operation. The incandescent bulbs are connected with the relays in such a way that, whenever the projector-relay infra-red light beam is interrupted, the bulbs directly above these respective pieces of equipment light up immediately. Assuming that a person in this room under normal circumstances breaks two beams (perpendicular to each other), four bulbs will light up at once, one on each of the four walls. If there is more than one person in the room, more lights will be on, four lights for each person. Thus the number of persons in the room determines the degree of illumination. The gallery has A.C. current, with numerous outlets, each with a separate 15 amp. Fuse."[223]

Sue Hartnett, Flynn, and others assisted Haacke with the infrared and photo sensor system; the group worked out the details of equipment and the floor plan of the installation [Fig. 3.50]. The enclosed responsive system echoed the technological interests Haacke had enumerated in his membership form: "Sculpture / Chemistry, hydrodynamics, aerodynamics, devices, responding to light, temperature, humidity and other environmental conditions. Engineering of acrylics and plastic film."[224] And yet Haacke's approach to environment differed sharply from other light installations of the time, such as Otto Piene's *Lichtballetts*.[225] If Piene's light ballets created a fully hemispherical constellation of stimuli, exploding the columnar light structure of Moholy-Nagy's *Light Prop* into a non-responsive, literally somnambulant experience—a kind of analgesic, anesthetic depression of both the nervous system and historical memory,

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[223] Hans Haacke, artist membership form and proposal, n.d. but likely fall 1967. E.A.T./GRI Box 6, Folder 42.

[224] Ibid.

[225] See Michelle Kuo, "Specters," in *Otto Piene*, ed. Joao Ribas, exh. cat. (Cambridge, MA: MIT List Visual Arts Center, 2011), 58-77.

Haacke's literally responsive environment activated the viewer's awareness of the relationship between his/her movement and the effect of the lights.

At the same time, *Photo-Electric System* destabilized any easy causal relationship between movement and effect. The viewer was never quite sure of the chain of reactions or events—as if the work was enacting the nonlinearity and contingency of technology itself.[226] The responsive system highlights the distinction between system and environment, self-reference and external reference, a system of interdependent processes rather than a discrete object. This immanent understanding of the system diverged from Burnham's early analysis of Haacke's work, which ultimately veered into a utopian notion of interactivity and autonomy. (And the tension between these viewpoints would grow as Burnham and Haacke's own notions of systems and the art-technology relationship would change—and grow into disillusionment—over time.) "A system is not imagined, it is real," Haacke wrote.[227]

Photo-Electric System maximized illumination depending on the number of bodies in the room. By contrast, Whitman's *Solid Red Line* literally effaced itself; the viewer did not trigger any response but rather seemed to watch the work disappear before their eyes. The laser cut a lateral plane throughout the gallery—a cylindrical source stood in the center of the room and rotated slowly, the line's tail end constantly fading as it progressed around the walls.

[226] By highlighting this destabilization in *Photo-Electric System*, my analysis of the work builds on the readings of Benjamin H. D. Buchloh and, more recently, Luke Skrebowski, each of whose brilliant analyses of Haacke's practice presuppose a transparent system at work—whether technological or natural or social—in the piece. See Benjamin H. D. Buchloh, "Hans Haacke: Memory and Instrumental Reason" (1988), in *Neo-Avantgarde and Culture Industry* (Cambridge, MA: MIT Press, 2000), 203-242; and Luke Skrebowski, "All Systems Go: Recovering Hans Haacke's Systems Art," in *Grey Room* 30 (Winter 2008): 54-83.

[227] Hans Haacke, statement in *Hans Haacke*, exh. cat. (New York: Howard Wise Gallery, 1968).

Solid Red Line debuted as one of three laser pieces in Whitman's show "Dark," at the Pace Gallery from October 7 to November 17, 1967; the exhibition was shut down by the health department over concerns regarding laser safety.[228] In February 1968, Flynn worked with Whitman on preparing the laser pieces for the "6 Artists, 6 Exhibitions" show at the Walker Art Center that spring.[229] Whitman then began working with engineer John Forkner, with whom he was matched via E.A.T. Forkner specialized in optics and lens design in the aeronautical division at PhilcoFord. His membership form outlined his specializations—and his dabbling in pottery:

> "16 years as mechanical engineer, optical engineer working in infra-red, visual optical design—lasers, fiber optics
> Comments: Your idea sounds great! I've believed in this for many years. My artistic interests have had some fruit in ceramic sculpture and pottery as an avocation. Have also been working on optical projection devices as a possible artistic medium, particularly in conjunction with music."[230]

Forkner and Whitman would go on to develop a sustained relationship, working on *Pond* with engineer Eric Rawson, for the Jewish Museum in 1968[231]; the mirror dome for the Pepsi Pavilion; and the vibrating mirror piece displayed in the US Pavilion and the "Art and Technology" exhibition at LACMA.

After his participation in the early meetings at E.A.T., Robert Morris continued to explore the resources of the organization. In Morris's E.A.T. artist membership form of

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[228] E.A.T., "Partial list of Technical Assistance to Large Interactive or Environmental Pieces—1968." E.A.T./GRI Box 9, Folder 26.

[229] As Flynn noted in his address book, "Whitman owes me $14.00 for 2-VTC PF3 Transformers." Ralph Flynn, address book, E.A.T./GRI Box 11, Folder 28. The exhibition ran from May 12-June 23, 1968 at the Walker Art Center in Minneapolis.

[230] John Forkner, engineer membership forms, 1967-68. E.A.T./GRI Box 8, Folder 2.

[231] Eric Rawson, "Pond," *TECHNE* 1, no. 1 (April 14, 1969): 10. See also John Gruen, "Spectator Participation," *New York*, Nov. 11, 1968, 19.

May 8, 1968, he wrote of his desire to explore new materials, circling "sculpture" as his medium of interest; he wrote: "Wish to find transparent plastics with large range of flexibility. Wish to use these in fluid (i.e. molding, casting, etc.) state and in connection with other materials." He was recommended to Alan Griff, a plastics engineer.[232] In a May 21, 1968 letter to Francis Mason, Morris responded to E.A.T.'s National Science Foundation call for proposals with a different set of concerns: "For some time I have had projects, ideas, sketches, for works of an environmental nature to be made outside. Some of these projects involve temperature control of an outdoor environment. I sought help in using steam at one point from an engineer at Bell Labs but had no response. I would be interested in extending, elaborating, developing the possibility of heating and cooling systems which would be part of large outdoor projects for parks, squares, public places. Refrigeration, steam, hot and cold water, air currents, solar reflectors, etc., would be considered. If the development of such projects sounds sufficiently experimental I would like to be put in touch with an engineer, or engineers, familiar with temperature control systems. I have no particular forms in mind which would then be activated by temperature—rather, the physical units (pumps, tubes, reflectors, etc.) would become part of the visible project itself."[233] While Morris's specific work with steam was to be realized without the assistance of E.A.T., his interest in steam, temperature, and currents—and the physical machinery becoming *part of the visible project itself*—clearly resonate with Nakaya's subsequent vision for the Pepsi Pavilion fog.

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[232] Robert Morris, E.A.T. artist membership form, May 8, 1968. E.A.T./GRI Box 9, Folder 13. As I have noted above, Morris himself had famously posed the authorial subject as precisely the bureaucratic form of the matching forms—an index-card catalogue—in his *Card File* of 1962.

[233] Letter from Robert Morris to Francis Mason at E.A.T., May 21, 1968. E.A.T/GRI Box 6, Folder 44. Morris's proposal was published in "Projects," *TECHNE* 1, no. 1 (April 14, 1969): 12.

In 1968, an E.A.T. project proposal from John Cage was sent to Matsuhita Electric Corporation; the company refused to participate.[234] That same year, however, Steve Reich worked extensively with Larry Owens of Bell, who would go on to be a central engineer for the Pepsi Pavilion, on a complex system Reich called *The Phase Shifting Music Gate*—which would essentially become the first sequencer, now the most basic tool, along with the synthesizer, in electronic music production and performance.[235] And other connections were successfully made for proposals from USCO, Juan Downey, Alison Knowles, Fahlström, Jean Toche (and the Guerilla Artists Action Group), Flavin, Serra, Snow, and Mierle Laderman Ukeles, who were all matched with engineers on various projects.[236]

E.A.T.'s publications offered another way to create matching and communication. The first issue of the high-production value journal *TECHNE* features, at the end, a section containing various project proposals by artists. "Any engineer or scientist interested in working on one of these projects," the notice read, "please contact E.A.T. and we will put you in touch with the artist."[237] Morris's questions about steam and temperature were printed, along with queries from Jean Dupuy and Pete Seeger. So, too,

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[234] John Cage, "Project Proposal: Atlas Borealis with the Ten Thunderclaps," Sept-Dec. 1968. E.A.T/GRI Box 6, Folder 3. "My project is to make a work for orchestra (probably string orchestra) with chorus, both modulated electronically so that the orchestra playing pitches corresponding to the star-positions will sound like rain falling on historically appropriate materials—rain at the beginning on water, at the end or near the end on concrete—and the chorus will sound like thunderclaps. Ten different thunderclaps are to be measured with respect to their acoustic properties; then, voices singing/speaking the [James] Joyce texts will be modulated—transformed—to fill up these envelopes."

[235] Steve Reich, E.A.T. project description for "Four Pianos / *The Phase Shifting Music Gate*, collaboration with Larry Owens, engineer at Bell Labs in Holmdel," March 1968. E.A.T./GRI Box 6, Folder 29; Box 11, Folder 6; Box 12, Folder 53. See also matching card for Larry Owens, E.A.T./GRI Box 14.

[236] See "Matchings, 1968-69," E.A.T./GRI Box 9, Folders 5-20.

[237] "Projects," *TECHNE* 1, no. 1 (April 14, 1969): 11-12.

were an intriguing, characteristically laconic diagram and set of questions by Carl Andre. A one-ton steel ball is shown perched at the edge of a curved track—essentially a *very* long, gently U-shaped ramp—one mile in length. Andre asks: "How long will the ball released remain in cyclic motion? What is the optimum arc for longest period? How to reduce friction? Stresses? Materials? Costs?"[238] The problem essentially posed a nearly unthinkable thought experiment, a massive one-ton ball rolling back and forth along an entire mile in as perpetual motion as possible. In the next (and last) issue of *TECHNE*, a physicist, Erwin W. Tschudi of Baldwin, New York, responded at length, calculating the possible parameters—dimensions, friction, resistance, kinetic energy, speed—under which such a scenario could occur, and the possible duration of the ball's movement under these conditions.[239] It is a completely practical and feasible response to the problem. While Andre never realized the experiment, its publication and dissemination created a small moment of connection, a matching, in the ambit of media circulation.

The spread of the organization, then, also meant the spread of information. Accordingly, the Technical Services Program accompanied many other forms of contact between artists and engineers. Kluver had taken artists on at least fifty tours of Bell Labs in the early 1960s[240]; he organized artist visits to IBM's headquarters and research facilities at Yorktown Heights, New Jersey in September 1967, with a focus on gaining access for artists to mainframe computers.[241] These field trips continued at other

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[238] Ibid., 12.

[239] Erwin W. Tschudi, "Steel Ball on Curvilinear Track," *TECHNE* 1, no. 2 (November 6, 1970): 12.

[240] Billy Klüver, "What are you Working on Now?," in *Abstract Painting: 1960-69*, ed. Donald Droll, exh. cat. (Long Island City, NY: P.S. 1 / Institute for Art and Urban Resources, 1983), n.p.

[241] Billy Klüver, "Memo/Outline for Visit to IBM on September 26, 1967," Sept. 19, 1967. E.A.T./GRI Box 41, Folder 4. See also *E.A.T. News* 1, no. 3 (Nov. 1, 1967). Attending artists included Les Levine,

laboratories and companies, including RCA and CBS—with artist-in-residence proposals following suit.[242]

Indeed, the artist in residence program created some of the most extended relationships in the history of E.A.T. Within this format, artists and engineers did not meet en masse or on neutral territory. Instead, the artist was sited within the research laboratory or corporation itself.[243] One such residency made stark the limits of that literal incorporation: Mel Bochner at the Singer Corporation.

VII. Artist in residence

In 1968, Mel Bochner took a photograph of a door [Fig. 3.51]. It would seem to clearly mark its own span, with black tape denoting 12 inches. But you are not actually seeing 12 inches; you are seeing something else.

Bochner took this picture, *Singer Measurement #1*, 1968, under unusual circumstances. The artist had worked with E.A.T. twice before, producing cyanotypes at Local One, Amalgamated Lithographers of America with a skilled lithography

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Simone Whitman, Robert Breer, David Tudor, Jim Tenney, David Antin, and administrator Sue Hartnett. Correspondence from IBM notes the "lively" exchange prompted by the visit: "Thank you for the visit last Tuesday…The presentations have generated heated and lively discussions among our staff and will, I hope, result in further contacts between them and your artists. …we have set aside our auditorium for one hour, starting at 12:00 noon, on Thursday, October 19, so that you may present your program to a larger spectrum of people here at the Research Center." Letter from R. Landauer, Asst. Dir. Of Research, IBM, to Billy Klüver, Sept. 28, 1967. E.A.T./GRI Box 41, Folder 4.

[242] Letter from Billy Klüver to President, Vice President at RCA, David Sarnoff Research Center, Princeton, Feb. 23, 1970. E.A.T./GRI Box 95, Folder 2. See also "CBS Artists in Residence," CBS press release, Nov. 29, 1967. E.A.T./GRI Box41, Folder 4.

[243] Another major E.A.T. artist's residency placed the electronic and computer music composer and artist James Tenney at Bell Labs, beginning in 1961; he was the first composer to actually be on the payroll at Bell. See James Tenney, "Computer Music Experiences, 1961-1964," 1964; "Interview with James Tenney by Libby Joyce, November 18, 1969." E.A.T./GRI Box 121, Folder 12.

technician; and E.A.T. connected him with a professional product photographer.[244] In the meantime, E.A.T. had partnered with Singer Company to place an artist in residence at the company. Bochner then applied, stating his interests in his E.A.T. membership form:

> "Medium: Sculpture involving photographic processes
> Interest: I am interested in discussing a number of ideas with a qualified computer engineer. These ideas involve numerical photograph translations, set determinations for serial projects and possibilities involving photographing from computers. I have been working in and around these areas for some time but have lacked the qualified assistance and computer time to substantiate my ideas.[245]

Singer had made sewing machines for nearly a century: but during WWII, they were conscripted into making other kinds of light machines for the government: artillery, weaponry. In the 1960s, they moved even further into the defense industry, acquiring several companies the researched flight simulation, etc.

Bochner was handpicked by Singer, based on his E.A.T. application and interviews, to work with Edwin Webb, an engineer with background in physics and "wide experience in servo-systems, flight simulators and information analysis techniques."[246] Francis Mason, E.A.T.'s then-director, wrote in a memo to Kluver, Rauschenberg, and Waldhauer:

> "The situation is genuinely exploratory and open-ended. There is an engineer collaborator. *Singer preferred people without any real knowledge of computers; they also wanted highly articulate people*.

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[244] Scott Rothkopf, "'Photography cannot record abstract ideas' and other misunderstandings," in *Mel Bochner Photographs: 1966-1969* (New Haven and London: Yale University Press, 2002), 1-49. See also Luke Skrebowski, "Productive Misunderstandings: Interpreting Mel Bochner's Theory of Photography," in *Photography after Conceptual Art*, eds. Margaret Iversen and Diarmuid Costello (West Sussex: Wiley-Blackwell, 2010), 117-147.

[245] Mel Bochner, E.A.T. artist's membership form, n.d. E.A.T./GRI Box 6, Folder 39. Bochner was responding to the form question: "If you would be interested in working on a project through E.A.T., Inc., please give us your name, address, and phone number."

[246] "Memorandum to BK, RR, FW from Francis Mason / Subj: Selection of artist for The Singer Company," 1968. E.A.T./GRI Box 41, Folder 16. Other candidates included Jud Yalkut, David Antin, and Simone [Forti] Whitman.

> Ralph and I both talked with the candidates and explained the ground rules: that the idea had originated with Singer and that they would make their choice from a number of people. All the artists were interested and turned up on Tuesday to talk with Richard Decker, the engineer in charge of the project, and Ed Webb, a physicist and engineer who will be the collaborator working with the artist.
>
> Decker and Webb were much impressed by all of the artists, as were the artists by them. The Singer people had in fact been so impressed that they foresaw great difficulty in making up their minds. They have since done so and notified me that Bochner was their man."[247]

The facilities at Singer were cutting-edge, with nascent computer scanning and graphics capabilities:

> "The equipment is available at the laboratory *to scan a two-dimensional artistic rendition in color and convert to computer language*. The exploratory research to be conducted by Mr. Bochner and Mr. Webb will be aimed at introducing the artist to the purpose of expressing himself directly through the computer and the various output devices to which it may connect."[248]

And so, starting in September 1968, Bochner went to Singer's laboratory in Denville, New Jersey, once a week for about four months. There, he gained access to precisely the sophisticated scientific and photographic equipment in which he had professed interest. As Bochner recounted, "I didn't want to be there as a 'tourist.' I wanted to be there on exactly the same terms as the scientists, so I demanded a salary—whatever the average salary was for a research scientist. I knew it was the only way to be taken seriously. My second requirement was an office, so I was physically part of that situation."[249]

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[247] Ibid. The research manager at Singer wrote to Mason, "Thanks again for your help in bringing Mel Bochner and Ed Webb together. They make a fine team and I am certain that 'productive growth' will occur as a direct result of their teamwork." Letter from Richard Decker, Research Manager, Singer Company, to Francis Mason, Sept. 27, 1968. E.A.T./GRI Box 41, Folder 16. Emphasis added.

[248] Press release, "Singer Company Announces Artist-In-Residence Project," Sept. 18, 1968. MoMA/E.A.T. Klüver Documents, #89. Emphasis added.

[249] Mel Bochner, interview with Hans-Ulrich Obrist and Sandra Antelo-Suarez, http://projects.e-flux.com/do_it/notes/interview/i003.html, last accessed January 21, 2017.

Most of Bochner's time was spent in conversations with staff, which he recorded in a notebook every day; these conversations centered on how to communicate experience and information, and thus quantification. Bochner would create a Xerox book of these thoughts, titled *The Singer Notes* (1968).[250] In it, the artist details ideas for feeding numbers into a computer that would generate permutations of those numbers and print them out as photographs. And yet, as Bochner later recounted, the programmers could not write a program that would perform these operations fast enough—it would be much more convenient to simply do them by hand. Ironically, as the Singer press release had stated, the facilities existed to perform the *inverse* operation: to convert a color photograph into "computer language," FORTRAN. It was in this sense that Bochner could entertain the question of conversion from image to information: from photography to digital code, from index to symbol, and vice versa, thus figuring the loss of indexicality from photographic ontology. As Bochner states,

> "I was very fortunate through EAT to get the opportunity to work at the Singer labs, which were out in New Jersey, and I think Singer, which had diversified from sewing machines, felt some competition with AT&T because they were both into all kinds of aero space things, at that point. They thought it might be interesting to have an artist come out and do work in a think tank situation with the scientists and engineers there. And basically it was about three months, two days a week, of just sitting around and talking with these guys and trying to find something to talk about. What we might have in common, what we might disagree with, what points on which our interests might overlap. this is what they did for a living, what they did every day. It was research and development, brainstorming new things for the company to produce, sitting around the table, scribbling notes to themselves. So, right from the very first day, I started saving every scrap of paper. I'd gone out there with a few ideas for actual projects, none of which panned out."[251]

[250] Mel Bochner, *The Singer Notes* (1968). Self-published Xerox book in edition of four.

[251] Mel Bochner, interview with the author, April 26, 2013.

"One idea," Bochner notes, "was to find a way to use their high-powered computers to translate some of my number drawings directly into photographic images. But in those days you couldn't type directly into a computer; everything had to be translated into a programming language called FORTRAN. The programmer said it would take him six months to write the program, making it faster for me to do it by hand. So much for computer-generated images in 1968!"[252]

Bochner still, however, pursued technological media that he could not have tested otherwise. As the *Singer Notes* detail, Bochner was interested in the conversion of color to "digital output," whether using scanning, another newly evolving technology, or a vector graphic system (vector graphics, in which shapes are defined by mathematical curves, are one basis for digital graphics today) [Fig. 3.52].[253] Bochner headlined the sheet with the mandate: "QUALITY TO QUANTITY TRANSDUCTION." And so qualitative to quantitative became, for Bochner, a way of investigating the conversion of material to information, or visual perception to numbers. While the computers could not actually handle the quantity of data at stake, Bochner played with video and photography. Bochner seemed to outline one such experiment in his notes as another transduction: "TELEVISION IMAGE TO PHOTO IMAGE / TRANSDUCTION." The artist set up a video feed of four wooden blocks arrayed on a grid, then toggled the vertical hold setting of the video camera, creating a stuttering and blurring image on the monitor. He photographed the monitor, creating eight gelatin silver prints titled *Roll* (1968), which, at 20 x 24 inches each, the curved frame of the monitor set into each picture, served as

[252] Mel Bochner, "Media Study," *Artforum International* 51, no. 1 (September 2012): 463.

[253] Bochner, *Singer Notes*, n.p.

chemical indices of a waveform image [Fig. 3.53].[254] It is almost as if the opposite "transduction" occurs: not from quality to quantity but the reverse, and back again—the wooden blocks converted into a televisual image, an electrical transmission, then converted into a resolutely material emulsion, a surface. Four years before Joan Jonas's seminal *Vertical Roll* would underscore the groundlessness of video, its irreducibility to a specific medium, Bochner's *Roll* captures the total instability and contingency of media transmission and reproduction.

Finally, toward the end of his residency, Bochner began measuring things. First, Bochner had Singer staffers themselves take Polaroids of the scenarios. Then he rephotographed the Polaroids, cropped them, and had the negatives developed as 8 x 10 gelatin silver prints. In the pictures, mundane objects are shown scattered throughout the office and lab. Black Letraset numbers and black tape mark off distances. Bochner describes the work as a manifestation of the failure of objective quantification and communication:

> "I saved all of the notes and papers and doodles that we wrote while we were sitting around, and I turned those into a book called *The Singer Notes*, and as time went on, the subject came to be objectification, how to communicate, and how to communicate objectively. It boiled down to the issue of measurement. So that's where measurement as an idea entered my work. Because the scientists would only trust that. There's nothing else they would trust. If they didn't have a measurement, and it wasn't repeatable, then it wasn't trustworthy, and there was no communication. So at a certain point I had this idea I would come in early one day with some Letraset, and I randomly put different measurements around the lab. Not attached to anything. Just free floating on walls on doors on the floor. I didn't tell anybody about it, I secretly went around. And they came in and discovered those, and of course that lead to a new round of questions, what does this mean, how do you divorce measurement from an object, etcetera etcetera, led

[254] Skrebowski persuasively reads *Roll* as an emblem of the ways in which analog photography itself was always already unmoored from the real: "In lieu of producing his proto-digital photographs, Bochner focused on the 'phantoms' that haunted analogue visual media." Skrebowski, "Productive Misunderstandings," 130-131.

> to some really interesting conversation. And then I asked the in house photographer to take some photographs of these, which he did, as documentation."[255]

Indeed, it was only after looking at these 8 x 10 photos that Bochner realized that the measurements indicated within the image had absolutely no relationship to the distance they marked on the print.

> "[A]s I looked through this stack of photographs, I began to realize that here you have a measurement written on something that purports to say what it is -- but in the illusion of the photograph it's represented as something else. So twelve inches equals three inches, but how do you pull that information out? There was no way to know the actual size of the object in the photograph."[256]

This recognition spawned Bochner's "Measurements" series, which would continue well after his residency at Singer. But the project also spurred the fundamental realization that measurements do not simply denote actual distances: the two sit in an uneasy relation. As Scott Rothkopf has shown, the markings in Bochner's photographs do not measure distances between *things*, as we normally use measurement; instead, they seem to hover between "arbitrary physical points."[257] (Even in a photo with a span between a spray can and wall molding, the mark does not totally line up with the can, because of the angle of the photograph and its perspectival distortion.) In this way, the essential scalelessness of photography becomes startlingly explicit: in the spray can photo, for example, "ten inches" depicted is less than five in the actual print [Fig. 3.54]. This "cleaves an a priori concept from the physical world it is meant to describe"; it

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[255] Mel Bochner, interview with the author, April 26, 2013.

[256] Mel Bochner, interview with the author, April 26, 2013.

[257] Rothkopf, "'Photography cannot record abstract ideas' and other misunderstandings," 35.

divorces the representation of a numerical sign from the "literal relationship of a measurement to its ground."[258]

Finally, this led Bochner to the 1968 piece *Actual Size (Hand and Face)* [Fig. 3.55], where, as the artist described it: "Photographs have no built-in mechanism to account for scale. And that's what led to the pieces *Actual Size (Face)* and *Actual Size (Hand)*, both 1968, where I put a twelve-inch measurement on the wall, stood next to it, took a face shot, took a hand shot, and then had the photograph printed so that the measurement was actual size in the print. Now you could tell the size of these objects, making the photograph directly answerable to the world outside itself."[259] The result was a tautology: "The measurement in the print would be exactly twelve inches, or actual size. By doing that the photograph became the index of the index, or a vicious circle. That, for me, was the end of photography."[260]

Bochner was exploring the transformation from one media to another, and more importantly, from one set of quantifications to another. From actual measurement to its photographic representation. And the end of photography, for Bochner, led him to "start thinking about real space as opposed to what seemed to be the representation of space."[261] Which, in turn, led from photography into architectural space, to the Measurement

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[258] Rothkopf, "'Photography cannot record abstract ideas' and other misunderstandings," 38. As Rothkopf notes, Bochner would have been acutely aware of precedents in Duchamp's *Three Standard Stoppages* and Johns' numerous paintings including rulers. Yve-Alain Bois discusses Bochner's works in relation to these precedents in Bois, "The Measurement Pieces: From Index to Implex," in *Mel Bochner: Thought Made Visible, 1966–1973*, ed. Richard Field (New Haven, CT: Yale University Press, 1995), 167-88; 66.

[259] Mel Bochner, "Media Study," 463.

[260] Mel Bochner, interview with Hans-Ulrich Obrist and Sandra Antelo-Suarez, http://projects.e-flux.com/do_it/notes/interview/i003.html, last accessed January 21, 2017.

[261] Mel Bochner, interview with the author, April 26, 2013.

rooms[262]: "This … led me to the first installational measurement pieces. Of course, once you put the measurements of a gallery, or any space, on the walls as a sort of three-dimensional blueprint, you realize that it's still a form of representation. But what's changed is significant. The viewer's experience has gone from a mediated one to one that is direct. At this point my concerns began evolving in a more phenomenological direction …"[263]

The *Measurement* series were not simply about visual or spatial mediation. According to Bochner, the *conversations* with Webb and the other scientists were what really constituted the work. The photographs are investigations of the different kinds of narratives or discourses at play in art and technology: *two kinds of language*.

They also function as a kind of documentation of a specific environment, the visual language of the laboratory: the Letraset, the linoleum floors and spare architecture, the mundane office supplies. In this sense, the media forms of 1960s industrial research are likened to that of *photography*—to the entropic nature of communication, whether technological, scientific, or aesthetic. And, of course, photography is what traditionally brought these discourses of art and technology together in the modernist era. Photography itself was predicated on the contingency of transduction, conversion, of slowness, incommensurability. As Bochner states,

> "With photography you have the lab, the waiting times. In the 60's, the photographic technology was so primitive, as opposed to what it is today, there are a lot of things you couldn't do. I wanted to do a lot of things in color photography that you just couldn't do. You couldn't go from a slide to a print."[264]

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[262] On the loss of indexicality in Bochner's Measurement pieces, see Bois, "The Measurement Pieces: From Index to Implex."

[263] Mel Bochner, "Media Study," 463.

[264] Interview with Mel Bochner by the author, April 26, 2013.

As Rothkopf has argued, Bochner's deep skepticism in the objectivity of measurement and quantification was very different, then, from Minimalism's faith in the unmediated physical experience of an object, and its anti-illusionist mandate. But it was also very different from the attitude of Conceptual artists, who treated the camera as a mere documentary device, as a way to *de*materialize, to eliminate mediation (in favor of the supposed transparency of linguistic or photographic signs).[265] Bochner instead "explores the relationship between literal *and* representational, a relation he could not escape in photography itself—and realizes that photography could not communicate ideas any more transparently than painting, or sculpture, or language itself."[266]

And yet the *Singer Notes* also reveal something else about photography, apart from the realms of real and referent, or Minimalism or Conceptual art. Bochner was not only exploring traditional photographic mediation, he was exploring the utterly new relationship between material and code, *between photography and the digital*.[267] The *Measurement* pieces do not only mark the loss of indexicality, but point to the nascent redefinition of photography as a digital medium, as a medium of information, and of conversion between signal and noise, recognizing right from the start that this conversion was never seamless or complete.

The question of analog-to-digital conversion and measurement was, in fact, foremost on the minds of Webb and the engineers at Singer. Handwritten notes,

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[265] Rothkopf, "'Photography cannot record abstract ideas' and other misunderstandings," 40.

[266] Rothkopf, "'Photography cannot record abstract ideas' and other misunderstandings," 41.

[267] See Skrebowski, "Productive Misunderstandings," 130-131.

presumably written by Mason, gesture toward a brave new world of computer interfaces that will seem "natural," or skeumorphic, to a new user:

> "Ed Webb, …
> Wed A. & T. through tool of digital computer
> Now speeding up manual dexterities
> Can be done long enough with desk calculator
> How comp. Can be used as a creative aid?
> …Color, form and texture – line, shape
> …Webb will be working with artist see how he works
> computer forces you to work three basic [?] rules
> To disc. How communication – creative sides –
> How artist begins and what he ends up with. Is there something there that can be absorbed [?]…Poss. [ibility] of feedback. In process of creation he changes, what is best way to get artist into transfer loop
> Want him to be a programmer of artistic algorithms. Artist will explain how he can comm. to comp. What he wants.
> --Can we sense a unity in the phenomenon
> to match a unity in science
> --Need artist to explore approaches through computer…if <u>he</u> can't do it, non-artist can't
> Artist: Verbal, not int. in technology <u>qua</u> computers… result that at end artist would be able to produce works of art thru computer
> If computer no good, we'll do info. systems
> That w/e communicate
> Visits to studios
> Begin with color
> Generate random nos. => color => form => feature."[268]

In this way, Webb, Decker, and the Singer scientists were interested in the interface between artist and algorithm—a new interface between a layperson, a visually acute subject, and the digital network, an interface that would test the very incommensurability so starkly borne out in Bochner's time at Singer. Bochner later reflected,

> "I look at E.A.T. as the beginning of something. There was a resistance on the part of the art system of that time to anything which challenged the hegemony of formalist painting and sculpture. I think a number of people sensed that the time for that was up. Even Minimalism was the endpoint of modernism rather than the start of something new. … Therefore the issue was to look for another way to work and another way for both the content and the form were your own. Instead

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[268] Anon. (likely Francis Mason), notes on Singer artist in residency, 1968. E.A.T./GRI Box 41, Folder 16.

> of trying to pour new wine into an old bottle, as they say, how do you find a new container?"[269]

E.A.T. provided a vessel, a new way, for Bochner to understand the incommensurability between two disciplines, two epistemologies: art and technology, representation and the real. But E.A.T. also mirrored his discovery of the fundamental instability and fungibility of media, providing an entirely new "way to work," a new possibility for organization, for making, that did not end in the telos of a stable object or form. The E.A.T. residency was, after all, stunningly open-ended. According to Bochner, "It was the only grant I ever had where they didn't even follow up to ask me what came of it."

VIII. Some More Beginnings

Other artist residencies took place in industry throughout the 1960s, most famously via LACMA's "Art and Technology" program, but these were comparatively short-lived, expressly limited by—and ending in—the conventional format of the museum exhibition. The artist residencies of E.A.T. were, by contrast, completely open-ended, their telos never defined by traditional institutions. And these would be accompanied by direct contraventions of the museum but also the academy.

Not an institution: rather than an entity defined by the stable conventions of the government, academy, corporation, or museum, E.A.T. would operate through and between such structures. It was to be a chain of catalysts, of perpetually mutable actors and events, a realm for testing. Perhaps this is why the group continually flirted with traditional institutions of art, only to break with them—posing unprecedented possibilities for the production, circulation, and reception of art and technology alike.

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[269] Interview with Mel Bochner by the author, April 26, 2013.

E.A.T. introduced a rift between the institutions of modernism and a new model of association.

The chasm opened wide in one of the group's next major endeavors, appropriately titled "Some More Beginnings." Once again, Hultén was the connector. For "The Machine as Seen at the End of the Mechanical Age," the major historical survey of art and technology that he organized at The Museum of Modern Art in 1968, Hultén tapped E.A.T. to curate a section devoted to new work.[270] True to form, Rauschenberg, Klüver, and the group put out an open call for artists and engineers to collaborate on a work to be considered for exhibition. The response—147 proposals from nine countries—was so overwhelming that E.A.T. decided to hold a simultaneous satellite exhibition at the Brooklyn Museum [Fig. 3.56].[271] Submissions included Kenneth Knowlton and Stan VanDerBeek's computer-generated drawings and films—at a moment when computer graphics were just being invented—and Haacke's designs for a room filled with steam and a self-regenerating column of ice (Haacke eventually displayed the related *Ice Table*, 1967 [Fig. 3.57]). The astonishing array of works registered the emergence of the digital and electronic precisely at the titular "end" of an older regime of the mechanical. What's more, they reflected Rauschenberg's own envisaging of an art that would envelop and respond to the viewer—an environment of sensory plenitude and continuous change, an

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[270] K. G. Pontus Hultén, ed., *The Machine as Seen at the End of the Mechanical Age*, exh. cat. (New York: The Museum of Modern Art, 1968). The show was on view from November 25, 1968, to February 9, 1969; it was explicitly posed in dialogue with MoMA's 1934 "Machine Art" exhibition. Rauschenberg and Klüver's own *Oracle* was included, and Tinguely's collaboration with Klüver, *Homage to New York*, served as something of a mascot for the show, being reprinted as the frontispiece and back page of the catalogue.

[271] "Some More Beginnings" was held at the Brooklyn Museum of Art from November 25, 1968, to January 5, 1969. See Klüver, "Draft statement on exhibition at Brooklyn Museum of Art," 1968. E.A.T./GRI Box 27, Folder 22.

interactive field that could somehow transform physical action into information flow: an art that was intelligent.

Nine proposals were selected for exhibition in MoMA itself, and each proposal was also considered for an award. Unlike other art-world competitions, however, this time the engineer—and the engineer alone—would be the winner.[272] The first-place winner was the engineer Ralph Martel for *Heart Beats Dust*, a collaboration with Jean Dupuy [Fig. 3.58]. The latter's investigations into the participatory and ludic (in the circle of Fluxus) here manifested as a vitrine containing intensely red powder pigment that violently erupted in response to a stethoscope held to a viewer's heartbeat.[273] Lucy Young, an artist, and her husband, engineer Niels O. Young, contributed *Fakir in ¾ Time*, 1968 [Figs. 3.59, 3.60], which was startlingly simple but entrancing: a ribbon was spun at 100 miles an hour, a kind of motorized lariat that, because of its speed, created looping forms that stood in space (and which could be perturbed by a viewer), the work spinning a "mechanical fountain."[274]

Another victor was the engineer Frank Turner, for *Cybernetic Sculpture*, constructed with the artist Wen-Ying Tsai [Fig. 3.61]. The work converted sound into light and motion: stainless steel rods vibrated at thirty cycles per second and were

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[272] "Experiments in Art and Technology announces a competition for the best contribution by an engineer to a work of art produced in collaboration with an artist. The project may be initiated by either an artist or an engineer. Experiments in Art and Technology will grant a first-place award of $3,000 and two second-place awards of $1,000 each to the engineer for his technical contribution to the collaboration. . . . The awards will be for the most inventive use of new technology as it evolves through the collaboration of artist and engineer." E.A.T., announcement for MoMA competition, *New York Times*, November 12, 1967. (Ads would also be placed throughout winter and spring of 1968 in publications such as *Scientific American*.)

[273] Hultén, *The Machine as Seen at the End of the Mechanical Age*, 200.

[274] Ibid., 202. See also Niels O. Young, "Standing Loops of Limp String," *TECHNE* 1, no. 1 (April 14, 1969): 8-9.

illuminated by strobe lights whose rate of flashing was controlled by sounds in the environment. When synchronized, the rods appeared to be still, in the shape of a harmonic curve; any sound would vary the rate of flashing, producing the illusion of strange and erratic undulations in the rods. The technical sophistication of the piece outstripped the kinetic sculptures that seemed to be everywhere in the late 1960s: going beyond linear physical motion, it incorporated an actual feedback system responsive to environmental stimuli in real time.[275]

What was most striking, though, was the conflict that ensued after the piece won an award. Or rather, when Turner won. Tsai was exhibiting widely at the time, but he had actually trained as an engineer himself.[276] He accused E.A.T. of failing to recognize him as the proper "creator" of the work and demanded that the piece be removed until he was rightfully credited.[277] E.A.T. refused to budge: "The competition was held not for the work of art but for the best technical contribution by an engineer to a work of art working in collaboration with an artist. . . . It has never been the intention of E.A.T. to reflect on the technical qualifications of Mr. Tsai."[278] The exhibition in general was beset by crowding, faulty equipment, damage from audiences handling the works, and the necessity of periodically turning off electrically powered works to preserve their motors:

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[275] Ibid., 201. See also "Some More Beginnings," *TECHNE* 1, no. 1 (April 14, 1969): 2.

[276] Wen-Ying Tsai, who had exhibited in "The Responsive Eye" at MoMA in 1965 and in "Cybernetic Serendipity" at the ICA London, in 1968, had trained as an architectural engineer. He would go on to join Gyorgy Kepes, Otto Piene, and others at MIT's Center for Advanced Visual Studies in 1969. The artist's own E.A.T. membership application, filed the year before the competition, listed his interests as "kinetic sculpture," "electronics and Physics," and a long-term project of developing "self-organization systems." See Tsai, E.A.T. membership form, 1967. E.A.T./GRI Box 6, Folder 47.

[277] As Tsai's lawyers put it, "You can readily understand . . . the consternation of Mr. Tsai when he learns that Mr. Turner has been credited as the creator and engineer of the work in question." Eastman & Eastman, letter to Powers, E.A.T., November 18, 1968. E.A.T./GRI Box 27, Folder 21.

[278] Klüver, letter to Eastman & Eastman, November 22, 1968. E.A.T./GRI Box 27, Folder 21.

during off cycles, audiences thought that works were broken.[279] New media made a host of new problems for the museum.

Then, in January 1969, the kinetic sculptor Takis threatened to pull his work (*Tele-sculpture*, 1960) from the show at MoMA, arguing that the piece—although it belonged to the Museum's permanent collection—was outdated and unrepresentative of his practice. The events boiled over into a strike of sorts. Takis, along with Tsai, Haacke (who was unhappy that his work was turned off each night), and others, famously began the Art Workers Coalition, which would go on to protest MoMA's and other museums' practices in the name of artists' rights, labor issues, and the Vietnam War [Fig. 3.62].

This role of technology in the birth of institutional critique is little known. The sudden spotlight on the engineer—and the bitter clash between Tsai, Turner, MoMA, and E.A.T.—laid bare persistent but little-acknowledged tensions surrounding artistic authorship, technical innovation, and the division of labor, just as Takis's protest paradoxically attempted to oppose a traditional form of institutional power by asserting an equally traditional form of proprietary authorship—*droit moral*. But the events also demonstrated that E.A.T. could not be assimilated into the institutional structure of the museum. This ran counter to finite endeavors such as the Los Angeles County Museum of Art's "Art and Technology" show, begun that same year, in which museological display—the single exhibition—was the end result of collaborative activity. Nor could

[279] "Unfortunately, this exhibition suffered from crowding, considerable interference between works and technical damage due to public handling—all of which brings us to the problems of presenting mixed media in the usual museum environment." Ann McMillan, "Explorations in sound in New York Museums—'Mixed Media,'" Voice of America broadcast, Rome, July 3, 1969. Transcript, E.A.T./GRI, Box 10, Folder 8. On the works broken or not repaired, see "Some More Beginnings," *TECHNE* 1, no. 1 (April 14, 1969): 2. "[O]ne work was destroyed at the opening and removed, one work was never completed and removed, and one work was judged unsafe and removed after opening night….13 out of the 75 pieces were on the average out of order…. 5 of the 75 pieces were broken by the pubic and never repaired."

E.A.T. be understood as a critique or an affirmation of institutions. Between opposition and complicity, museum diktat and authorial control, E.A.T. pointed to a different path, one that disrupted the myth of a supposedly discrete and unified creator, artwork, or institution. The organization escalated Rauschenberg's longstanding model of collaborative production and assemblage, his openness toward *all* entities as material—whether people or machines, gold or junk, readymade or something never made before.[280] Like Rauschenberg's revelatory leveling, E.A.T.'s unwieldy processes troubled hierarchies of artist and "mere" technician, tool and work, disturbing conventional notions of individual production and institutional possession alike.

IX. Knowledge demonstration

E.A.T. contravened the academy, too. In sharp contrast to other art-and-technology ventures of the time—such as the group Zero, which would settle into the Center for Advanced Visual Studies at MIT—E.A.T. never ended up in a pedagogical institution. Instead, it created its own kind of learning. In fall 1967, the organization launched a series of forty "demonstration-lectures," designed to be free and determined by the interests of members [Figs. 3.63-3.65].[281] The events, held at E.A.T.'s loft on 16th Street, reached a startling array of artists and broached subjects that would have been inaccessible to most. Renowned scientists and engineers gave talks and workshops on lasers, "art and electron microscopy," "dissolving papers," "luminescence," casting and

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[280] On the long arc of Rauschenberg's engagement with materials, materiality, and immanence see Joseph, *Random Order*.

[281] Discussion of specific lectures by Herwig Kogelnik (on holography), Wayne Gustafson (on "computer basics"), Leon Harmon and Kenneth Knowlton (computer graphics and the "Computer Nude"), and other engineers appears in *E.A.T. News* 1, no. 3 (November 1, 1967). Transcripts of individual lectures from 1968-69 are archived in E.A.T./GRI Box 28. See also "Program listing for E.A.T. demonstration-lectures, February 4–May 1, 1968, 9 E. 16th St., New York." E.A.T./GRI, Box 11, Folder 7.

molding, computer languages, video.[282] Max Mathews, the father of computer music—he was developing the field at that time at Bell—spoke on the subject. Eva Hesse signed up for the lecture on polymers.[283] These were informal, open conversations that explicitly avoided any formal *Vorkurs*. Yet the information being disseminated was at the most advanced level of techno-science. It was as if the discourse of the clandestine hallways of the think tank had been brought into the artist's loft, or vice versa. This was a remarkable form of knowledge distribution—one that connected the utterly disparate fields of the art world and the industrial research laboratory—and it would proliferate, as E.A.T. went on to organize demonstration-lectures of all kinds in cities across the world.[284]

The lecture-demonstrations were precisely the kind of idiosyncratic, ad-hoc dissemination of knowledge that Latour describes in his sociology of big science: the building of networks through which knowledge is circulated. Unlike the top-down bureaucracies of a previous epoch of institutions, actor-networks thrive on the horizontal spread and multiplicity of links, their very reach and span constituting their power.

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[282] Ibid.

[283] Eva Hesse, attendance form for demonstration-lecture "Polymers," given by F. H. Winslow, Bell Laboratories, February 11, 1968; Hesse, E.A.T. membership form, 1968. Both E.A.T./GRI Box 6, Folder 42.

[284] See programs for "Lecture Series," 1968-1969, E.A.T./GRI Box 28.

Chapter 4

Dispersion

CHAPTER 4

DISPERSION

By 1969, the number of matching requests exploded.[1] In the wake of "Some More Beginnings" and "The Machine Show," E.A.T. was creating matches at the rate of 40 per month.[2] During the first three months of 1969, 113 were matched. And according to the collaboration "report cards" returned, 27 of these connections resulted in definite collaboration, technical assistance, or information; two did not. By September 19, 1969, the group had initiated more than 600 collaborations.[3]

What did these collaborations actually produce? As we have seen, any number of myriad objects, images, and events resulted. But to pose the question of product—to understand E.A.T. in terms of sheer results—is to miss the point. As the organization itself declared, E.A.T. was about process and not product.[4] Indeed, we must understand E.A.T.'s collaborations as *media processes* themselves: as a set of techniques that allowed the conditions of possibility for meaning to unfold. And these techniques, as manifested both in the collaborations and in resulting works, were means of conversion: conversion between materials, sensations, states, modes of information. They were, as I have argued, technologies of recording, retrieval, processing, and transmission. E.A.T.

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[1] Matching forms, 1968-69. E.A.T./GRI Box 9, Folder 3.

[2] *E.A.T. Operations and Information* no. 2 (April 24, 1969): 1-2.

[3] *E.A.T. Information*, September 19, 1969, 1.

[4] "We will not picture, show or demonstrate any individual work, collaborative or otherwise, as a representative work of art, in any E.A.T. publications or activities. In discussing specific works or projects, our emphasis is always on the necessary processes involved in accomplishing the work." Moreover, the organization would not only describe its own medium but its "style" as "neutral, factual and functional." *E.A.T. President's Report*, October 1, 1969, 1.

did not consist of a series of artworks or a group of individuals. By contrast, it was a network that would be extended through, but not defined by, the works and information and subjects it produced.

I. Bigger science

E.A.T.'s network—its media—depended on growth. But growth was slow on the technological side. The organization faced a middling response from industry, dubbed the "basic problem" E.A.T. must solve in order to grow its engineering membership: "A telling statistic about E.A.T. at this point in its development is that there are two times as many applications coming in from interested artists as from interested engineers."[5]

So E.A.T. took out a booth at the trade for the Institute of Electrical and Electronics Engineers' annual convention in New York from March 18-21, 1968. (Although Klüver dated this event to 1967, which has subsequently been replicated in other sources, this seems to have been a simple error/misdating, since all the documentation from the time clearly dates the booth to 1968.) Other sessions at the IEEE convention included "Man-Machine Interface—Or Who's in Charge Here?"; "The Op Art of Voltage Measurements"; "Management of Research and Development"; Computer Output as Art."[6] A photograph from the event shows a suited Hans Haacke and Tom Gormley manning the E.A.T. booth, complete with posters and literature, attempting to strike up conversations with engineers and encouraging them to become members [Fig. 4.1]. The goal was to have one thousand engineer members by the year's end. Yet the enrollment hit a few snags, as Peter Poole observed in hindsight:

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[5] *E.A.T. News* vol. 1, no. 4 (December 20, 1967).

[6] "IEEE Convention Guide, 1968." E.A.T./GRI Box 11, Folder 18.

> "[the] booth should have contained a piece which was extremely sophisticated technically, which would have arrested passersby, aroused their curiosity and allowed EAT people to open up a conversation…more engineers could have been persuaded to fill out application forms…It should have been made clear to engineers that being a member is not necessarily a commitment to collaborate—and then on the form they should have been asked to state 'available for collaboration, consultation, or neither. This would have saved us a lot of bother subsequently."[7]

Regardless, the ties with the IEEE did allow greater access to engineers. And the engineers came from big science.

Engineers, the story often goes, simply followed the lead of the artists in E.A.T. But any serious examination of the projects and processes of E.A.T. shows that this narrative is false. The engineers absolutely changed the direction—the very stuff, the very means—of every work. The engineers were not instrumentalized into mere sources of information. This is why E.A.T. did not stop at a database of technical information; it was crucial to create a far broader and more dynamic network of knowledge, people, and tools. As the group made clear from the outset of the matching program,

> "E.A.T. emphasizes the collaborative relationship between artists and engineers. Thus, the idea of making E.A.T. into a library of technical information has been rejected. ... Instead, E.A.T. will act as "matching agency" where an artist with a problem is matched to a member engineers whose qualifications are such that he understands what the artist is talking about."[8]

The collaborations produced active relationships: knotty, vexed, and complex interactions between each subject and agent involved. And every "problem"—unlike the linear problem-solving of Greenbergian modernism—was only the beginning of a

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[7] Peter Poole, "Notes from IEEE Convention," March 21, 1968. E.A.T./GRI Box 11, Folder 18.

[8] *E.A.T. News* 1, no. 2 (June 1, 1967). As a postscript in the newsletter states, Klüver, Rauschenberg, and Waldhauer were directly responsible for the contents of this particular issue.

contingent and endlessly forking series of paths. Already in 1967, the organization aimed to generate such nonlinear complexes of subjects and objects:

> "The fact that art and technology are such separate worlds will result in many interesting and stimulating situations. We see as a possibility today that the technical work will become an integrated part of the performance. This opening up of the dynamics of the technical process to the audience will also bring them closer to the engineer's work. There is another aspect of this integration: granted limited time, number of engineers, and money, what will be the most interesting use of this resource? Broadway requires a slick performance that will run flawlessly; they have to spend time and money checking and rechecking simple systems. The opposite would be to introduce as many technical elements as possible without ever spending time and money checking any of them. *All of it may fail.* We can operate anywhere between these two extremes. *The way technology is used does not have to follow historic norms.* What happens in each case is a function of the personalities of the people involved."[9]

E.A.T. augured new contaminations between artist, audience, technology, engineer, and the brave new world of big science.

But big science was not always so big. The proliferation of large-scale research took time. This was mirrored by the spread of communications networks, such as the global telephone system, which was built, cable by cable, across continents and oceans during the twentieth century. And this abstraction of messages, this transmission of signals, paralleled the expansion of markets. This was a shift from a linear grid to a topological network, in which we can no longer think only in terms of Euclidean space but must account for the nonspatial field of information, the non-space of the network.[10]

The spread of big science was, similarly, not a linear progression; it was a nonlinear and exponential transformation. It involved changes in administrative and legal organization, but it also entailed the massive restructuring of experimental procedures, of

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[9] Ibid. Emphasis added.

[10] On the topology of the network, see de Bruyn, "Topological Pathways of Minimalism."

dispersed networks of information, of new kinds of research, new configurations of the laboratory. And large-scale research is irreducible to any one definition. Its growth encompasses many dimensions and entails many different kinds of activities:

> "Big science is big relative not just to what scientists knew before, it is big relative to all science.
>
> The rapid growth of big science in the half century from the 1930s through the 1980s has not occurred without resistance. The life of the experimenter has shifted as experimental practice has been increasingly coordinated with subcontractors, review committees, military demands, and the complex social order of running what amounts to a small scientific community on a single experiment. … the experience of these scientists has been diverse, just as the 'big' in big science connotes expansion on many axes: geographic (in the occupation of science cities or regions), economic (in the sponsorship of major research endeavors now costing on the order of billions of dollars), multidisciplinary (in the necessary coordination of teams from previously distinct fields), multinational (in the coordination of groups with very different research styles and traditions)."[11]

If the twentieth century saw the rise of large-scale research and innovation, this escalation was inseparable from the rise of diversification and new kinds of managerial administration. "[I]n modern industrial nations technological systems tend to expand,"[12] as Thomas Hughes has written—in large part to take advantage not only of economies of scale but of different markets. In this way, two kinds of managerial enterprise emerged before WWI, with General Motors and Du Pont: "…only two basic organizational structures have been used for the management of large industrial enterprises. One is the *centralized, functional departmentalized type* perfected by General Electric and Du Pont before World War I. The other is the *multidivisional, decentralized structure* initially

[11] Galison, "The Many Faces of Big Science," 2.

[12] Hughes argues that this tendency toward expansion is "shown by electric, telephone, radio, weapon, automobile production, and other systems. A major explanation for this growth …. Is the drive for high diversity and load factors and a good economic mix." Hughes, "The Evolution of Large Technical Systems," 71. The "load factor" is the ratio of average output to the maximum output during a specified period—to maximize utilization of a system (i.e., how can an energy company maximize the usage of energy from different sources and at different times?).

developed at General Motors and also at Du Pont in the 1920s. The first has been used primarily by companies producing a single line of goods for one major product or regional market, the second by those manufacturing several lines for a number of product and regional markets."[13] Diversification begets new, multidivisional structures and techniques of industrial management after World War I.[14]

In the 1920s, then, diversification becomes an explicit strategy of growth for industrial corporations.[15] And this new strategy of diversification depends on the growth of research. One conglomerate—whether through corporate mergers or expansion—comes to oversee many different kinds of production. Research divisions were necessary, as Arthur Chandler has shown, "to improve product and process, to develop the new products that might be particularly suitable to their production processes or marketing skills."[16]

Companies had to create separate divisions to handle separate products. The multidivisional structure adopted by General Motors, Du Pont, General Electric, and other technologically advanced industries "institutionalized the strategy of diversification. In doing so, it helped to systematize the processes of technological innovation in the American economy… By the outbreak of World War II, the diversified

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[13] Chandler, *The Visible Hand*, 463; italics author's own. See also Ibid., 459.

[14] Ibid., 464. The techniques developed at GE, Du Pont, and GM spread rapidly in the 1920s, ushering in new accounting, budgeting, and forecasting methods. And this leads as well to the growing professionalization of managers in large industrial enterprises.

[15] Ibid., 466-67. If the management studies of Gilbreth and Taylor around 1911 focused on factory management and production engineering, these analyses beget the study of more general management problems immediately after the war. This was the moment of the formation of business schools, and the discipline of "Industrial Organization."

[16] Ibid., 474. "… this new use for industrial research was first developed in the same industrial groups where the large enterprise had come to cluster by World War I."

industrial enterprises using the divisional organization structure were still few, but they had become the dynamic form of American business enterprise."[17]

This growth exploded during World War II. The conflict famously ushered in a massive expansion in applied science in order to generate technologically complex products demanded by—or finding new uses in—war: radar, synthetic rubber, etc. [476] Along with this expansion in research came the expansion of managerial procedures and controls: "Automation, the computer, and the new materials (such as plastics) increased output of existing large-batch and continuous process plants and factories…Thus, the technological advances in production encouraged the continuing spread of the integrated enterprise."[18] For Chandler, research itself is what augurs diversification, not the other way around: "The obvious rewards of research and development turned more and more integrated enterprises to a strategy of expansion through diversification."[19]

By the 1960s, most industries had adopted this multidivisional structure in both production and research. The military demanded new kinds of hardware and, indeed, new kinds of science. It is no secret that large industry was a juggernaut that would continue long after World War II: "These giant enterprises generated by far the largest share of nongovernment funds and provided most of the nongovernment personnel involved in industrial research and development. These same firms were the prime contractors used by the government in World War II and in the two decades of the cold

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[17] Ibid., 475-476. See also Leonard Reich, *The Making of American Industrial Research: Science and Business at GE and Bell, 1876-1926* (New York: Cambridge University Press, 1985).

[18] Ibid., 478. See also David F. Noble, *Forces of Production: A Social History of Industrial Automation* (New York: Alfred A. Knopf, 1984). I discuss the control revolution in more detail in subsequent chapters.

[19] Chandler, *The Visible Hand*, 479.

war. They were the companies that provided the hardware for its atomic energy and space programs."[20]

The model for these large systems—the original network—was the railroad system of the 19th century, from which the colossal enterprises of the next century sprang. The railroad system created the infrastructure for the transcontinental and transatlantic electrical grid—and, in turn, the efflorescence of transmission networks in the late 1800s. [21] In this germinal moment, the "Research Revolution" of the 19th century also took place: the waning of the scientific societies of the 17th century, which viewed science as gift from God, science as a "sport of nature." After the Industrial Revolution, the notion of research, especially in the natural sciences, began to change society itself. As Kargon and Leslie argue, "Directed scientific endeavor—goal-directed research—became an economic factor to be reckoned with."[22] Science becomes directly useful; science becomes an organized enterprise. The production of science was no longer an act of God but a thing or commodity. Mission-oriented research begins to overtake "pure" research.[23]

New and more specialized areas of study—electrons, X-rays, radioactivity—were beneficiaries of a brief period of philanthropic funding of basic science "so that applied

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[20] Ibid., 483.

[21] On electricity, Edison, and the growth of systems, see: Thomas P. Hughes, *Networks of Power: Electrification in Western Society 1880-1930* (Baltimore: Johns Hopkins University Press, 1983), 18-78. Crary also discusses Edison and the construction of new transmission and communication grids; see Crary, *Suspensions of Perception*, 31-33.

[22] Kargon, Leslie, and Schoenberger, "Far Beyond Big Science: Science Regions and the Organization of Research and Development," 337.

[23] Ibid. See also Reich, *The Making of American Industrial Research: Science and Business at GE and Bell, 1876-1926*; George Wise, *Willis R. Whitney, General Electric, and the Origins of U. S. Industrial Research* (New York: Columbia University Press, 1983).

science could follow in its trail" at the turn of the century. Then corporations such as Bell and GE formed their own internal organizations for the production of research. Universities became involved.[24] The story of modern capital is the story of big science—of specialization, on the one hand, and on the other, the horizontal and vertical expansion of research within and across institutions.

Big science thus tends toward paradox: large technological systems increasingly strive for diversification and decentralization, as outlined above. But at the same time, they also strive for coherence and centralization, even if they do not always achieve it. They are suspended between sweeping expansion and minute specialization, centralized command and profligate dispersion. (Indeed, big research could not exist without big management. As Kargon, Leslie, and Scohenberger have noted, Weinberg's warning about the social costs of big science was apt: "More and more bosses."[25]) On this, the main approaches to the history of technology agree: both the social construction of technology (SCOT), which stresses the role of human actors in technological change, and actor-network theory (ANT), which privileges both human and non-human actants, material things and immaterial concepts, have traced the dual movement toward coherence and complexity in big science. As Thomas Hughes notes, over the course of the twentieth century, centralization often won out:

> "One of the primary characteristics of a system builder is the ability to construct or to force unity from diversity, centralization in the face of pluralism, and coherence from chaos. . . . Over time, technological systems manage increasingly to incorporate environment into the system, thereby eliminating sources of

[24] Kargon, Leslie, and Schoenberger, "Far Beyond Big Science: Science Regions and the Organization of Research and Development," 338.

[25] Ibid., 335. E.A.T. actually invited Weinberg himself to their "Esthetics" symposium and conference for Projects Outside Art in 1970. See Loewen, "Experiments in Art and Technology: A Descriptive History of the Organization," 316-317.

uncertainty, such as a once free market. Perhaps the ideal situation for system control is a closed system that does not feel the environment. In a closed system, or in a system without environment, managers could resort to bureaucracy, routinization, and deskilling to eliminate uncertainty—and freedom."[26]

Bureaucracy, routinization, and deskilling: This extended to the research itself. The burgeoning of big science meant the gradual ebbing of the independent inventor or scientist—that hero of the nineteenth-century Research Revolution—in favor of "conservative invention":

> "To achieve…breakthroughs, the independents had the insight to distance themselves from large organizations. They rightly sensed that the large organization vested in existing technology rarely nurtured inventions that by their nature contributed nothing to the momentum of the organization and even challenged the status quo in the technological world of which the organization was a leading member. Radical inventions often deskill workers, engineers, and managers, wipe out financial investments, and generally stimulate anxiety in large organizations. Large organizations sometimes reject the inventive proposals of the radicals as technically crude and economically risky, but in so doing they are simply acknowledging the character of the new and radical."[27]

Many inventions in large corporations were and are responses to reverse salients—impediments to an already existing system—and are seen as not truly "radical." That is, conservative inventions do not usher in completely new technological systems themselves, as radical inventions do. And "Industrial research laboratories, which proliferated in the first quarter of this century, proved especially effective in conservative invention. The laboratories routinized invention."[28] Carl Duisberg, a director of the chemical/pharmaceutical corporation Bayer before World War I, described the inventions

[26] Hughes, "The Evolution of Large Technological Systems," 52-53.

[27] Ibid., 59.

[28] Ibid., 74.

of industrial research laboratories as having "*Von Gedankenblitz keine Spur*": no trace of a flash of genius.[29]

Early industrial labs picked problems that were seemingly conservative in this way. Bell was no exception. "After the Bell Telephone System in 1907 consolidated its research activities in the Western Electric Company and in American Telephone and Telegraph, its staff of scientists and engineers concentrated on reverse salients that arose out of the decision to build a transcontinental telephone line."[30]

And yet the result was nothing less than a universal network—one of the most profound and sweeping transformations of modernity, on the level of electrification and, today, the Internet: "The design and installation of universal power systems in the 1890s is comparable to the introduction by AT&T a decade or so later of a universal telephone network and is similar to the recent design by computer manufacturers of large interconnections for diverse systems."[31]

The mergers and standardizations of the telephone, auto, and other systems in the twentieth century accompany and abet those systems' vast growth. But this does not mean that they are simply autonomous or determinist technologies unfolding of their own accord, ex machina. Technological systems, even after growth and consolidation, according to Hughes, "do not become autonomous; they acquire *momentum*. They have a mass of technical and organizational components; they possess direction, or goals; and

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[29] Ibid., 74; Henk van den Belt and Arie Rip, "The Nelson-Winter-Dosi Model and Synthetic Dye Chemistry," in Bijker, Hughes, Pinch, and Douglas, eds., *The Social Construction of Technological Systems*, 129-154.

[30] Hughes, "The Evolution of Large Technological Systems," 75.

[31] Ibid., 76.

they display a rate of growth suggesting velocity."[32] And "actor networks," material-semiotic linkages between things and ideas, as defined by Latour and Michel Callon, augment system momentum.[33]

From 1910-30, master system builders at the helm of growing organizations combined expertise from disparate fields. One such leader was none other than Walther Rathenau of AEG; the company famously partnered with Peter Behrens and provided one model for the German Werkbund and, later, the Weimar Bauhaus and its promise of industrial organization. Rathenau was "fascinated by the aesthetics of system building"; and by 1908, when Behrens designed the landmark AEG Turbine Hall, AEG had arguably built the largest European industrial system under centralized organization.[34] Decades later, Bell would outstrip the likes of prewar industrial organizations such as AEG, becoming the epitome of the "mammoth, high-momentum systems" that ruled postwar industry, with massive interconnections of information lines and distribution channels and a core of highly ambitious research and development.[35]

II. Bell Laboratories

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[32] Ibid., italics author's own.

[33] Latour, *Reassembling the Social*; Michel Callon, "Society in the Making: The Study of Technology as a Tool for Sociological Analysis," in Bijker, Hughes, Pinch, and Douglas, eds., *The Social Construction of Technological Systems*, 77-98.

[34] Hughes, "The Evolution of Large Technological Systems," 78; Hughes, *Networks of Power*, 179; on Rathenau and scientific management and industrial rationalization at AEG, see Mauro F. Guillén, *Models of Management: Work, Authority, and Organization in a Comparative Perspective* (Chicago: University of Chicago Press, 1994), 100-103.

[35] "interconnected production lines, processing plants, raw material producers, transportation and materials-handling networks, research and development facilities, and distributors and dealers made up the Ford system. Interconnection of production and distribution into systems with high flow or throughput also took place in the chemical industry early in this century." Hughes, "The Evolution of Large Technical Systems," 79.

Big science, as we have seen, involves patterns of organization that inform scientific method itself. The rise of big science was distinguished by its simultaneous *diversification* and *centralization*: corralling diverse specializations within a complex management structure, hierarchy, and vertical integration of collaborative research groups, even as research spread horizontally via the geographic dispersion of science centers in cities and regions.[36]

At Bell Labs, this conjoining of organizational and scientific process would take a singular form: within the mammoth, high-momentum system of AT&T, a structure that rewarded the routinization and bureaucratization of research, the Labs developed what can only be described as radical invention. More so than any other corporate laboratory in history, Bell begins to break down the distinctions between applied science and pure science. For a brief, extraordinary window of time, Bell Labs pioneers a more open, undirected form of research, one that was not single-mindedly focused on predetermined applications, with research groups ruled less by hierarchy than by unexpected encounters.[37]

The stories of Bell Labs' astonishing string of inventions, discoveries, and innovations in the twentieth century are the stuff of legend. Yet beyond such mythmaking, it is undeniable that the Labs gave rise to a unique crucible of pure research within the mantle of applied research, and that this environment created the conditions for unprecedented scientific breakthrough. The technical revolutions are well known, and

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[36] On the management structures of big science, collaborative research, and hierarchy, see Hevly, "Reflections on Big Science and Big History," in *Big Science*, 356-57; 361. On vertical integration and regional distribution, see Kargon, Leslie, and Schoenberger, "Far Beyond Big Science: Science Regions and the Organization of Research and Development," 334-354.

[37] James B. Fisk, "The Bell Telephone Laboratories," in *The Organisation of Research Establishments*, ed. John Cockroft (Cambridge: Cambridge University Press, 1965), 198-212.

studies in the history science and technology have covered this ground in depth. But it bears reciting that Bell Labs, as part of a corporation dedicated to the production and spread of telephony, went far beyond—developing some of the first and most enduring computer languages, from UNIX, C, to C++; the transistor, without which no personal computer or digital technology or electronic device would exist; the detection of the background radiation of the Big Bang, thus verifying the origin theory of the universe; the satellite; the laser; computer graphics; superconductors; information theory. As studies by Prescott Mabon, Michael Riordan, Lillian Hoddeson, Hendrik Bode, John Pierce, Jeremy Bernstein, Jon Gertner, and others show, Bell created a distinct laboratory culture that allowed thinkers from Claude Shannon (information theory) to William Shockley (the transistor) to Pierce (the satellite) to Klüver to flourish, and to flourish in their interactions with one another.[38] Across all these ideas and advances, so seemingly disparate in kind and so seemingly removed from telephony, it is nevertheless clear that they spiraled out of Bell's corporate charter. For Bell, technology *was* information and communication, both what it produced and how it was produced.

AT&T's mission was universal connectivity. Formalized as Bell Telephone Company in 1875, shortly after Alexander Graham Bell had invented the telephone system, the firm created the first nationwide long-distance network in 1880, incorporating as American Telephone and Telegraph Company that year; they dubbed the system "AT&T Long Lines." The network was built on length and domination: Ma Bell, as the company came to be known, was a monopoly for nearly one hundred years. Its Bell

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[38] Prescott C. Mabon, *Mission Communications: The Story of Bell Laboratories* (Murray Hill, NJ: Bell Telephone Laboratories, 1975); Jeremy Bernstein, *Three Degrees Above Zero: Bell Laboratories in the Information Age* (London: Cambridge University Press, 1987); Jon Gertner, *The Idea Factory: Bell Labs and the Great Age of American Innovation* (New York: Penguin, 2012).

System controlled the phone system throughout the US and Canada throughout the better part of the twentieth century. The system was not broken up until 1982, initiated in 1974 by the US Justice Department filing an anti-trust lawsuit against AT&T. Until divestiture, Bell *owned the network.*

And the network begat Bell Labs, hailed as "the world's greatest industrial laboratory."[39] Western Electric Company, owned by AT&T, incorporated its engineering department as Bell Telephone Laboratories in New York in 1925. Almost a decade later, the Development and Research Department of AT&T merged with Bell Laboratories, and moved to Murray Hill, New Jersey, in 1941 [Fig. 4.2].[40] The physicist Frank B. Jewett, the first president of Bell, envisioned a new model of scientific research in industry, of basic science practiced in the context of applied science. Moreover, he pioneered the idea that a kind of critical mass could be achieved by research at a large scale. In a 1932 essay titled "Modern Research Organizations and the American Patent System," Jewett claimed that a real laboratory could go beyond primitive experimentation and launch "an aggregate of creative force on any particular problem which is *infinitely greater* than any force which can be conceived as residing in the intellectual capacity of an individual."[41] Infinitely greater than the individual: this was the model for modern research,

[39] Francis Bello, "The World's Greatest Industrial Laboratory," *Fortune* 58 (November 1958): 214.

[40] See Reich, *The Making of American Industrial Research: Science and Business at GE and Bell, 1876-1926*; Mabon, *Mission Communications: The Story of Bell Laboratories*; Hendrik W. Bode, *Synergy: Technical Integration and Technological Innovation in the Bell System* (Murray Hill, NJ: Bell Telephone Laboratories, 1971).

[41] Frank Jewett, *Modern Research Organizations and the American Patent System* (New York: Bell Telephone Laboratories Incorporated, 1932), 1-9. See also Gertner, *The Idea Factory*, 343; Bernstein, *Three Degrees Above Zero*, 8. Emphasis added.

multiplying in “aggregate force”—and gaining this force via the resources of an industry predicated precisely on building the largest network in the world.

The sheer scale and force were remarkable: in the 1940s, the Labs had nearly 6000 researchers, of which more than a third were Ph.D.’s; the total number climbed to 17,000 by the mid-1970s.[42] Prior to divestiture, seven Nobel Prizes and countless patents had been awarded to Bell researchers. That something beyond the ordinary scope of industrial research—something strange, something unorthodox—was taking place was evident. In 1950, Mervin J. Kelly, president from 1951-59, went so far as to call Bell Labs an “Institute of Creative Technology.”[43] Science and technology have long been in tension—and their fraught relationship endlessly chronicled. But at Bell, a distinctive relation between science and technology—between basic research and specialized research, pure and applied—arose. From the anechoic chamber to the mainframe computer, the laboratory became a site of unprecedented resources *and* unprecedented latitude [Fig. 4.3]. Bell Labs paradoxically realized basic research—free, undirected, “creative”—with the magnitude of applied research, and within one of the most immense corporate-industrial networks of its time.

III. A solution without a problem

John Pierce was one of the most creative, and polymathic, of Bell’s researchers [Fig. 4.4]. I have detailed his incredible support of Klüver and E.A.T., but Pierce is far better known for developing the first satellite telecommunications technology—which

[42] Ernest Braun and Stuart MacDonald, *Revolution in Miniature: The History and Impact of Semiconductor Electronics*, 2nd edition (Cambridge: Cambridge University Press, 1982), 33.

[43] Mervin J. Kelly, “The Bell Telephone Laboratories—An Example of an Institute for Creative Technology,” *Proceedings of the Royal Society A* 203, no. 1074 (October 10, 1950): 287-301.

makes everything from television to wireless to GPS possible today.[44] He was perhaps the first to propose a "passive," reflective inflatable structure, which would become the model for Echo I, the first satellite (launched in 1960), on which Pierce would then work; and developed Telstar, which relayed the first satellite telephone and television communications in 1962.[45] These would, as we will see, provide direct structural and material models for E.A.T.'s Pepsi Pavilion. The Telstar test involved the largest inflatable structure in the world at the time (in Maine). And such watershed technology was immediately implicated in the space race and in national defense. The Communications Satellite Act of 1962—which created a new communications corporation, COMSAT—ultimately took global satellite research, and control of commercial satellite communications, away from AT&T, rendering telecommunications under the purview of the government and NASA.[46]

Pierce was not only celebrated for the satellite, however. As Director of Research in Communications, he had an unusually wide berth. He was also a pioneer in computer music and signal processing, and I have detailed his personal interest in Cage, Tudor, and experimental sound. He was a foundational figure for E.A.T., nurturing, in particular, E.A.T.'s explorations in sound and digital music along with the other legendary computer music paterfamilias, his Bell colleague Max Mathews [Fig. 4.5]. Mathews had joined

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[44] Among other texts, Pierce published the popular book *An Introduction to Information Theory: Symbols, Signals and Noise* (New York: Harper, 1961), which I have cited in Chapters 1 and 2.

[45] Mabon, *Mission Communications*, 71, 176; John R. Pierce, "Orbital Radio Relays," *Jet Propulsion* 25 (April 1955): 153-157.

[46] On COMSAT, see Harvey J. Levin, "Organization and Control of Communications Satellites," *University of Pennsylvania Law Review* 113, no. 3 (January 1965): 315-357; see also Gertner, *The Idea Factory*, 224.

Bell after being a radar repairman, then school at Caltech and MIT; he began to work on the compression, encoding, and transmission of speech. Meeting Pierce was a catalyst:

> "I also was very lucky that I had a boss who was very smart, very famous, very lucky, and very powerful. His name was John Pierce, and he's best known for the invention of, or the propagation of, communication satellites. Pierce was very interested in music. He was interested in information theory, how much information there is in speech—which is a good question [to answer in order] to know how to compress speech, and how much information there is in music. He himself liked to play the piano and to compose pieces. He invited me to many concerts, and we went together. At one of these, a local pianist played some [Arnold] Schoenberg, which was very good, we thought, and some [Karl] Schnabel, which we detested. In the intermission, John suggested to me that perhaps the computer could do better than this, and that since I had the equipment to convert computer-digitized tapes into sound, I could write a program to perform music on the computer."[47]

From 1957 on, with Pierce and Mathews in key roles, Bell was at the forefront of audio sampling, which is the foundation for converting any sound into digital information. Mathews (with Joan E. Mitchell) developed the programming language MUSIC, which included the first software noise generator. In 1961, Mathews used MUSIC III to make "the first computer sing," as it became it known, programming the IBM 7090 to belt out the popular tune "Daisy Bell."[48]

Pierce and Mathews also brought in a range of artists, composers, and non-engineers into Bell, people who otherwise would have no access to mainframe computers, or to the panoply of different minds and fields at Bell. Pierce, for example, hired the artist James Tenney to take up residence at Bell in 1961, well before E.A.T. This was, as Mathews described it, "a dual experiment—an experiment by Bell Labs, to

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[47] Tae Hong Park, "An Interview with Max Mathews," *Computer Music Journal* 33, no. 3 (Fall 2009): 9-22; 10.

[48] Max V. Mathews, Joan E. Miller, F. R. Moore, John R. Pierce and J. C. Risset, *The Technology of Computer Music* (Cambridge, MA: MIT Press, 1969); Max V. Mathews, "The Digital Computer as a Musical Instrument," *Science*, (November 1963): 553-557.

see what a composer would do with our sound programs, and an experiment for Tenney, to see if he could stand the computer." (Tenney was a student of Lejaren Hiller—and the partner of Carolee Schneemann; Pierce met Tenney through Hiller, who himself would go on to work with E.A.T. on the Pepsi Pavilion, and had already been in the circle of Cage and Tudor.) In 1961, Tenney worked with Mathews on digital noise synthesis using the IBM 7090 as well.[49] Another computer music engineer, Ted Wolff, worked with artist Max Neuhaus on sound pieces such as the transistor-radio work *Max-Feed*, 1966, and with Michael Snow, La Monte Young, and others [Fig. 4.6].[50] These were incredible examples of Bell Labs's exploratory and eccentric verve, and an origin point for the entire model of art-engineer collaborations and of E.A.T. itself.[51]

In a captivating essay for *TECHNE*, "Computer Composers: Comments and Case Histories," Mathews outlined some of the early experiments in computer music at Bell—by composers, performers, mathematicians, physicists—and the unique environment that gave rise to such experiments.[52] The new level of processing power of computers allowed exploration of new sounds and new music.

Enumerating the "phases" that musicians go through "when they first comprehend that a computer is a musical instrument": first, "complete disbelief—like the man who

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[49] Curtis Roads, *Composing Electronic Music: A New Aesthetic* (Oxford: Oxford University Press, 2015), 93-94; 101.

[50] Theodore Wolff, "Proposal for sound-modulated light sculpture," n.d. E.A.T./GRI Box 6, Folder 35. See also Max Neuhaus, "*Max-Feed*," project description, n.d. E.A.T./GRI Box 6, Folder 24.

[51] Max V. Mathews, "Computer Composers: Comments and Case Histories," *TECHNE* 1, no. 2 (November 6, 1970): 10-11.

[52] Ibid., 10.

feels the noose on the scaffold and can' believe that it is happening to him."[53] The next is "panic": "This is the end of all art. This machine is doing in everything that I value. We are succumbing to a mechanical monstrosity. The human being has abdicated his rights, the machine is now in the ascendancy." Then comes "a period of long hard work in mastering a new medium." After a few years of hard work lies "Existential Nausea": "The composer at last realizes that the new technology does not solve his most difficult problem—the fundamental problem [of] what to compose, or what he is trying to say.

Mathews's wry, perceptive text lays bare the anxieties surrounding the effect of technology on art—anxieties surrounding deskilling, dehumanization, composition, meaning. Yet for Mathews, the endgame is no humanist recuperation of technology or easy rapport with it. "At this point…the composer finds that he has become completely trapped. And so, for that matter, are all his contemporaries, whether they have chosen his route or not. They are unable to reject the new technology without becoming anachronisms. There is no turning back to the past. The technical world has inflicted itself upon them."[54]

But this point of no return would yield other paths, new directions. At Bell, Tenney explored random number generators and sound composition. John Chowning played with the high-power computer at Bell and went on to get a music program to run on a computer designed for artificial intelligence experiments—"an impossible task," according to Mathews. ("Chowning was not an expert programmer at the beginning—he was an expert drummer. What he did to succeed, I don't know. It may have been his

[53] Ibid.

[54] Ibid.

charm."[55]) He also experimented with changing position of sounds relative to multi-channel speaker systems, introducing "an entirely new dimension to music—that of motion of the sound source." Jean-Claude Risset studied instrumental tones, and used the computer to synthesize tones that were indistinguishable from the real tones—a breakthrough in the analysis and synthesis of sound.

In this riveting environment, thinkers in completely different fields *talked to each other*. As Mathews put it,

> "[W]e had experts in various fields in physics and chemistry and mathematics, and they were all willing to listen and talk to each other and spend enough time listening to understand the question that someone from another field might have and possibly, if they got interested, to actually help that other person solve the question. … When I changed to a university job, I've been sort of disappointed that the interactions between real experts in various fields are much more limited … I always felt that my job was to try to recruit people who seemed both very smart and who seemed interested in problems that were broadly related to the work of the Bell System communications."[56]

But "broadly" could mean anything from researching the ear and cortex of the brain to anarchically aleatoric music. Mathews's role leading the Behavioral and Acoustical Research division was, he said, that of simply finding exceptionally smart people and then "letting them alone to do their thing."[57] Bell also essentially invented the field of computer graphics. A number of the engineers I have mentioned—Leon Harmon, A. Michael Noll, and Kenneth Knowlton of the *Computer Nude*—worked with artists such

[55] Mathews, "Computer Composers: Comments and Case Histories," 10.

[56] Tae Hong Park, "An Interview with Max Mathews," 14-15.

[57] Ibid., 15.

as Lillian Schwartz on the first graphical scanners and plotters (an early form of printing) that would convert code into image.[58]

Collaborative research is, as we have seen, a defining characteristic of big science in general. Working environments that are highly "populous" forge "large, long-term experimental collaborations," as Bruce Hevly argues—collaborations that have indelibly changed how individuals contribute to the production of new knowledge.[59] Scientific concepts themselves "have undergone a complex social history *before ever emerging from the laboratory*": "The coordination and management of research, the sharing of key instruments, the preparing of reports and proposals for funding agencies, and the division of labor among those designing, building, and interpreting instruments and experiments all complicated the production of knowledge."[60] But even within this broader scenario of collaborative research, Bell Labs went a step farther. There, sharing and exchange and division of labor often exceeded their coordination and management. The likes of Pierce and Mathews were letting researchers alone "to do their thing." Bell created a highly distinctive institutional context: a remarkable social situation of open-ended thought and communication, one that has never quite existed anywhere since. These were not organization men, faceless, inward-looking; they represented a new form of collaborative

[58]A. Michael Noll, "Early Digital Computer Art at Bell Telephone Laboratories, Incorporated," *Leonardo* 49, No. 1 (2016): 55-65. See also Caroline Kane, "Digital Art and Experimental Color Systems at Bell Laboratories, 1965–1984: Restoring Interdisciplinary Innovations to Media History," *Leonardo* 43, No. 1 (February 2010): 53-58; Zabet Patterson, *Peripheral Vision: Bell Labs, The S-C 4020, and the Origins of Computer Art* (Cambridge, MA: MIT Press, 2015); Rebekah Rutkoff, "Painting by Numbers: The Art of Lillian Schwartz," *Artforum International* 55, no. 2 (October 2016): 238-245.

[59] Hevly, "Big Science and Big History," 361.

[60] Ibid. Emphasis added.

exchange.[61] And this collaboration across disparate fields, across seemingly incommensurate epistemologies and languages, was enabled in every way by *size*: by the multiplicity of people, but also by the increase in memory and power of the computer, and, finally, by the "Long Lines" of Bell—the rampant spread of the network.

The dream of universal connectivity also fed into the aim of merging of all electronic transmission and data into one device. Indeed, we can trace the idea of mobile communication—so integral to the concepts of *9 Evenings* and E.A.T., of remote control and action at a distance—to Pierce's own research. Even Bell's research into the transmission of images over the phone—resulting in the Picturephone, one of Bell's rare commercial failures—pointed to this realm of speculation.[62] Despite these dead ends, others would prove transformative. Bell researchers invented the charge-coupled device, which could convert an electrical signal into digital information—the foundation of digital photography (and of surveillance imaging).[63] The exploration of connectivity appeared to reach into every and all corners of experience and knowledge. The scope of research at Bell Labs was seemingly boundless.

A network's strength derives from its magnitude. Bell both inaugurated and enacted this principle. As Pierce and Shannon called it, the Bell System was "the largest

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[61] See William H. Whyte, *The Organization Man* (New York: Simon and Schuster, 1956).

[62] On Pierce, the mobile phone, and the Picturephone, see Gertner, *The Idea Factory*, 274. The product of long-term research into the transmission of images via telephony, the Picturephone was launched at the 1964 Worlds Fair, and by 1968, AT&T was betting on its success. But consumers did not take, and the Picturephone was a failure at the time.

[63] These technologies, too, were implicated in national defense systems from the start. In 1957, Pierce and Shannon were enlisted as part of an advisory committee for the NSA (then-secret) on conversion of information into intelligence and encryption. James Bamford, *The Puzzle Palace* (New York: Penguin, 1983), 429.

and most complex machine ever built."[64] The mode of innovation there produced devices that make use of many different technologies, which were developed at different times and often *without purpose* at the time. For example, the cellular phone, integrated circuits, fiber optics, and the satellite all fall under this rubric.[65]

In 1962, the Labs moved a large part of its operations from Murray Hill into a new building designed by Eero Saarinen in Holmdel, New Jersey—a staggering edifice of mirrored glass with an enormous open atrium inside. By then, the staff of researchers had grown to 13,000.[66] Holmdel was not as dense as Murray Hill, however, and the tightly packed warrens of the older complex, designed by Voorhees, Walker, Foley & Smith in 1937-49, had actually intensified its signature "huge mass of diverse specialists who interact closely."[67] Basic research remained centered at Murray Hill, while more specialized research—much of it now aligned with the new field of computer science—took place at Holmdel. In contrast to Holmdel's infinitely flexible glass matrix, Murray Hill was an "immense beehive," as one journalist called it.[68] Even decades later, in the 1980s, "[Murray Hill] houses 3,049 researchers, developers, and support staff along

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[64] Gertner, *The Idea Factory*, 282.

[65] Ibid., 282-283.

[66] Ibid., 276.

[67] Gene Bylinsky, "THE NEW LOOK AT AMERICA'S TOP LAB: How has Bell Labs weathered the breakup of AT&T? Surprisingly well. Basic research still thrives, but there's a new emphasis on applying it to products," *Fortune*, February 1, 1988. [http://archive.fortune.com/magazines/fortune/fortune_archive/1988/02/01/70146/index.htm, accessed August 1, 2016.]

[68] Ibid. Bylinsky's article underscored the continuing commitment to basic science at Bell: "Since AT&T views basic science as a competitive tool, the scope of research at Bell remains wider than at most other industrial labs and even some universities. The staff includes 3,430 Ph.D.s—more than the total research staff of the closest rival corporate lab, at IBM (see box). They and the other scientists are spread among physics, chemistry, computer science, mathematics, electronics, and sundry fields. Bell Labs' method has always been to assemble a huge mass of diverse specialists who interact closely."

quarter-mile-long corridors lined with hundreds of small labs crammed with the latest instruments. The physics research division alone employs 250; it's larger and more diverse than most university physics departments." This density, most acutely at Murray Hill and in the formative years of the late 1950s to early 1960s, combined mass and interaction.[69] And as Gertner has argued, it was not just the size of the laboratory but the interface between disciplines, between fundamental science and applied science, that spawned innovation.[70] This bespoke a central irony: monopoly was what actually allowed free research, research that might produce paradigm-shifting invention and innovation. And research could be supported for years. Bell's dominance and omnipotence as a corporation and communications network allowed it to foment a diversity of ideas and the time to dwell on them, under the aegis of a completely controlled market.

Monopoly also allowed *long-range* research at Bell. (Pierce and Noll themselves deemed this the main factor in Bell's success.[71]) If technological development is usually traced along four stages—discovery, invention, innovation, and diffusion—these stages had an unusually long metastasization period at Bell, as Gertner argues. For example, as Hoddeson, Riordan, Gertner, and others have shown, once the transistor was invented and developed for larger production, Bell simply distributed it—for free. They could do this

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[69] Reinhold Martin has shown that the flexibility of free research in the postwar period demanded flexible architecture, such as Saarinen's Holmdel site; Murray Hill preceding and anticipating certain features of interactivity and flexibility (here I would go further than Martin), which Saarinen aimed to take to the next level in Holmdel itself. See Martin, *The Organizational Complex*, 186.

[70] Gertner, *The Idea Factory*, 336.

[71] John R. Pierce and A. Michael Noll, *Signals: The Science of Telecommunications* (New York: Scientific American Library, 1990).

because of their monopoly status, and the free distribution actually fulfilled AT&T's aim of enhancing its own status, its scientific merit, its service to the greater good.[72]

Bell's size also created the conditions of possibility for Pierce to allow Klüver and so many other researchers to begin to pursue E.A.T. in their *free time***.** The notion of granting researchers a certain amount of time for pure exploration of anything they liked had been circulating in R&D since the war. "Free rather than directed research" had been deemed the mission of the Office of Naval Research, progenitor of the National Science Foundation, following Vannevar Bush's groundbreaking arguments for the value of basic research to military research.[73]

3M had cemented the practice by instituting its famous "15 percent time" in 1948—echoed in Klüver's signal refrain, to which I have repeatedly returned, that an engineer who was not failing 96 percent of the time was not doing his job.[74] 15 percent time led to such innovations as the Post-It Note; beyond such mundane products, it has become firmly entrenched in the innovation culture of Silicon Valley. Today, Google researchers' "20 percent time" has led to the development of Gmail and Google Earth.

But rather than draw a simplistic logic of progress from sticky notes to online maps, I want to note the idiosyncrasy of the practice of free time at Bell. Protected by monopoly, Bell's efflorescence of free research went far beyond that of 3M or IBM or the

[72] Gertner, 113. See also Jack A. Morton, Bell Laboratories, "The Innovation Process," n.d. AT&T Archives.

[73] Edwards, *The Closed World*, 59-60, 380 n. 39. See also Vannevar Bush, US Office of Scientific Research and Development, *Science, the Endless Frontier: A Report to the President* (Washington, D.C.: US Government Printing Office, 1945).

[74] On 3M and the "15 percent rule," see Paul D. Kretkowski, "The 15 Percent Solution," *Wired*, January 1988; and http://solutions.3m.com/wps/portal/3M/en_US/3M-Company/Information/Resources/History/, accessed August 7, 2016. As a recent headline ecstatically put it: "Why Top Innovators Make Time to Waste Time." See Jason Gots, http://bigthink.com/humanizing-technology/why-top-innovators-like-3m-make-time-to-waste-time, accessed August 7, 2016.

beginnings of undirected research in wartime. Pierce's own wide-ranging interests—but also his canny sense of allowing a "release valve" for his employees, as I have described—represented the apex of a postwar notion of free thought that would, by virtue of its very *in*applicability to industry, eventually pay off. This commitment to the large-scale in the long-term is what allowed so many Bell engineers to deviate from the main program. It was only at Bell, after all, that engineers launched a large-scale collaboration outside the institution, with art. The conditions of the laboratory allowed these researchers—from Klüver to Kogelnik (a pioneer in fiber optics and in the development of applications of the laser [after its invention by Charles Townes of Bell]); Biorn; Mathews; Knowlton and Noll; Robinson; Hodges; Coker; Kieronski, and countless others—to experiment with Experiments in Art and Technology.

Pierce would go on to make the case for E.A.T. as an outgrowth of such free time, not only stimulating "new ways of doing things" but "new products." In his remarks for the first press conference at Rauschenberg's studio in 1967, he laid out the argument for a new kind of research:

> "Industry traditionally gives money to local causes in fulfilling a social obligation. Industry frequently gives the time of its employees as experts and consultants to aid the government in problems of defense, health, education, etc. Industry supports education through funds and manpower, partly as a social obligation, and partly as a means of shaping higher education so as to effectively fill its needs for trained manpower. In all of these services, industry benefits through its contacts with non-industrial circles, both in making the nature and problems of industry known and in intellectual stimulation of industry in tackling its problems freshly and creatively. Except on the most applied commercial, and generally unimaginative level, industry has not had profitable contact with the arts. We wish to establish a meaningful interaction between technology and art. We argue for this on grounds of both social obligation and mutual benefit. Such an interchange will call for both money and the time of scientists and engineers. Just as public money is available for science and technology, so public money is becoming available for the arts. But the skilled scientists and engineers and their technological tools are in industry. Certainly, the arts have much to gain from

> industry. We believe that industry has much to gain from the arts, not only in public image, but also in intellectual stimulation toward new products and new ways of doing things."[75]

Pierce's vision of E.A.T. was as an irruption of Bell innovation outside of Bell. But could the Labs' corridors be turned inside out, as it were? Could its exceptional models of research and thought and experimentation be dispersed, disseminated, through other channels?

The network thrives on expansion. It doesn't mean anything if there's no one on the other end of the line. And as Galison has eloquently argued, the network's expansion is predicated on decentering. None other than AT&T is the genesis of this decentralization, of "war against the center": the decentralization of the telecommunications network made it a powerful military deterrent in the advent of postwar defense systems.[76] AT&T's Annual Report of 1958 made the case for a new strategy of "defense by communications," "building communications for a strong defense": "new telephone routes bypass critical areas to insure that essential nationwide communication will be maintained in case of disaster."[77] AT&T mapped out how to route telephone lines *around* major cities in case of destruction. This complemented Bell Telephone's 1957 construction of the Distant Early Warning Line, a radar system

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[75] J.R. Pierce, "Statement," in "Preparatory documents for first 'official' meeting in 1967, October 1967." E.A.T./GRI Box 11, Folder 1. Pierce concludes: "The purpose of the foundation is to encourage, bring about, smooth and maintain profitable interaction by workers in the arts and in technology. In doing this the foundation must have the funds and organization to work with leaders in industry and in public bodies as well as with individual artists and engineers. And, it must be in a position to foster and to help the artists to exploit the new resources which come into being through the interactions it helps to establish."

[76] Galison, "War Against the Center," 196-227.

[77] American Telegraph and Telephone Corporation, *AT&T Corporation Annual Report* (1958), inside front cover.

stretching from Alaska to Greenland for the early detection of a missile attack.[78] Dispersion and distribution *were* defense. Unlike any other entity at the time, the Bell System's very existence and purpose depended on decentering. And yet its research was literally centered in the laboratories in Murray Hill and then Holmdel. Bell demonstrated the extraordinary possibilities of decentralization. Pierce, Klüver, and E.A.T. can be seen to follow what Adorno called "a tendency to expand": they wondered whether horizontal decentralization and expansion were possible beyond even the biggest network in the world.

IV. Local Groups

E.A.T. learned from Bell. It, too, aimed at vast mass and momentum and connectivity, a "universal network." As the ranks of the group grew, its own literature increasingly emphasized the importance of an information network. Plainly stated in E.A.T.'s Ford Foundation Proposal, the *organization was becoming a network*:

> "During the past two years we have allowed the structure of the organization to evolve on the basis of the experience gained from our activities and personal contacts with artists, engineers, scientists, and members of industry and labor who are active in E.A.T. *The organization is now emerging as a network* which will incorporate the latest communication and computer technology to provide the individual artist with access to the fullest range of information, materials and opportunities to participate in projects. We feel this network can serve as an experimental model of the more general way any individual could in the future use his professional capacities and personal energies to work and study in a variety of fields."[79]

In an issue of *E.A.T. Proceedings* that accompanied the Ford proposal, the group proclaimed: "Experiments in Art and Technology is an international network of

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[78] *The DEW Line Story* (New York: Western Electric Company, 1958), informational brochure.

[79] E.A.T., "Ford Proposal—Version 2: Complete copies—May 19, 1969." E.A.T./GRI Box 42, Folder 15. Emphasis added.

experimental services and activities…The aim of the network is to create possibilities for mutual contact between individuals in a live, responsive society."[80]

At the same time, E.A.T. began to use the term *growth* over and over, in numerous charts, tables, and graphs that traced the group's projected expansion.[81] According to E.A.T.'s records, in October 1967, artist members totaled 300; engineers 75.[82] By November 1967, artist members grew to 400.[83] In 1968, the engineers who were deemed "active" and available to be contacted for matchings numbered 391—a subset of 1560 total engineer members; 129 matchings were made. In the first quarter of 1969, that roster of participating engineer contacts had grown to 453; as cited above, 119 matchings were made.[84]

Something else comes to light in these charts. One graphic notes:

Table 1. Geographical distribution of participating technical membership[85]

	NYC	50 mi. NYC	Elsewhere	Total
1968	153	140	247	540
1st quarter 1969	43	37	96	176

[80] "Experiments in Art and Technology: A Summary," *E.A.T. Proceedings* 9 (May 19, 1969): 1.

[81] E.A.T., "Ford Proposal—Version 2: Complete copies—May 19, 1969" appendix, 1-5. E.A.T./GRI Box 42, Folder 15.

[82] Ibid., 1-5; *E.A.T. News* 1, no. 2 (June 1, 1967).

[83] *E.A.T. News* 1, no. 3 (Nov. 1, 1967).

[84] E.A.T., "Data," n.d. E.A.T./GRI Box 9, Folder 3.

[85] E.A.T., "Data," n.d., E.A.T./GRI Box 9, Folder 3.

The majority of matchings are now taking place *outside* New York. Geographic distribution becomes key to the aims of the organization. *Like big science, E.A.T. aimed at the dispersion of participants and projects, across space but also across fields of inquiry.* But *unlike* big science, E.A.T. struggled against a vertical hierarchy that would unify and consolidate its research.

In late 1968, E.A.T. discontinued its newsletter, and began a new publication, *E.A.T. Operations and Information*. The first issue, of Nov. 1, 1968, pronounced: "The artist membership of E.A.T. has now passed 2,000; the flow of requests for artists, from industry and institutions, is beginning to increase rapidly. It is impossible to continue dealing with everyone on an impartial and impersonal basis unless we have more specific information about the work of all those artists who wish to be considered for such requests." [86] It continued: "National groups are in the process of being set up."

And so E.A.T. began to diversify: The group decided to branch out into "Local Groups," spin-off chapters of E.A.T. in cities around the world. Already in 1967, they had begun to think of radically extending "action at a distance," proposing a move from "large-scale performances," as they dubbed *9 Evenings*, to growth via local groups. In 1969, E.A.T. structured their major application for funding from the Ford Foundation around "Growth"—and, specifically, the growth of the Technical Services Program through local groups. The proposal recounted: "The interest in E.A.T. from outside the New York area grew steadily. In May 1967 we decided not to confine our activities to New York but become a national organization. We encouraged local groups to be

[86] *E.A.T. Operations and Information*, no. 1 (Nov. 1, 1968): 5.

organized where interested artists and engineers felt a need for one. By the end of 1967, local groups had begun in 16 places in the United States and abroad."[87]

The rate of growth continued to increase. And E.A.T.'s language began to emphasize the tentacular reach of the organization, the open-endedness of its connections: "Services in the network are not terminal but catalytic and experimental."[88] Nearly twenty active Local Groups would be formed. E.A.T. documented the expansion plan, beginning in 1967:

> "…Local Groups
> It was decided in May 1967 to extend the activities of E.A.T. outside the New York area and encourage local groups in any area that wanted them. At the time of the Newsletter in June, there were 6 local group representatives active in their areas. E.A.T. activities were initiated in Sweden in the Summer of 1967. By December, 16 people in different cities had expressed interest in forming E.A.T. groups. In February 1968, a letter was sent to all members announcing the formation of groups, suggesting procedures for initiating activities in their areas, and asking anyone interested to act as local representative. By March 1, there were 35 local representatives and during the spring, Julie Martin, Francis Mason and Billy Kluver traveled to the first public meetings of different local groups to inform them of the activities of the New York office and to help stimulate local activities."[89]

On June 22-23, 1968, a conference was held for "local groups representatives and other people interested in setting up the national organization of E.A.T." at the E.A.T. loft in Manhattan; "53 people attended, representing 21 areas."[90] Speakers ranged from Haacke to Burnham to Louis Gerstman, a professor of psychology at Queens College who had worked at Bell Labs and co-invented the first computer program to produce

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[87] E.A.T., "Ford Proposal—Version 2: Complete copies—May 19, 1969." E.A.T./GRI Box 42, Folder 15.

[88] *E.A.T. Proceedings* no. 9 (May 19, 1969): 7.

[89] E.A.T., "Ford Proposal—Version 2: Complete copies—May 19, 1969." E.A.T./GRI Box 42, Folder 15.

[90] Ibid.

artificial speech; Jonas Mekas, Douglas Davis, and others went as well.[91] Klüver's address to the attendants made a direct link between growth and diversification, and it is worth quoting at length:

> "[T]he general position of E.A.T. is that there has been steady growth, organic growth … One of the most telling aspects has been an interest from all over the country and from all over the world. One reason that we have been able to move so slow [sic] is that we are overwhelmed by letters, telephone calls from people who are interested. It became clear in January that we had to do something. Either we would have to stick within the limits of Manhattan and return all the other letters, or we would have to organize on a national basis. And, as usually happens, decisions are made between 11:30 and 12:00 at night. Paul suggested, 'Well, what do the churches do?' or 'the labor unions?' The idea to create local groups which were as autonomous and corresponded to local needs and ideas came up. As a result of that idea we got over forty people that wanted to start local groups in America, Europe and everywhere.
>
> So Francis [Mason] and I have been traveling the country side to see many of you in other groups to deal with the loyalty and enthusiasm. The letters keep coming and telephone lines are always busy. Now we are at a point where we can actually sit down and say, 'OK, we've got all this interest of at least 20,000 people who know about EAT., what shall we do?' We get interest from universities, engineering societies, national science foundation, and even scientific establishments. Of course the art world is where it all comes from. But we never thought we would get involved with the universities.
>
> We still have the same problems however…I believe the more eloquent and interesting way of solving this would be to establish a national organization where we have full-fledged E.A.T. groups using our name, tax exemption, what have you, in the various cities (about five or six) across the United States. They could be associated groups, not so formalized in other areas. There are of course other groups who are interested in the same subject that might want to be associated with us. So, I think that here we all agree that the nicest solution would be for E.A.T. to become a full-fledged national organization. We have the people, ideas, and we are on the right side of the tracks. However, this implies certain things. One, we must be able to operate here in New York and we must be able to sustain a yearly budget of between 200 and 250 thousand dollars which is what the minimum cost is to handle the daily flow of information. One of the implications of the national organization is that we will have many ideas and exhibitions to cope with. There are many possibilities of generating national projects which would actually go like waves across the country. They don't necessarily have to be shows or exhibitions in the normal sense, it could be people concentrating on computer or television or some material like our idea of the light

[91] Letter from Francis Mason to Jack Burnham, June 27, 1968. E.A.T./GRI Box 30, Folder 31.

sounds which was suggested. In this way E.A.T. would be involved in situations on a local level.

> …My final point is that…each community has its capacities and possibilities which are inherent to that particular area. This is due to geographical locations and the way industry is distributed and the type of people who live there and so on. Each area is also deficient in something and let me make it clear that Manhattan is no exception. We've got four or five thousand artists, but we haven't got the industry, and we haven't got the engineers, nor the facilities to put up large projects as other areas across the country do have. This means that one can foresee the possibilities of collaboration where the whole idea of this type of activity becomes *decentralized*. This is inherent in the use of technology anywhere."[92]

Despite this rhetoric of decentralization, the initial plan more closely resembled the familiar top-down hierarchy of big science. Diversity was contained by centralization. A memorandum from February 1968 outlines a policy on the organization of local groups:

> "The majority of applications for E.A.T. membership come from outside the New York City area. It has long been clear to us that Local Groups must be established for E.A.T. to function most effectively all over the country. This memorandum contains suggestions for establishing such Local Groups and possible activities that such groups can use to take advantage of local opportunities."[93]

The group goes to great pains to establish protocols for organization, describing how local representatives should convene meetings, set up administration ("an administrator and secretary" were recommended!), solicit finances, and find members:

> "Organization.
>
> The local representative should call a meeting of local artists and engineers. E.A.T. will provide the names of the local artists and engineers who have written us. Based on this local support a loose organization can be established with an administrator and a secretary. Financing for this local administration should come from local sources. State Councils on the Arts can be a source for initial administrative funds.

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[92] Billy Klüver, "Address to Local Groups Conference," audio transcript, 6/22-6/23, 1968. E.A.T./GRI Tape 1, Box 30, Folder 35.

[93] "Experiments in Art and Technology, Incorporated: Local Groups," memorandum, February 1968. E.A.T./GRI Box 29, Folder 1.

> Local Groups can generate engineer members from local industry and engineering faculties in nearby schools and colleges. Methods of making contact with engineers include: direct mailings through the local chapters of engineering societies; stories in local press and industry house organs; well-publicized general meetings; recruiting and giving talks at local technical and scientific conventions; and personal contacts.
>
> Bringing artists and engineers together to work on projects is a very important part of the process. A formal matching procedure can be instituted. However more informal methods may be effective, for example, weekly open houses where artists and engineers meet informally and do their own 'matching.'"[94]

The plan makes clear why E.A.T. wants to diversify: "Local situations provide unique opportunities for raising funds and initiating projects."[95] *Diversification meant site-specificity.* It would allow each satellite group to take advantage of specific local resources and industries. It would allow experimentation across new areas and specializations. The group called on artists to utilize their ties to universities and schools; to engineering faculties; and to local industrial laboratories and technical libraries. They might help members borrow equipment, get credit for loans, act as guarantors; engineer members were to persuade industrial laboratories to allow artists access. The groups were to act as *conduits* rather than as sources of technology; in order to "stay flexible,"

> "…we would like to suggest that the Local Groups consider themselves the means by which artists gain access to technical equipment, technical information, and industrial laboratories, rather than the source of the technology and service.
>
> If possible the Local Groups should not purchase equipment, but stay flexible by using the equipment of others. Larger equipment such as vacuum forming, computer, television, audio etc. can be borrowed…"[96]

In this sense, E.A.T. becomes an overlay: a network that maps and mirrors the burgeoning network of industrial research across the world.

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[94] Ibid.

[95] Ibid.

[96] Ibid.

Local Groups formed in numerous cities over the course of 1968. A list that summer included Hunstville, Alabama; Detroit; Chicago; Boston; LA; Connecticut; Denver; Washington, D.C.; Florida; New Orleans; Indiana; Maryland: Minnesota; Missouri, and the like.[97] Some well known figures appear on the roster: legendary curator Jan van der Marck was interested in heading the Chicago chapter; Alice Denney, who had organized "The Popular Image" exhibition and "NOW" festivals, was leading Washington; Jack Nolan of Lincoln Labs at MIT, the famed national security research facility where the SAGE air defense system was developed, helped organize in Boston.[98] But countless other groups were headed by little known artists or academics or engineers. Engineers from various corporations and scientists at research universities—most of whom have never appeared in art histories of the period—enthusiastically responded.[99]

In early 1969, E.A.T. formulated even more specific policies on national organization. The "regional" offices would act akin to spokes radiating outward from "Headquarters" in New York:

> "<u>Network</u>
> There will be two classes of offices—Regional offices and Network Terminals, in addition to E.A.T. Headquarters in New York. Staff of these offices can be expanded according to needs, and with approval from E.A.T. Headquarters.
> Regional offices and network terminals will submit reports on their activities to E.A.T. headquarters.
> National E.A.T. projects can originate from any office and, when approved by the Executive Committee, will be the responsibility of that office."[100]

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[97] E.A.T., **"**Major Local Groups and their leaders," July 31, 1968. E.A.T./GRI Box 29, Folder 8.

[98] On "The Popular Image" (which included Klüver, Olga Klüver, Rauschenberg, Warhol, Watts, and others) and NOW festivals, see Chapter 2; on SAGE (Semi-Automatic Ground Environment), see Paul N. Edwards, *The Closed World: Computers and the Politics of Discourse in America* (Cambridge: MIT Press, 1996).

[99] E.A.T., **"**Major Local Groups and their leaders," July 31, 1968.

[100] "Policy for E.A.T. National Organization," July 9, 1969. E.A.T./GRI Box 29, Folder 1.

Budgeting, even bookkeeping, was stipulated in detail:

> "Regional offices in the national organization are incorporated in the E.A.T. headquarters bookkeeping system. Any local E.A.T. office should, however, do its daily bookkeeping on separate sheets as per sample enclosed. This should include assets, liabilities, receipts and expenses. This bookkeeping is to be done by day and should include all actual economic transactions made.
>
> On the fifth day of the following month, at the very latest, complete reports in terms of original bookkeeping sheets have to be sent to New York Headquarters with original receipts and original bills paid attached to it.
>
> All costs have to be proved by receipts or expense forms, duly signed."[101]

At first, then, E.A.T. organized Local Groups within a hierarchy—a bureaucracy of by-laws, offices, bills. Martin and Ordover conducted copious research on comparable organizations with local chapters and tax exemption, from the Rand Corporation, to Aerospace International, to the League of Women Voters.[102]

Martin and the group concluded that a national non-profit, tax-exempt organization with local and state chapters would be the most "effective" structure for enabling E.A.T. as a nationwide organization.

> "The principal reasons for creating a national organization with local or state chapters are:
>
> 1. To enable each chapter to utilize most fully and effectively the knowledge and experience in organization, procedures, fund-raising, etc., gained by the New York and other chapter offices.
> 2. To develop and pursue most effectively nation-wide activities such as: *relations with large industries with many branches*; relations with the technical community at meetings, conferences and conventions; forming a technical information retrieval system; national or traveling exhibitions.
> 3. To *consolidate and systematize files* of artists, engineers and others by gathering data on standardized forms. This will provide all chapters with maximum information in most convenient form for effective matchings,

[101] "Financial and Bookkeeping Procedures for E.A.T. National Organization," May 23, 1969. E.A.T./GRI Box 29, Folder 1.

[102] Penny Kullaway (West Coast E.A.T. chapter), memorandum to Julie Martin, April 17, 1968. E.A.T./GRI Box 29, Folder 3.

collaborations, approaches to local industry, as well as provide information for galleries, museums, and media people.

4. To facilitate exchange of information and contacts among chapters; encourage collaborative projects between chapters in different areas; and maximize the mobility of the artist and the engineer by making them aware of opportunities in other areas.
5. To make it possible for each chapter to be tax-exempt as soon as they become an E.A.T. chapter and operate under all the advantages of tax-exemption.
6. Open up the possibility of national grants from foundations and government agencies that might not contribute to any individual group.

…There are *no physical requirements* for becoming an E.A.T. chapter in terms of size, members, staff, budget, etc. However, the group must agree to abide by the national by-laws of E.A.T. – particularly with regard to being *open to all artists, engineers, and other interested people with no esthetic or technical bias*. Further, the group would submit the necessary financial and program reports to the national office and comply with state and federal laws governing the behavior of tax-exempt organizations." [103]

A separate draft letter on national organization added:

"The main reasons for creating a national organization with local or state chapters are:

1. To enable each chapter to utilize the knowledge and experience gained at the New York and other chapter offices.
2. To effect economy by developing forms and written material which could be mass produced and used in all locations, as well as computer programs for materials research and other information systems.
3. Each chapter would immediately be tax-exempt and could operate under all the advantages of tax-exemption [This item is marked to move to #1. in draft]
4. The chapters could operate more economically since most of the administrative functions, record keeping and nation-wide activities such as matchings, and relations with large industries, would be performed by the New York Office.
5. To *facilitate the exchange of data and information between chapters, encourage collaborative projects between groups in different areas*, and maximize the mobility of artists and engineers.
6. Open up possibility of national grants from foundations and government agencies that might not contribute to any individual group. Get national grants for individual groups.
7. *Consolidate and systematize* files of artists and engineers for maximum access to the information and maximum matching and collaborative projects.
8. Facilitate planning national exhibitions.

[103] "Draft Plan for E.A.T. National Organization," n.d. E.A.T./GRI Box 29, Folder 3. Emphasis added.

9. Magazine."[104]

In this way, *consolidation*, *systematization*, and *exchange* of information formed the rationale for the organization. As with other large-scale organizations of the time, *diversity would be contained within the system*.

But all along, as we have seen, the desire for something more open, more flexible, more decentered, remained. The draft for by-laws concludes on this note: "…Although a national structure in the manner indicated above will be an added burden on the New York office, it will reduce the burden on the local chapters, allow *them greater flexibility and autonomy for activity in their areas* as well as the possibility to operate with tax exempt status as soon as they become an E.A.T. chapter.[105] And as Julie Martin wrote to lawyer Jerald Ordover in January 1969, "[W]e want [local groups] to be completely part of a national organization but to have as much autonomy as possible in their activities…*We have to set up a structure which is as flexible as possible, and can adapt to the situation which will of course change as E.A.T. grows*."[106]

And so as it grew—indeed, *in order to grow*—E.A.T. made a shift to decentralization. E.A.T. chose *dispersion* over hierarchy. An extraordinary exchange between Klüver and David MacDermott, an artist who was one of the leaders of E.A.T.'s local group in LA, reveals the stakes. MacDermott commented on an "E.A.T. National Organization Statement," penned by Klüver June 25 in Tokyo, in a documented dated July 1, 1969. MacDermott writes, "EAT must get off dead center." And to add to this

[104] Ibid. Emphasis added.

[105] Ibid. Emphasis added.

[106] Julie Martin, memo to Jerald [Jerry] Ordover, January 13, 1969. E.A.T./GRI Box 29, Folder 3.

call for decentralization, he writes, "EAT should be open to radical changes in any existing policy if it seems necessary to do so based on feedback from expericne. [sic] … EAT is metastable—it is going beyond what is safe, usual, and proven—it takes chances with limited reseources [sic] to achieve levels of accomplishment beyond what would have been anticipated by reasonalbe [sic] people."[107] Going beyond what was safe, usual, and proven: E.A.T. should act as a radical feedback system, and, as MacDermott concluded, "Authoritarian control, by the simple fact of its existence, cannot accomplish this." Organization was meaning: *How* E.A.T. was organized was just as important—and defined—what it did.

Shortly thereafter, on July 9, MacDermott sent another set of comments and drew a flowchart of how the organization should be more like a "nodal network" and less a top-down bureaucracy with central control [Fig. 4.7].[108] Here, the "Headquarters" is not a point from which all other branches derive, but a node within a network of flows between "regions" and "terminals." The relative importance of any node is denoted by the number of channels flowing to and from it.

> "Anyone in the network can communicate directly with anyone else in the network.
> However, flows of information are heavier in some directions than in others.
> *There is no centralized bureaucracy in E.A.T.*
> There is no pyramidal structure.
> The network of E.A.T. is like the network of the brain where information is conveyed in patterns. Information can go anywhere at anytime. However, it is loaded with a contingency factor in such a way that messages tend to go where they are most useful.
> Reports should not be made to headquarters.

[107] "Comments by David MacDermott on Policy & Procedure for E.A.T. National Organization Statement by Billy Klüver, dated June 25, Tokyo, Japan," July 1, 1969, 1-2. E.A.T./GRI Box 29, Folder 16.

[108] David MacDermott, "Comments on E.A.T. Policy Statement," July 9, 1969, 1-6; annotated by Klüver. E.A.T./GRI Box 29, Folder 16.

Instead, messages about activities should be released into the network wherever they will be most useful. It may very well be that all regional offices will want and need to know about what is going on elsewhere—not just New York. Also, within a region all network terminals may want to know what all other terminals are doing, not just regional offices.

A change in naming of these parts of the network might be an effective way to make their function clearly <u>not</u> part of a centralized bureaucracy. Words have connotations, and the terminology E.A.T. uses should imply the new concepts it intends to promote in society.

'Headquarters' is the wrong word for New York. It is <u>not</u> the place where the head is located, all other parts following its orders. Instead, the entire network of E.A.T. is a giant brain—every part is in the head.

Therefore, it might be better to call New York the Chiasma, it being the only place to intersect all information in the network.

'Regional office' might better be called Neurons, since they are relay transmitters.

'Terminals' are not 'final,' as the word implies, nor are they necessarily required to go back thru the regional office to get a message into the network. This terminology implies a centralized bureaucracy. Synapse implies a place where information is exchanged. This might be a better name for local offices."[109]

Finally, MacDermott underscored,

> "Executive committee decisions should be based on information available to everyone. [BK underlined this sentence.] E.A.T. must not operate like a military organization which defends its decisions on the fact that the authorities know things which the citizens do not know.
>
> Here is an important opportunity to set an example for society by organizing E.A.T. in a new way.
>
> … *E.A.T. must be multiplistic, not monistic*."[110]

The language of multiplicity heightened even further in a subsequent document about a week later, of July14-15, 1969, in which MacDermott seems to finally put forth his own full version of a policy/mission statement for the organization of E.A.T.[111] The

[109] Ibid. Emphasis added.

[110] Ibid. Emphasis added.

[111] David McDermott, "E.A.T. as a service organization is…," July14-15, 1969. E.A.T./GRI Box 29, Folder 16.

organization is a “catalyst,” a “transducer”; it is most fundamentally “AN INFORMATION NETWORK”[112]:

> “E.A.T. is attempting to establish a symbiotic, mutually beneficial, metastable, asymptotic, reciprocal, cybernetic interaction between humans and the world biosphere of which they are a small, but disproportionately powerful and carelessly shortsighted part. Humans are only one among a complex diversity of interacting, mutually interdependent elements.
>
> E.A.T. exists to encourage through art the idea that we live in a thin stratum of life on this earth, and since this planet is the only one we have, we must learn to live in it with ecological responsibility. Otherwise we shall die in the poisons of our own wastes like a disease bacterium which lives very well until the host animal it is living in dies.”[113]

In order to change the relationship between technology and society, E.A.T. must achieve *large scale* in relation to the individual subject:

> “The only function of EAT should be to provide a limited number of worthwhile services.
>
> These services must be available to everyone who wants them, and they must be impersonal.
>
> Therefore, EAT cannot provide in-depth help to any individual or group. In-depth services can only reach a few dozen people per year. *EAT services must reach thousands of people per year.*”[114]

By 1970, Klüver seems to take this feedback to heart and echo Bell’s model once again. He explicitly ties *growth* and *diversification* to *decentralization*. In a text titled “Rainforest” from January 30, 1970, he writes:

> “The rainforest is made up of thousands of feedback loops of continual activity. Thousands of animals, plants and trees live in the rainforest. Its roots are few and shallow as opposed to the oak tree’s deep roots in the ground. The oak tree takes energy out of the ground and shades the area so that no small bush or flower can grow near it.

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[112] Ibid.

[113] Ibid.

[114] Ibid. Emphasis added.

> The main purpose of Experiments in Art and Technology is to develop, through experimentation and experience, fluid organizational forms whose model is that of the rainforest rather than the oak tree."[115]

Nowhere else is the decentralization and dehierarchization of E.A.T. stated so directly. The rainforest and the rhizome—fluid, horizontal, dispersed rather than top-down—become the model for the organization. And, once again, *organization is meaning*: for E.A.T., a fluid structure means fluid thought, action, and experimentation.

V. E.A.T./LA and Bay Area

The experimentation and expansion of the LA and Bay Area local groups were exemplary in this regard. In September 1969, Klüver and Rauschenberg appealed to "industrial collaborators" to join the local groups in California, which, they emphasized, had become a particular hotbed of art and technology collaboration:

> "While Experiments in Art and Technology began in New York, which, as you know, has become the center of the art world since World War II, its development has not been confined here. The idea of collaboration between artists, engineers, and industry has become widely acknowledged, and art and technology projects have been initiated all over the world. *We find that California has become a center of such activities.* In particular, for one of our recent projects in which ten artists and seventeen engineers, both Japanese and American, collaborated to design an environment for the Pepsi Pavilion at Expo '70 in Osaka, Japan, much of the research and development is being done in California.
>
> We are opening offices in Los Angeles and the Bay Area and would like you to be part of these initial E.A.T. efforts in California. We would like to offer you a first viewing of the full-scale model of the 90 foot diameter spherical mirror which will be the central attraction of the pavilion, which has been erected at the Marine Corps Air Facility Base in Santa Ana. The party and demonstration will take place on September 30th, 7-11 p.m., and all members of your family are welcome. Do come and share what we feel is an important moment for E.A.T., and what can become and important involvement for you."[116]

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[115] Klüver, "Rainforest," January 30, 1970, 1. E.A.T./GRI Box 120, Folder 26. (The text seems to be a manuscript for a small book on the history of E.A.T.)

[116] The letter began: "Dear Industrial Collaborator: I would like you to join us in our efforts to bring about a new kind of industrial involvement in the arts: not as patrons only, but as participants as well. Three years ago I, a scientist then working at Bell Laboratories, and artist Robert Rauschenberg, both concerned about the separation of the artist from the technical industrial world, started Experiments in Art and Technology in order to explore new ways of closing this gap. In order to provide the artist with access to

The invitation focused on the demo of the spherical mirror dome for the Pepsi Pavilion (which I will discuss shortly). E.A.T./LA, as it would be called, became one of the most extensive and independent local groups of E.A.T. Drawing on the large community of engineers, scientists, and artists in the industrial complex of the booming defense industry in the Sun Belt, from Caltech to Lockheed Martin, the chapter would pursue numerous collaborations, conferences, and its own publication. At the Mirror Dome demo alone, Los Angeles-area institutions and corporations included the Jet Propulsion Laboratory, Caltech, Teledyne, Rocketdyne, Philco-Ford, Bell Labs's local engineers, the experimental collective Envirolab, and he UCLA School of Architecture.[117] The LA team maximized the local resources for technology and fabrication, basing the design on then-brand-new inflatable, reflective Melinex satellite design and manufacturing.

Klüver and E.A.T. staff had been in touch with MacDermott as early as 1967, and with others, such as James Turrell, over the course of 1968. MacDermott (who had been a key participant in the Mirror Dome demo) and Penelope Kullaway headed the LA chapter in the spring of 1969.[118] The ACE Gallery loaned them space while they searched for an office. By May, they found a headquarters in Hollywood, specifically drawing on connections to local industries, from film/media to aerospace, and

new technology, we involve engineers, scientists, and industrial organizations in direct one-to-one collaborations with artists. Through our services and projects, which are described in the material I am enclosing, we are developing Experiments in Art and Technology as an organization that can operate effectively at this interface." Letter from Klüver and Rauschenberg to "Industrial Collaborator," Sept. 22, 1969. E.A.T./GRI Box 11, Folder 6. Emphasis added.

[117] "E.A.T. Report 1970: Los Angeles," September 18, 1970, 1-5. Langlois, EAT C10-17; 193.

[118] Letter from Klüver to David MacDermott, June 20 ,1967; Letter from James Turrell, June 10, 1968, to Francis Mason; "Organizational meeting announcement," Feb. 21, 1969. E.A.T./GRI Box 29, Folder 12.

universities.[119] A "multi-media environment performance" celebrating the historic moon landing in July kicked off the proceedings, specifically garnering sponsorship and equipment loans from the industries in the "space technology field."[120] Artists and choreographers included Barbara T. Smith, Steve Paxton, Alex Hay, and physicist Elsa Garmire.[121]

E.A.T./LA immediately established autonomy in soliciting and approving project proposals, even as they struggled with the question over how many resources to devote to collaborations.[122] The coordinators asked to receive salaries from the national E.A.T. coffers; most of the membership fees raised in the LA area were to go back to the local group for administrative expenses, and the group could benefit from national grants as well.[123] They teamed with E.A.T. Bay Area to form their own board of directors for

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[119] "Minutes: Proposals Committee," May 6, 1969. E.A.T./GRI Box 29, Folder 12. "An EAT organization was officially established in LA in March 1969 following several years of informal activity involving artists, engineers, scientists, and others interested in exchanging ideas and developing collaboration relationships amongst themselves and in generating opportunities within the community for furthering art and technology. The EAT/LA office functions as the headquarters for both the Western regional and local activities." "EAT LA Report, 9/25/69." E.A.T./GRI Box 29, Folder 12.

[120] "E.A.T. Report 1970: Los Angeles," September 18, 1970, 1-2. E.A.T./GRI Box 29, Folder 12.

[121] "Moon Landing Celebration—Performance," *E.A.T./LA Survey* 7 (January 1971): 16. E.A.T./GRI Box 29, Folder 13.

[122] "Minutes: Proposals Committee," May 6, 1969. The next month, Kullaway wrote to Klüver: "Met with lawyers; see options as a national corporation with regional and local offices; separate E.A.T. corporations established in several states, or regional state-combines, with local groups relating within a state or region with some over-riding agreement of affiliation with other E.A.T. state corporations; local groups separately incorporated with affiliation arrangement [seen as not feasible] … Both lawyers recommend #1… in addition to determining the inner organizational relationships and interfaces, we need to decide just how involved even a local group should become in regard to projects and activities, e.g. should it directly sponsor or should it help others organize certain types of programs, should it provide technical information or refer out to already existing sources of information? (These are just typical of the most obvious types of questions we face.)" Memorandum from Penny Kullaway to Billy Klüver, June 24, 1969. E.A.T./GRI Box 29, Folder 12.

[123] Letter from Francis Mason to Jan Butterfield, Feb. 5, 1969. E.A.T./GRI Box 29, Folder 12.

California.[124] Throughout, the homeostasis and balance of the local versus the national was at stake.

E.A.T./LA collaborated with Envirolab to develop a proposal for the American contribution the Sixth Paris Biennale, at the Musée d'Art Moderne de la Ville de Paris, in September-October of that year, at the behest of E.A.T. New York and the Smithsonian Institution.[125] E.A.T./LA then invited various "representatives of art, science and industry" for an open discussion held at Caltech in November. They began holding monthly Open Houses as well as meetings with artists and engineers at various local companies, including IBM, Vidtronics (a video subsidiary of the media and film corporation Technicolor), Scientific Data Systems, Computer Image Corporation, and a laser demonstration at Glendale Federal Savings.[126] An event on "Light" at the Pasadena Museum followed in February 1970, with light show, psychedelic, and LA light and space artists from Single Wing Turquoise Bird to Mary Corse to Garmire to Robert Irwin. Architects including MacDermott organized lectures on "Invented Environments" at the UCLA School of Architecture and Urban Planning in March. In May, they presented the conference " Experiments in Art and Technology: In Process," at the University of Southern California, with artists Allan Kaprow and Newton Harrison, cyberneticists

[124] The E.A.T. California board comprised figures from all sectors—from metallurgists to art historians to the son of architect Eero Saarinen. In 1969, the members included: Jan Butterfield, Public Relations, LACMA; Morton Dubman, mathematician, Rocketdyne; Elsa Garmire, physicist, Caltech; Joan Hugo, librarian, Otis Art Institute; David MacDermott, artist; Beverly O'Neill, art historian, Occidental College; Ardison Phillips, artist; Monroe Price, lawyer, UCLA; Eric Saarinen, filmmaker; Boris Sojka, optical engineer, Pichel Industries; Al Sorkin, metallurgist, Jet Propulsion Lab. "Board of Directors, E.A.T. California," 1969. E.A.T./GRI Box 29, Folder 12.

[125] The project, *Elektradermis*, was a "three-foot aluminum cube housing beam splitters, mirrors and film loop. An inflatable sphere on a time cycle emerged from the cube upon which the film was projected and then collapsed back into the cube." "Paris Bienale [sic]—Competition," *E.A.T./LA Survey* 7 (January 1971): 15.

[126] "E.A.T. Report 1970: Los Angeles," September 18, 1970, 2.

Gordon Pask and Heinz von Foerster, and visionary architect Paolo Soleri; 5,000 attended.[127]

In fall 1970, E.A.T./LA convened a series of its own lecture-demonstrations—an "art and technology course"—at Cal State Long Beach.[128] Sixteen free, public lecture-demonstrations were given by experts and collaborators, several of whom were at the center of the aeronautics and space industry, including Garmire of Caltech, who was working on the Pepsi Pavilion, on laser light; John Forkner of PhilcoFord, who was collaborating with Whitman, on optics, "pseudoscopics" (the reversal of depth perception via optical instruments), and cylindrical mirror reflections; Alex Jacobson, an engineer from the aerospace, defense, and communications behemoth Hughes Research (later sold to Raytheon), on holography; and others on computer-generated sound and

[127] "E.A.T./LA Report," *TECHNE* 1, no. 2 (November 6, 1970): 7.

[128] "The first art and technology course, prepared by E.A.T./LA, for the interdisciplinary Studies Program at Cal State Long Beach will begin Wednesday, September 23.

Sixteen lecture-demonstrations will be given by artists and scientists/engineers that will be open to the public from 7:00 pm to 8:30 pm in the lecture hall…

Laser-light (Elsa Garmire, Caltech): Description of various kinds of lasers, how they work, and what colors can be produced. Discussion of the uses of lasers in art.

Holography (Alex Jacobson, Hughes Research) A discussion of the principles of holography will be presented with emphasis on the physical mechanisms and the techniques of the holographic process. Examples of holograms will be displayed.

Optics (John Forkner, Aeronautics, PhilcoFord): Description and illustration with slides and films of art and technology projects in which he has been involved. Technical aspects that will be covered include optical information theory as applied to the light machine and geometric optics principles used to generate pseudoscopic images and to develop a special cylindrical real-image mirror system.

Optical and Sound Effects in E.A.T. Dome, for Pepsi Cola, Expo '70 (Ardison Phillips, Artist): The 'dome,' a major collaboration in construction of more than 100 persons including scientists, engineers, and artists has been recorded on film by Eric Saarinen. It will be shown along with a demonstration on tape of how different environments affect the same sound.

Electronic Sound (Genevieve Marcus, Musicologist, UCLA): The effects of technology on the style and philosophy of contemporary music will be demonstrated with examples of music evolved through the influence of magnetic tape recorders, electronic synthesizers, and computers.

Computer sound/Composition: The lecturer will define and discuss such concepts as computer numbers, logic peripheral devices and how they can be applied to sound generation, musical composition, line drawings, sculpture, areal composition, and animation."

"Program listing for Cal State Long Beach, first art and technology course, prepared by E.A.T./LA for Interdisciplinary Studies Program and Cal State Long Beach," Sept. 23, 1970. E.A.T./GRI Box 11, Folder 7.

composition.[129] They were joined by Gene Youngblood on "ART AND TECHNOLOGY / WORLD GAMES"; Tom Mee, who had helped devise the fog for the Pepsi Pavilion; MacDermott; Al Hibbs of the Jet Propulsion Laboratory on "TECHNOLOGY-COMMUNICATIONS-SPACE," curator Jane Livingston from LACMA on "THE MUSEUM"; and experimental filmmaker John Whitney on computer filmmaking.[130]

E.A.T./LA launched the Projects Outside Art initiative "Recreation and Play" that same year (detailed in Chapter 5), spearheaded by Phillips, Allan Kaprow, and others. The local group also partnered with Cal State Fullerton's department of Interdisciplinary Studies—a new field at the time—to publish a "Technological Studies Review," which included a bibliography of reference material on art and technology. With these projects, E.A.T./LA made inroads into a geographically and historically specific intersection of West Coast Light and Space, land art, conceptual art, and regional industry. If the links between aerospace and Light Space are well known, for example, the precise ways in which information, people, and techniques were shared has been little explored beyond a handful of specific collaborations, such as Robert Irwin and James Turrell's exploration of the ganzfeld with NASA psychologist Ed Wortz. E.A.T./LA provides a framework with which we can understand the full range of communication and exchange within which such collaborations were taking place, helping us to map the local nodes within a vast network.

Knowledge dissemination was paramount, and E.A.T.'s seemingly endless print publications helped multiply and disperse the organization, pinpointing specific

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[129] Ibid.; "E.A.T. Report 1970: Los Angeles," September 18, 1970, 4-5; Paul Gersten, "Sessions of the Art and Technology Course," *E.A.T./LA Survey* 7 (January 1971): 12-13.

[130] "E.A.T. Events," *E.A.T./LA Survey* 6 (October 1970): 8.

audiences. Each local group was, in fact, encouraged to develop its own publication, printing it themselves or sending a paste-up ("minimum 8 pages") of a local version of E.A.T.'s longer-form newspaper, *TECHNE*, to New York to be printed and mailed out to E.A.T. members all over.[131] In this way the local groups become self-sustaining communication nodes, feeding back into E.A.T.'s burgeoning information and distribution channels—the hierarchy flattening out into a network.

E.A.T./LA launched its own bulletin, a small, square publication they titled *Survey*. Beginning in January 1970, they published five monthly issues, with a print run of 3,000 copies each (except for April 1970, no. 5, which doubled to 6,000) [Fig. 4.8].[132] After May 1970 they published two more, number 6 in October 1970 and the seventh in January 1971. The first issue focused on the Pepsi Pavilion preparations and the Mirror Dome demo taking place in LA; the second issue examined Claes Oldenburg's colossal kinetic *Ice Bag*, undertaken (with television special effects firm Krofft) for LACMA's "Art and Technology" exhibition and the US Pavilion at Osaka. In these pages—within this circulation of media—E.A.T./LA emerged as a distinct local node, with its own actors and operations and affiliations and channels of distribution.

And the group continually explored how this *local* node was to operate in tandem with the larger network of E.A.T. Caltech engineer Garmire, so pivotal to the Pepsi Pavilion, is a key player in LA, and her essay in the first issue of *Survey* expresses the ardent desire for—and tension between—diversification and integration, specialization

131 "…we plan that many subsequent issues [of *TECHNE*] will originate with Local Chapters. … Any Local Chapter which would like to contribute an issue of *TECHNE* can do so immediately. Issues will be printed on a first-come-first-serve basis." *TECHNE: A Projects and Process Paper* 1., no. 1 (April 14, 1969): 1.

132 "E.A.T. Report 1970: Los Angeles," September 18, 1970, 5.

and universalism, decentralization and coherence: "No single man understands thoroughly a ingle complex modern computer, a jet aircraft, a hydrogen bomb, the telephone or electrical power systems. Deification of the machine has arisen from man's inability to fathom its complexities; from our intellectual inertia in the face of rapid, incomprehensible change. Our educational system produces super component experts incapable of relating to the machines they build."[133] By contrast, "The technological artist approaches and utilizes the incomprehensible for his own ends in ways often *irrelevant* to the original 'purpose' of the device. This irreverent approach provides new access to the machine, elicits whole new responses from them and toward them. Technological art *redefines the machine* in terms far greater than those for which it was built."[134] Garmire describes nothing less than invention without end, experimentation "against method," an irruption against the specialization, atomization, and instrumentalization of scientific knowledge. And yet this is to take place in the service of a new universalism: "As with all art, it encourages us to take a larger view of the world around us. When the native artist walks through technology as well as forests and cities, he becomes a universal spokesman, an artist of his total environment."[135] Garmire extols the radical upending of scientific rationality—of "technical understanding"—simultaneously with a near-humanist yearning for the artist as "universal spokesman."[136]

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[133] Elsa Garmire, "Art and Technology—Ruminations of an Engineer," *E.A.T./LA Survey* 1 (January 1970): 5; first printed in *Technological Studies Review*, Technological Studies Institute, California State College, Fullerton.

[134] Ibid.

[135] Ibid.

[136] Ibid.

And yet E.A.T./LA nurtured highly particular attitudes toward perception and media, attitudes specific to the singular nexus of the film, television, and aerospace industries in southern California. The group held an Open House at Universal Studios with Wilton Holm, the Vice President of the Association of Motion Picture and Television Producers and the Director of the AMPTP Research Center, in September 1970; Holm published his lecture in an article in *Survey* 6, thereby expanding the audience of the Open House to the circulation of the journal.[137] Titled "Motion Pictures in an Evolving Culture," the piece outlined the deficiencies of the current state of cinematic projection, predicting new forms of video, 3-D and holographic film, and all manner of illusive and immersive images. Even more important than the enhancement of the picture would be the reach of its release: No longer printed and sent to theaters, "Distribution by coaxial cable, microwave relay links or even by satellite would become possible. … TV will prosper, too. In perhaps 10 years all television is likely to come to the home via cable because all homes will be 'wired'…." And the future of the motion picture industry depends on something far more intangible than ticket sales: 'In an affluent society, human needs tend to move up a scale from material goods toward a desire for self-realization. Even the most avid consumer can use only so many TV sets or so many cars. Thus for a corporation to continue to serve a useful function, it has to redefine its role. It will have to create the qualities of life that people really want." What Holm is describing is, in other words, the experience economy to come.

The studio exec pushing for industrial innovation found an uncanny echo in Gene Youngblood's wild "Video Computer Interface" in *Survey* 2 from February 1970. An

[137] Wilton R. Holm, "Motion Pictures In An Evolving Culture—A Perspective," *E.A.T./LA Survey* 6 (October 1970): 8.

excerpt from his *Expanded Cinema*, published in May that year, Youngblood's tract is breathless, fantastical. It predicts the complete universalization of human experience via the computer: "The computer does not replace man. It liberates him from specialization." Against specialization, the computer "is the arbiter of radical evolution. It changes the meaning of life."[138] And yet behind the hyperbole, Youngblood anchors this universal shift in highly specific and local innovations: in the development of computer graphics. If the television could establish a continuous scan on the screen, new computer graphics systems, while still extremely expensive, time-consuming, and demanded enormous amounts of memory, foreshadow the demise of video as we knew it. "We are quickly approaching that point at which real-time realistic computer-generated motion graphics will be possible." Youngblood then details how "this was demonstrated to a group of E.A.T. members recently during a tour of Jet Propulsion Laboratories in Pasadena. Scientists explained the MTC-1219 video system used in translating pictures of Mars in the various Mariner 69 encounter operations. This extraordinary system transforms the real-time TV signal from Mars into digital picture elements (pixels) which are stored on special datadiscs. … Only the digital code is stored." Echoing the computer graphics research at Bell, the Jet Propulsion research is specifically geared to the exploration of *moving* images. And while artists such as Vanderbeek and the Whitney brothers were exploring abstract computer video at the time, "… it is now clear that sustained collaborations between artists and scientists could quickly bring about a realization of graphics in motion that was until recently inconceivable to humanity. … the frontier of the machine- controlled *realistic* image is about to be crossed. Beyond that

[138] Gene Youngblood, "Video Computer Interface," *E.A.T./LA Survey* 2 (February 1970,): 7-8.

point we will enter a mythic age of electronic realities existing only on a metaphysical plane."[139] Youngblood, echoing his discussion of the Mirror Dome for the Pepsi Pavilion a few months prior (discussed below), is auguring a new plane of simulation: a mode of spectatorship predicated on *special effects*. This was an understanding of perception that was inextricable from the discourses of the cinema and the space mission, from the film industry and the aerospace industry. It was an extraordinary collapse of the spectacular image and the scientific image, perceptual models absolutely embedded in specific media histories and sites. E.A.T. reached broadly and deeply into these specific nodes even as it introduced them into the network at large.

VI. International Groups

Such sprawling reach—*full decentralization*—meant a push for international groups. It meant a push for *globalization* before the term as we know it existed.[140] As early as 1968, Klüver had projected such a need during his attendance at the "Industrial Negative" symposium in London, organized by the Artists Placement Group, or APG, and following on the heels of the famous "Destruction in Art" symposium in London in 1966, organized by Gustav Metzger, Jasia Reichardt, and other major artists and curators engaging technology in the UK.[141] At "Industrial Negative," Klüver gave his "Interface" speech, which I have discussed in detail above; this led to invigorated efforts to establish international branches of E.A.T., above and beyond those already beginning in the US.

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[139] Ibid., 8.

[140] On globalization, see Pamela M. Lee, *Forgetting the Art World* (Cambridge, MA: MIT Press, 2012); Theodore Levitt, "Globalization of Markets," in *Harvard Business Review* 61, no. 3 (May-June 1983): 92-102. On Rauschenberg and globalization, see Hiroko Ikegami, *The Great Migrator: Robert Rauschenberg and the Global Rise of American Art* (Cambridge, MA: MIT Press, 2010).

[141] "Press release for 'The Industrial Negative' symposium, Sep. 11, 1968, Mermaid Theatre, London." E.A.T./GRI Box 41, Folder 8 ("London Trip—Klüver").

Key to this endeavor was building ties to APG.[142] Beyond its three-initial moniker, APG shared clear similarities with E.A.T.: The group attempted to "place" artists in industrial corporations and laboratories; they likewise sought to bring artists, engineers, and industrialists into contact with one another and forged a number of residencies and relationships.[143] Artists such as John Latham, Barbara [formerly Latham] Steveni, and Stephen Willats spearheaded the endeavor. As Klüver wrote to Barbara Latham and APG that fall: "After my visits to London, Amsterdam and Paris, I feel it may be a serious mistake not to establish a strong international organization or association of organizations immediately. Industry must be made to understand what it is all about before the artist is categorized as an ornamental piece…"[144] APG would remain at the level of individual artist residencies in corporations, and its activities would take place within the UK, at a much smaller scale than those of E.A.T. Yet they clearly inspired Klüver to renew the international scope of E.A.T.

Klüver, Martin, and the others began to look at ways to globalize quickly. In 1969, they began a membership drive directed toward embassies. A form letter from Klüver to ambassadors at embassies from May 1, 1969, details an attempt to spread to other nations.[145] The response was swift and enthusiastic. Embassies from Venezuela to Haiti, Mogadishu, and Morocco declared their interest in fostering E.A.T. groups.[146]

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[142] Letter from Billy Klüver to Barbara Latham [Steveni] and Artists Placement Group, Sept. 25, 1968. E.A.T./GRI Box 41, Folder 8. See also Stephen Willats's landmark publication *Control*, particularly its first three issues, with contributions by Latham, Roy Ascott, etc.: *Control* 1-3 (1965-1967).

[143] Claire Bishop, "Rate of Return: Artists Placement Group," *Artforum International* 49, no. 2 (October 2010): 231-37. See also *White Heat Cold Logic: British Computer Art 1960-1980*, eds. Paul Brown, Charlie Gere, Nicholas Lambert, and Catherine Mason (Cambridge, MA: MIT Press, 2009).

[144] Letter from Billy Klüver to Barbara Latham [Steveni] and Artists Placement Group, Sept. 25, 1968.

[145] Form letter from Billy Klüver to "ambassadors," May 1, 1969. E.A.T./GRI Box 10, Folder 13.

In August 1970, some months after Klüver's "Rainforest" text, E.A.T. released a formal statement on "A Structure for E.A.T. International Activities between E.A.T. National Organizations."[147] The document forcefully calls for the need for *global*, *international* reach. Technology is international, and yet it is not universal. A vast field of possibility awaits in the translation and development of technology across fundamentally disparate contexts:

> "There has been spontaneous interest in our activities from all over the world and many people have approached us for advice and help on starting E.A.T. organizations in their countries. Many activities have started on their own, and the original E.A.T. idea has been carried out by individuals, independent groups, universities, museums, foundations.
>
> …Pressures for something new come from the rate of development of technology, the consciousness of the degree of rate of change of the environment, the increasing involvement of the technical community in problems in the environment, politicalization of the society in general and the artist in particular and general recognition of and concern about the man-machine relationship and ecological problems. The politicalization of the artist over the past year indicates that the artist wants not only to change the art world but to move out of it into greater social involvement. However, the technical community has become involved in problems in the environment at a faster rate than the art community. Given the rate of change of non-art development, the artist is in a position of becoming anachronistic and irrelevant; he is not taken seriously in those areas of development in the environment where he could make a valuable contribution.
>
> E.A.T. as an organization is based on the belief that the artist has a relevant and necessary contribution to make in non-art areas in the social environment and is committed to developing as many forms in which the artist can be full participant in projecting this area."[148]

In an astonishing and astonishingly prescient claim, E.A.T. argues that *hardware is not neutral*: we cannot assume that hardware can be seamlessly transferred between different

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[146] See "E.A.T. Membership Inquiries, 1969: Embassies." E.A.T./GRI Box 10, Folder 13.

[147] "A Structure for E.A.T. International Activities between E.A.T. National Organizations," August 25, 1970. MoMA/E.A.T. Klüver Documents, #187. An adapted version of this text appeared as "A Structure for Relations Between E.A.T. National Organizations," *TECHNE* 1, no. 2 (November 6, 1970): 6.

[148] Ibid.

cultures, and it may even bring "a whole culture with it." E.A.T. urgently calls for experimentation with adapting technologies to local contexts and exploring technologies that are specific to regions or environments—an experimentation in which artists are crucial:

> "Our experience has shown that the artist can make an important contribution in aspects of technology which involve the *adaptation of technology to different cultures and environments*, as it affects the individual. He is valuable in developing means for localizing the technology in terms of application, access and use, to support rather than destroy the indigenous cultural heritage and the dignity of the individual. *There is growing recognition in the technical community and elsewhere that the hardware need not be a fixed constant, and there are no unalterable rules for using it.* Whether a satellite or a tractor will bring a whole culture with it is an open question. But there is little known in this area of interface between the individual and technology and there is a great need for open-ended experimentation. In such experimental situations the artists' input is needed.
>
> These are international problems and concerns. Technology is spreading and the hardware is being taken up by all countries. The present structure of E.A.T. international contacts, which have developed from spontaneous random interest, is totally inadequate and has not led to an expansion of E.A.T. involvement that corresponds to the scale of the problems and changes in the social and political environment. We plan to take the following action: E.A.T. in New York will actively stimulate the setting up of independent parallel national E.A.T. organizations and work with them to establish an *international forum for exchange of information hardware and people, and collaboration on projects on international scale.*
>
> The development of E.A.T. along these lines will begin with the establishment of national organizations in Japan and India. The involvement in the Pepsi Pavilion in Japan provided the contacts and impetus for the organization there. Two projects in India generated initial contacts and interest. Japan is the most industrialized nation in Asia and has begun to export technology; India is the most acute developing nation undergoing rapid introduction for technology in a situation of old, diverse and strong cultural traditions. The E.A.T. organizations will be oriented to experimental projects outside a specific institutional framework which utilizes the skills and talents of different professionals, including the artist. In addition to doing projects inside the country, members of these E.A.T. organizations would have direct contact with E.A.T. members in other countries to exchange information, experience, and collaborate on projects. An indigenous E.A.T. organization combined with the international contact between E.A.T. organizations will provide interested people a means for effective

> action on the problems introduced by technology in developed or undeveloped situations where the presence of the artist can have great importance."[149]

E.A.T. launched American Artists in India in 1970, an educational program directly linked to the mission of the Local Groups. The project aimed to send artists to India for one-month periods to collaborate with Indian artists. Partnering with the Sarabhai family, who had been involved with E.A.T. and whom Tudor, Cage, and others had known for years and had visited during Merce Cunningham's 1964 world tour, and the National Institute of Design in Ahmedabad (famously designed by Le Corbusier), Klüver sought to turn the relationship into a sustained model of exchange.[150] Trisha Brown, Yvonne Rainer, La Monte Young, and others all traveled via the program in 1971, exploring their various interests in raga, traditional dance, and Eastern philosophies. Funding from the John D. Rockefeller III Asian Cultural Fund was sourced but not renewed, and the NID's experimental activities had gradually lost governmental support. While it did not continue, it posed a vital model of global interaction and travel, not least to address "the cultural problems associated with the introduction of technology into new environments."[151] Introducing technology into different environments was

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[149] Ibid. Emphasis added.

[150] See Alexander Keefe, "Subcontinental Synth: David Tudor and the First Moog in India," *East of Borneo*, last modified April 30, 2013, http://www.eastofborneo.org/articles/subcontinental-synth-david-tudor-and-the-first-moog-in-india.

[151] "This program is an attempt to enrich the life experience of the American artist and to give him insights into the resources of another culture. We also feel that the artist has a natural sensitivity to a new environment and by working with younger Indian artists can reinforce their efforts to carry out projects and ideas of their own. The American Artists in India program is supported by a grant from the JDR 3rd Fund which must be matched. The purpose of the benefit is to raise these matching funds and extend the program, based on the experience of the first group of artists. Experiments in Art and Technology, a tax-exempt, non-profit organization, carries out experimental projects in the arts and sciences which deal with the cultural problems associated with the introduction of technology into new environments." E.A.T. Membership flyer, 1971. E.A.T./GRI Box 11, Folder 4.

cultural. With this insight, E.A.T. aimed to penetrate new and different cultures not from above but from the ground up.

The Anand Project offered precisely this adaption of new technology to a culturally specific context [Fig. 4.9]. "An Experiment in Developing Television Software in Rural India," the proposal was to "develop a field laboratory to carry on experimental projects in developing effective instructional television software for use in rural Indian villages."[152] For the first experimental project, they hoped to use television to teach members of the Amul Dairy Cooperative in Gujarat State the care and breeding of milk-producing buffaloes. The long-term goal was to develop a prototype that could be used on a much wider scale for instructional software. A team of videographers, including at least one artist, would work with villagers to create the programming. Satellite television had not yet been introduced in India; a one-year experiment in satellite television was planned with NASA for 1974 (and spearheaded by Vikram Sarabhai in India), occasioning the Anand Project. This was the radical beginning of "The use of television as a tool" in India—and E.A.T. claimed, "virtually no experience exists in producing instructional software on the scale that will be needed."[153]

Didactic television programming (on cattle farming, etc.) might transform both its audience *and* the medium of delivery itself. The project remained under study by the Indian government for several years. While it went beyond the scope of the local groups,

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[152] E.A.T., "A Proposal for a Series of Twenty-Six Television Programs," Sept. 24, 1970. E.A.T./GRI Box 95, Folder 3. See also Billy Klüver, Julie Martin, and Barry Kaplan, "The Anand Project: An Experiment in Developing Television Software in Rural India," Sept. 23, 1970. MoMA/E.A.T. Klüver Documents, #191.

[153] "The Anand Project: A Television Experiment in Rural India," *TECHNE* 1, no. 2 (November 6, 1970): 7. On the Anand Project more generally, and E.A.T. and mass communication, see also Bettina Funcke, *Pop or Populus: Art Between High and Low* (Berlin: Sternberg Press, 2009).

suffice to say that the Anand Project united the desire to expand and diversify the reach of telecommunications media, and E.A.T. would go on to research television and communication "delivery systems"—and the then-debate over nationalization versus privatization—in Central America, Asia, and the US. (I discuss this project in relation to E.A.T.'s Artists and Television program in Chapter 5). In 1971, in anticipation of the celebration of the American Revolution Bicentennial in 1976, E.A.T. proposed "U.S.A. Presents…," a massive, participatory national satellite television communication system:

> "a single-channel national television system with indigenous programming in which 20,000 groups or individuals from all over the country would make films to be broadcast simultaneously to the whole country.
>
> The proposed plan consists of a satellite transmission and ground-based rebroadcast system over existing or available VHF, UHF and cable systems as well as direct reception units, which would reach the whole country from Puerto Rico to Hawaii and Alaska. The participating groups and individuals will use simple Super 8 equipment to record and edit their films. Films will be sent to a single earth station transmitting to the satellites and will be broadcast on a random basis 24 hours a day. The total system is conceived to give the greatest number of Americans and opportunity to create and view a year-long self-portrait of America."[154]

One (or more) synchronous satellites would be placed in stationary orbit, capable of illuminating the country from Puerto Rico to Hawaii and Alaska, in order to receive and transmit a single television channel. Such a synchronous satellite system, as outlined in an elaborate diagram [Fig. 4.10],

> "would give people a chance to present themselves, their lives, their activities directly to all other Americans without the overlay of the assumptions and fixed esthetic of professional broadcasting. 'U.S.A. Presents…' is designed to provide for the greatest number of community-produced programs from all over the country and for the widest simultaneous distribution of the programs. This

[154] E.A.T., letter to Jack Massey, American Revolution Bicentennial Commission, March 5, 1971. E.A.T./GRI Box 95, Folder 4.

> revolutionary, grass roots broadcasting system will bring about a recognition, renewal and celebration of the unique and vital energies of American culture."[155]

The proposal was never realized, but it evinces the ways in which, for E.A.T., the decentralization of a *physical network* of people paralleled the decentralization of the *telecommunications network.*

E.A.T. pursued horizontal expansion *without* vertical integration. It rejected the centralization and hierarchy of big science even as it embraced the diversification of big science. And decentralizing and diversifying E.A.T. were now fully linked to the organization's *expansion*. By 1971, *scale* became the literal key word for E.A.T. Over and over, a document titled "Notes on purpose of E.A.T." from that year emphasizes that the organization's activities are taking place "*outside* institutions" and "On a large scale … always with scale in mind." Indeed, the three keywords repeated throughout are: "Commitment, responsibility, scale."[156] A 1971 membership drive further extended the scope of the group's global and local network, building on the August 1970 "Structure for E.A.T. International Activities and for Relations Between E.A.T. National Organizations."[157]

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[155] E.A.T., "U.S.A. PRESENTS... / A Proposal for a Satellite Television System Programmed by the American People," submitted to the American Revolution Bicentennial Commission, Feb. 22, 1971. E.A.T./GRI Box 95, Folder 4.

[156] "Notes on purpose of E.A.T.," 1971. E.A.T./GRI Box 11, Folder 4. On scale and size—the former being relative, the latter absolute—see Yve-Alain Bois, "Matisse and Arche-Drawing," in *Painting as Model* (Cambridge, MA: MIT Press, 1993), 3-64; 25.

[157] "Over the years, there has been spontaneous interest in our activities from all over the world and many people have approached us for advice and help on starting E.A.T. organizations in their countries. Many activities have started their own, and the original E.A.T. idea has been carried out by individuals, independent groups, universities, museums, foundations. However, these activities, sometimes carried on under the name E.A.T., have usually concentrated on a single aspect of the artists involvement with technology—exhibitions, workshops, courses in art and technology, artist in residence, or one-time involvement with industry—and have never developed beyond the original concept of art and technology. Thus our efforts have effectively legitimized the artist's use of new materials, and his working with the engineer or scientist on a practical, but minimal, level. But the interaction of artists, engineers, and

Decentralization and multiplicity at a colossal scale were difficult, however, to achieve in practice. E.A.T./LA was a case in point. It had, in fact, been roiled by tumult

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industry never became a catalyst for social change. The movement was absorbed into the art world. The structure of the art world and the social role of the artist everywhere has remained basically unchanged.

Other forces for change have radically changed the situation. Pressures for something new come from the rate of development of technology, the consciousness of the degree of rate of change of the environment, the increasing involvement of the technical community in problems in the environment, politicalization of the society in general and the artist in particular and general recognition of and concern about the man-machine relationship and ecological problems. The politicalization of the artist over the past year indicates that the artist wants not only to change the art world but to move out of it into greater social involvement. However, the technical community has become involved in problems in the environment at a faster rate than the art community. Given the rate of change of non-art development, the artist is in a position of becoming anachronistic and irrelevant; he is not taken seriously in those areas of development in the environment where he could make a valuable contribution.

E.A.T. as an organization is based on the belief that the artist has a relevant and necessary contribution to make in non-art areas in the social environment and is committed to developing as many forms in which the artist can be full participant in projecting this area. The role of the artists in planning the Pepsi Pavilion demonstrated their concern for the individual and their seriousness in using new technology to provide freedom and variety in individual experience.

Our experience has shown that the artist can make an important contribution in aspects of technology which involve the adaptation of technology to different cultures and environments, as it affects the individual. He is valuable in developing means for localizing the technology in terms of application, access and use, to support rather than destroy the indigenous cultural heritage and the dignity of the individual. There is growing recognition in the technical community and elsewhere that the hardware need not be a fixed constant, and there are no unalterable rules for using it. Whether a satellite or a tractor will bring a whole culture with it is an open question. But there is little known in this area of interface between the individual and technology and there is a great need for open-ended experimentation. In such experimental situations the artists' input is needed.

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The development of E.A.T. along these lines will begin with the establishment of national organizations in Japan and India. The involvement in the Pepsi Pavilion in Japan provided the contacts and impetus for the organization there. Two projects in India generated initial contacts and interest. Japan is the most industrialized nation in Asia and has begun to export technology; India is the most acute developing nation undergoing rapid introduction for technology in a situation of old, diverse and strong cultural traditions. The E.A.T. organizations will be oriented to experimental projects outside a specific institutional framework which utilizes the skills and talents of different professionals, including the artist. In addition to doing projects inside the country, members of these E.A.T. organizations would have direct contact with E.A.T. members in other countries to exchange information, experience, and collaborate on projects. An indigenous E.A.T. organization combined with the international contact between E.A.T. organizations will provide interested people a means for effective action on the problems introduced by technology in developed or undeveloped situations where the presence of the artist can have great importance."
"A Structure for E.A.T. International Activities and for Relations Between E.A.T. National Organizations," draft, 1971. E.A.T./GRI Box 11, Folder 4.

from the beginning. At a November 18, 1969 meeting, hardly a year since the group's inception, all but the minimum number of directors and officers resigned, including MacDermott. Ruth Baker was appointed as director and Acting President; Ardison Phillips became the Technical Director. As MacDermott wrote to Klüver, he had begun spending more time organizing and administrating than producing art—and felt that E.A.T. should become more removed as well:

> "My reasons for doing this are many and various, but essentially the most important one is simply that as an artist I am much more interested in making technological art myself than in encouraging other people to make it.
>
> As you know, my position is that E.A.T. should be a service organization for people who want to be involved in art and technology in any way. Fundraising, planning organizational strategy, increasing membership and publicity are not activities that hold any great interest for me in themselves, apart from actual art and technology projects. And, as you know, it is my opinion that E.A.T. should not be directly involved in projects. Such involvement should be carried out only by private individuals or profit-making corporations with E.A.T. performing limited, clearly defined services for them—such as publicity, person-to-person introductions or access to information resources."[158]

Financial cutbacks spurred the reorganization of E.A.T./LA and MacDermott's diminishing role. As Kullaway wrote to Klüver and Martin, the group sought even greater local autonomy, identity, and responsibility:

> "With all that upon us we held a meeting of the Board of Directors of E.A.T. of California corporation (the original founding group of A&T and then EAT/LA) to discuss the situation. It was felt by the group that in order for EAT to succeed at all it had to involve top level individuals in the leadership of the organization and that this could really only be done by having *local autonomy and identity* with corresponding responsibility for finances, program, policy, projects, etc. Thus, it

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[158] MacDermott wrote, "I am writing this to inform you of my resignation as Western Regional Director of E.A.T. … I am starting a new profit-making corporation called CHRYSALIS. With any luck at all, we should be able in a short time to provide the involvement and wherewithal for a limited number of artists, engineers, architects and filmmakers to get involved in some definite projects whereby they and CHRYSALIS can survive and thrive. I hope that E.A.T. will survive and thrive, too, so that we all can help to bring about the awareness which must precede reciprocal sharing of values between the artistic and technological communities. The only real change for betterment of the human condition on this planet depends on this." Letter from David MacDermott to Billy Klüver ("CABLE EATWESTERN"), December 5, 1969. E.A.T./GRI Box 29, Folder 16.

> was concluded that the California corporation, which now has legal operating status as a bona fide non profit, tax-exempt corporation, be activated as the EAT organization out here. Of course, we would want to have an official tie-in and affiliation with the New York corporation whereby we would coordinate activities in various areas, e.g. fund-raising, membership, publications, special projects."[159]

They hoped to reorient the board to more prominent figures, from Richard Feynman of Caltech to filmmaker Michael Whitney to Forkner to Al Hibbs, an engineer at JPL.[160] Over the course of the next year, the group successfully launched any number of programs, collaborations, and conferences, as noted above; but the higher-profile board and entrenchment into the LA "establishment" never quite took hold.

In April 1971, E.A.T./LA ran out of money. They discovered that E.A.T. NY did not have a right to operate offices outside of New York as a corporation, and therefore it could not pay salaries or cover expenses directly until it was qualified to do business in California.[161] If big science depended on the vertical integration of collaborative research groups *at the same time* as horizontal expansion via the geographic dispersion of science centers in cities and regions, E.A.T.'s local groups attempted *full horizontality*. But they could not sustain it.

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[159] Letter from Penny Kullaway to Billy Klüver and Julie Martin, Dec. 19, 1969. E.A.T./GRI Box 29, Folder 12. Emphasis added.

[160] "There are now nine vacancies which can be filled with appropriate 'heavies' from the LA area… Some prospects, a number of whom have already expressed interest in Board-level involvement, include: Richard Bellman, Ph.D. at USC; Feynman, Caltech; Citron, IBM; Michael Whitney, filmmaker; Al Hibbs, Jet Propulsion Laboratory; John Forkner, Philco-Ford; Herbert Blau, CalArts; … Gifford Phillips, 'industrialist/philanthropist,' of Phillips oil family." Letter from Penny Kullaway to Klüver and Martin, Dec. 19, 1969.

[161] As Klüver wrote to Ruth Baker and Ardison Phillips, "[it] became clear last fall when we discovered that the New York Corporation had not been qualified to do business in California …E.A.T. of California was not legally a separate organization. Our lawyers advised that we could not pay salaries or other expenses directly from the New York corporation until it was qualified to do business in California, and now the qualification procedures have stretched over a four to five month period." Letter from Billy Klüver to Ruth Baker and Ardison Phillips, April 28, 1971. E.A.T./GRI Box 29, Folder 14.

Perhaps this was the point. Local groups would persist in cities all over the world, from Tokyo to Ahmedabad to Detroit, but they, too, found it difficult to continue operations without sufficient support from E.A.T. Or, seen another way, they would gradually spawn independent activities that grew out of—but also away from—the aegis of E.A.T., so that the network continued even as it become unrecognizable.

Only big science could create the conditions for Bell, which became its apotheosis, or limit case. And only Bell could create the conditions for E.A.T. From the beehive of the laboratory to the open rainforest, from integration to decentralization, E.A.T. attempted to scale up a mode of experimentation specific to Bell Labs—yet horizontally dispersed and not vertically integrated. To spread, like the Bell System, but also distribute the sites and structures of research. I have argued that E.A.T. rerouted the free research already pioneered at Bell Labs. But, more specifically, E.A.T. sought radical decentralization *and* dehierarchized collaboration, over and against the research organization at Bell, which ultimately remained centralized in the pathways of Murray Hill and Holmdel. E.A.T. attempted to bring an "experimental method," as we might call it, to a vast scale—and yet provoke experimentation itself as an indissolubly specific, localized, and autonomous field of thought and action. Not an expansion that could be consolidated, not a diversification that could be hierarchized, but a *decentralization of invention itself.*

In this sense, E.A.T.'s network countered the logic of "systems" in the 1960s. E.A.T.'s decentered and multiplicitous nodes of research could not have been more different from the utopian legacy of the Bauhaus, with Kepes's model of an organicist pattern-seeing that would lead to morphological and social unification, to utopian harmony; and in which systems were predicated on modularity, symmetry, an attempt to once more rescue the human subject and "nature" from the sphere of capital.[162] If this organicist vision of homeostatic equilibrium, as Reinhold Martin has characterized it, came to define postwar systems and organizations more broadly—with big science itself an outgrowth of the already organicist dreams of the unity of science—E.A.T. fundamentally breached such fantasies of unification.[163]

There is no question that E.A.T. was made possible by big science. It could not have existed without it. And it dabbled, too, in Kepes's vision, actually partnering with Kepes and CAVS on occasion, as we have seen. But E.A.T. ultimately rejected the utopian rhetoric of systems, unity, and order: In an undated essay, "On the Thing in Stockholm," Klüver asserted that since Sweden seemed to be "the most 'perfect' society today," a model of civic and international harmony, "it must be the object of [the] thing to increase the entropy of such a perfect society—to create disorder."[164]

The irruptive invention and innovation of E.A.T.—its disorder, its turbulence—similarly departed from the systems of modularity in the likes of IBM. As John Harwood has argued, IBM promoted a logic of design, a counterenvironment, to *combat the disorder* of the actual environment; for IBM, scalar expansion explicitly followed a rationale of module and metonymy, of iterative self-similarity, metonymy, isomorphic

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[162] See Martin, *The Organizational Complex*, 185-87; Anna Vallye, "The Reenchantment of the World: Ruth Vollmer's Science," in *Thinking the Line: Ruth Vollmer, 1961-1978*, eds. Nadja Rottner and Peter Weibel (Ostfildern: Hatje Cantz, 2006), 98-115.

[163] Martin, *The Organizational Complex*, 186. See also Harwood, *The Interface*, 109.

[164] Billy Klüver, "On the Thing in Stockholm," manuscript, n.d. E.A.T./GRI Box 3, Folder 2.

regularity and sameness.[165] E.A.T.'s expansion clearly followed a different order, even Klüver's "disorder." Cage himself famously pronounced, "Where there's a history of organization (art), introduce disorder. Where there's a history of disorganization (world society), introduce order."[166] The Local Groups proliferated *against* iterative sameness, against modular repetition, and pursued radical specificity and hetereogeneity.

E.A.T.'s understanding of expanding, decentralized networks also departs from Burnham's model of systems, in which information processing always tends toward anthropomorphism—toward a focus on the ways in which machine systems mimic human cogitation, a technocratic replication of human life.[167] And while Klüver, Rauschenberg, Cage, and others were directly informed by Fuller's notion of synergy and McLuhan's global village, these models of seamlessness do not map onto E.A.T.'s network, either.[168] For the network has no center. Rather, it has *connections*, more or less of them; and, moreover, they are differential. (This is why, for Latour, actor-network

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[165] This logic of modularity was cloaked by the illusion of flexibility in the architecture of IBM: "…each modular element is articulated as a whole in and of itself, and as a part, or organ, within a greater whole made up of the iterative reproduction of said part. The imperative of flexibility that is so often stressed in the literature on the architecture of IBM, whether in professional architectural journals or in the company's own organs, is thus better understood as the amount of maneuvering room for the architect to articulate the module tectonically than it is as a matter of open plans and moveable partition systems." Harwood, *The Interface*, 137.

[166] John Cage, "Diary: How to Improve the World (You Will Only Make Matters Worse) 1965," *A Year From Monday: New Lectures and Writings* (Middletown, CT: Wesleyan University Press, 1967), 3-21; see also *Aspen* 4 (Spring 1967).

[167] See Rosalind Krauss, *Passages in Modern Sculpture* (Cambridge, MA: MIT Press, 1977), 209-212.

[168] On the reception of Fuller and McLuhan by Rauschenberg and Cage, see Joseph, *Random Order*, 184, 348; Eva Diaz, *The Experimenters: Chance and Design at Black Mountain College* (Chicago: University of Chicago Press, 2015); Pritchett, *The Music of John Cage*, 145-159. Klüver repeatedly described Fuller and McLuhan as being removed from "hard-core" science and engineering, and thus perhaps less effective in their efforts to unite art and technology. In the manuscript for his never-published book *Technology and the Individual*, he categorized them as such: "Current attempts to eliminate alienation of technology from the individual: development of groups removed from hard core, e.g. MacLuhan [sic], Fuller, C.P. Snow, Futurists, etc." Billy Klüver, "Technology and the Individual: Outline Proposal for a Book," April 15, 1968. E.A.T./GRI Box 120, Folder 4.

theory is precisely a way of looking at networks rather than systems, of understanding big science not as a seamlessly functioning, large-scale orchestration but as differential and discontinuous.[169])

I began with the observations of Weber, Adorno, and Latour, each of whom argued, in different moments, that expansion is a defining characteristic of modern organizations. Yet expansion was also the source of disarray, of excess, unraveling. Even as they were part of the invention of a globalized communications space—a smooth, coterminous, instantaneous world of "universal connectivity"—E.A.T. had to grapple with distance, disruption, and material difference. And even as AT&T would decentralize its network along the "long lines" of "distant early warning," E.A.T. explored the holes, the gaps, the roughness and slowness of the network. Even as E.A.T. partook in a wholly unprecedented, massive extension of the network, they also enacted its puncturing.

And so E.A.T.'s vision of expansion departs from the scalar expansion of big science and the mainstream postwar corporation, because its growth is based on *difference* rather than self-similarity. Its decentralization moves not toward order but toward *disorder*, not toward an abstract unity but toward material specificity and heterogeneity. Its growth, its entropy, would not be stabilized or contained. Seamless connectivity did not obtain. E.A.T. would spread through the aggregation of radically non-isomorphic domains and disciplines, via transformation, *transduction*.[170] If Klüver

[169] Bruno Latour, "Networks, Societies, Spheres: Reflections of an Actor-Network Theorist," http://www.bruno-latour.fr/sites/default/files/121-CASTELLS-GB.pdf, last modified February 19, 2010.

[170] Latour writes of scale, transformation, and the predication of scientific innovation on the extension of the network: "Every time you hear about a successful application of a science, look for the progressive extension of a network. Every time you hear about a failure of science, look for what part of the network has been punctured. I bet you will always find it." Latour, *Science in Action*, 249.

once pronounced that "The engineer is a material," E.A.T. promised nothing less than a mutual transformation of matter, agency, and ontology.[171]

E.A.T.'s network reached across radically different registers of time, space, scale—but its conception was not immaculate. Its scalability was not immediate, nor direct, nor seamless. Networks are predicated on scale: the more links they have, the farther they reach, the more powerful they are. And so the question of E.A.T.'s network became: how do you scale up sensation, the sensorium?

Normally, when we think of scale and experience, we think of Pop: of art's reckoning with mass culture. And mass culture in the postwar period is generally discussed in terms of spectacle and simulacrum—two ways in which the image is seen to have expanded and enforced relations of power at a mass scale. Indeed, for Fredric Jameson, postmodernism is defined by the image taking over the world, the total permeation of life by the image and, therefore, by art: by the very scale—the totalizing omnipresence—of the image in relation to the individual.[172] Spectacle, for instance,

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[171] Billy Klüver, "The Engineer as Material for the Artist," unpublished manuscript, circa 1966. E.A.T./GRI Box 3, Folder 2. As Klüver writes, "Technology as material—not for decoration. Material like paint, or stone. Everything has been used as material so why not technology? The painting is an object, the motion is an object, silence is an object, the person is an object—material. So why not technology? Why not the engineer?" (Klüver would also doubtless have been echoing information theory, which treats information as a physical quantity, like mass or energy.) This closely echoes Rauschenberg's materialist stance: "You see there is really very little difference between the action of paint and the action of people, except that paint is a nuisance because it keeps drying and setting." Robert Rauschenberg, quoted in Richard Kostelanetz, "The Artist as Playwright and Engineer," *New York Times Magazine*, October 8, 1966, 109. Finally, one can look to Cage's direct discussion of materiality in his short 1969 text in E.A.T.'s journal *TECHNE*, which recapitulates a number of his most famous pronouncements, and concludes with a specific discussion about E.A.T.: "Tried conversation (engineers and artists). Found it didn't work. At the last minute, our profound differences (different attitudes toward time?) threatened performance. What changed matters, made conversation possible, produced cooperation, reinstated one's desire for continuity, etc., were *things*, dumb inanimate things (once in our hands they generated thought, speech, action)." John Cage, "Art and Technology 1969," *TECHNE* 1, no. 1 (April 14, 1969): 11.

[172] Fredric Jameson, "Transformations of the Image in Postmodernity," in *The Cultural Turn: Selected Writings on the Postmodern* (London: Verso, 1998), 110-12.

creates the illusion of unifying people, even as it isolates them. It is a technique of creating mass, of size, where there is none. If, for Debord, the age of spectacle was heralded by the fact that "the image has become the final form of commodity reification," for Jameson the world had become "a vast collection of images, a multitudinous photographic simulacrum."[173]

Mass culture—and the art that engages it—has generally been defined as a mere reflection of this condition. But in E.A.T.'s largest collaborative project—the Pepsi Pavilion of 1970—such pieties regarding art and mass culture would be dismantled.[174] The Pavilion created a colossal, immersive environment that literally mirrored the expanding image-saturation of the world, or spectacle, or simulacrum. But it did not simply mimic that world. It pushed *beyond*, as we shall see—taking the "vast collection of images," the "multitudinous simulacrum," to its limits. And rather than mass culture, E.A.T. looked to big science. The Pavilion looked to a different model of scale and experience—only to undo it.

VII. Pavilion

It looked like smoke and mirrors. The Pepsi Pavilion, a giant dome created for the world's fair in Osaka in 1970, was shrouded in an all-encompassing and ever-shifting fog [Fig. 4.11]. Inside, one wandered within a 90-foot-diameter, 210-degree spherical mirror—the largest spherical mirror ever built. The optical effects were unprecedented: reflections that were fully three-dimensional, inverted, hovering in space [Fig. 4.12]. An

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173 Debord, *The Society of the Spectacle* (1967), trans. Donald Nicholson-Smith (New York: Zone Books, 1994), 32; Jameson, *The Cultural Logic of Late Capitalism*, 74.

174 This echoes, in part, Crary's aforementioned argument about the "eclipse of spectacle," its transformation from reified image into ceaselessly circulating data flows at some point in the 1970s. See Crary, "Eclipse of the Spectacle," 287.

elaborate, programmable electronic control system generated complex lights and sounds that demonstrated the equally wild acoustic properties of the dome. Wireless radio handsets allowed visitors to pick up different audio transmissions as they walked around.[175] Kinetic sculptures, lights, lasers, and performances animated the Pavilion throughout the interior and exterior [Fig. 4.13].[176]

Nothing could seem more spectacular, more redolent of the global expansion of technology and capital. This was a large-scale project, international in scope, which proffered a vast arena of sensory experience—but also of communications media, blending the physical movement of bodies with pulsing transmission, computation, and electronic systems. It was immersive; it went *beyond*. And the subtitle of the pavilion was, fittingly, "World Without Boundary."[177]

But the Pavilion was not just a simple reflection of the global village, not just another chapter in the story of culture subsumed into industry. It defies the fundamental binaries—art and technocracy, spectacle and anti-spectacle, subject and object, simulation and reference—with which we usually still talk about the postwar period. The Pavilion was riven with strangeness, multiplicity, testing, failure. And *unlike* so many

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175 E.A.T., "Loop system and handsets," September 26, 1969. E.A.T./GRI Box 46, Folder 5.

176 For extensive descriptions and accounts of the pavilion, see E.A.T., "Exhibit A: Live Programming for Pepsi Pavilion," Pepsi Pavilion contract, October 15, 1969. E.A.T./GRI Box 43, Folder 4. See also E.A.T., "Pepsi Contract," January 6, 1970. E.A.T./GRI Box 43, Folder 1. Press coverage included Philip Shabecoff, "Glittering, Clicking, Clanking Expo '70, in Japan, Emphasizes the Practical Use of Modern Technology, " *New York Times*, March 22, 1970, 15; Douglas Davis, "Improbable Marriage," *Newsweek*, April 20, 1970, 100; Barbara Rose, "Art: Getting It Together," *Vogue*, September 1, 1970, 304. E.A.T. published an entire book about the project with extensive documentation and essays by engineer, journalist, and E.A.T. member Nilo Lindgren and critics Barbara Rose and Calvin Tomkins: *Pavilion by Experiments in Art and Technology*, eds. Billy Klüver, Julie Martin, and Barbara Rose (New York: E. P. Dutton, 1972).

177 Pepsi-Cola and E.A.T., "Elements of the Pepsi-Cola Pavilion" and "A Walk Through the Pepsi-Cola Pavilion at Expo '70," Expo '70 press releases, September 30, 1969. MoMA/E.A.T. Klüver Documents, #135.

other pavilions or displays at Expo 70 and previous world's fairs—which were staged by the likes of IBM and Disney to present new information technologies, but nevertheless relied on essentially static proscenium displays of imagery—the Pepsi Pavilion constructed an *actual* technological system of programmable software and hardware. It was not a mere image of technology but an *operative* site of subject formation, of mediation, of a fantastical kind of *research and development*.

The very making of the Pavilion was a collective experiment: an unprecedented undertaking of more than 75 artists, engineers, and architects in collaboration—or competition—with Japanese and American construction firms, Pepsi executives, and festival bureaucrats [Figs. 4.14, 4.15].[178] This unwieldy aggregate renders impossible any tidy attributions of individual intention or agency, artist or engineer, author or patron, in the production of the Pavilion.

The Pavilion can, however, be traced along a set of contingent relations: a network. The artist and experimental filmmaker Robert Breer—who had participated in *9 Evenings* and other E.A.T. projects—happened to live in an upper-middle class enclave in upstate New York, and his neighbor happened to be a man named David Thomas, the Vice President of Pepsi Corporation [Fig. 4.16]. Pepsi had already garnered a spot for a pavilion at the upcoming Expo 70, and the soft-drink empire wanted to make the most of it: the fair was buzzing with high-tech designs and intermedia experiments by groundbreaking Japanese architects Arata Isozaki and Kenzo Tange; an overall view shows Festival Plaza, the center of the Expo, and pavilions for Kodak and Ricoh [Fig. 4.17]. This was the first Asian world's fair, and the largest world's fair ever; it was the

[178] E.A.T., "Pepsi Pavilion Organization: Responsibility list," 1969. E.A.T./GRI Box 43, Folder 13. See also "Expo 70 Participation," list of participants, March 11, 1970. Langlois EAT C9-4; 165.

first such event in Japan after the war.[179] Needless to say, the horrific near-past was to be sublimated in a display of nationalist, humanist, and techno-utopian pomp. Multinational corporations fit right in to this endeavor. Alan Pottasch, the president of PepsiCo Japan, had launched the massive and massively successful "Pepsi Generation" ad campaign in 1963, essentially inventing youth-oriented lifestyle marketing, and the Pavilion was intended to extend this futurist branding.[180]

Pottasch's first idea was a worldwide rock competition, a battle of the bands, with an original film—he thought it might be about sports—to be projected on six overhead screens inside a dome that Pepsi had already commissioned from a Japanese architect. Disney submitted a bid, but Pepsi balked at the projected budget of millions.[181] Thomas was then put on the project; he realized that the dome would have terrible acoustics for a live rock show; what's more, no one seemed interested. Thomas began to think that "We

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[179] For discussions of the geopolitical and social context of the Pavilion, see Hiroko Ikegami, "World Without Boundaries? E.A.T. and the Pepsi Pavilion at Expo '70, Osaka," *Review of Japanese Culture and Society* 23 (December 2011): 174–190; Midori Yoshimoto, "Expo '70 and Japanese Art: Dissonant Voices, an Introduction and Commentary," *Review of Japanese Culture and Society* 23 (December 2011): 1-12; Fred Turner, "The Corporation and the Counterculture: Revisiting the Pepsi Pavilion and the Politics of Cold War Multimedia," *The Velvet Light Trap* 73 (Spring 2014): 66-78. On Expo '70, technocracy, and intermedia in Japan, see Midori Yoshimoto, "From Space to Environment: The Origins of Kankyō and the Emergence of Intermedia Art in Japan," *Art Journal* 67, no. 3 (Fall 2008): 24-45; Miryam Sas, "Intermedia, 1955-1970," in *From Postwar to Postmodern, Art in Japan 1945-1989*, MoMA Primary Documents, eds. Doryun Chong, Michio Hayashi, Fumihiko Sumimoto, Kenji Kajiya (Duke University Press, 2012), 138-157; Yoshiaki Tōno, "Artists Participating in the World Expo, Speak Out!" (1970), trans. Christopher Stephens, in *From Postwar to Postmodern, Art in Japan 1945-1989*, 247-252. Tōno, like many others, refers to Osaka as the "expo of sound" (versus Expo 67 as the expo of film); and he emphasizes the anti-monumental experience of the Expo: "In rejection of such visible idols as the Eiffel Tower and Atomium…all the invisible incidents that occur inside the plaza—with regard to sound, light, and films created with a variety of devices, and the movement and inner experiences of people who gather, rest, pass through, kill time, and leave the area—have themselves been defined as the symbol of the Expo." Yet Tōno's interest in ephemeral and intangible experience was at odds with the overt monumentality and traditional symbolism of Tarō Okamoto's Tower of the Sun, the primitivist totem that loomed over Festival Plaza.

[180] See Alan Pottasch, oral history interview, 1984-85. The "Pepsi Generation" Oral History and Documentation Collection 1938-1986, Archives Center, National Museum of American History, Smithsonian Institution, Subseries 3.1.

[181] See Nilo Lindgren, "Into the Collaboration," in *Pavilion*, 5-6.

would be very smart, instead of going the gimmick route, to do something genuinely prestigious; to create a piece of contemporary art, one very much in keeping with an avant-garde group, but one also understandable by the people in Japan."[182]

In September 1968, Thomas asked Breer if he might be interested in participating. While Breer initially demurred, he realized that he might just have the perfect solution: E.A.T. If the group sought to facilitate collaborations between artists and engineers at a large scale, by 1970, E.A.T. boasted no less than 5000 members around the world, ranging from core participants like Whitman and Klüver to sociologists like Daniel Bell to physicists like Vikram Sarabhai, head of the Indian Atomic Energy Commission. The magnitude of this reach is unparalleled. It absolutely sets E.A.T. apart from other endeavors in art and technology at the time, which remained tethered to individual artists' practices or were rapidly subsumed into the academy or the museum.

E.A.T., in other words, formed an extraordinary homology between art and the rise of another kind of postwar organization: big science—that explosion in scale of scientific and technological laboratory research in the mid-twentieth century. So, too, the Pepsi Pavilion was E.A.T.'s largest single collaboration to date, focused on one work. And it was one of the largest single collaborations in postwar art. Not surprisingly, it was chaotic.

The project's organizational structure constantly changed as it unfolded, but it began with a loose echo of the large-scale laboratory from which so many of the participants came: Bell Laboratories. Klüver and the majority of the engineers who came to work on the Pavilion worked at Bell Labs; others came from Philco-Ford,

[182] David Thomas quoted in ibid., 7.

Caltech, Toshiba, laser manufacturers, plastics companies. What transpired at Bell, however, was a very particular—and ultimately short-lived—situation: it was unconventional even within the nascent and changing structure of the postwar R&D laboratory. Within several decades, Bell had given rise to more Nobel prizes, more inventions that shaped the whole of contemporary technology—from the transistor, which is the foundation of all digital computing hardware, to information theory, to the detection of the background radiation that proved the existence of the big bang. How it did so is the subject of extensive discussion in the previous pages; here, I will note one main characteristic that was cited, over and over, by Klüver and the other engineers who pursued their quixotic, off-duty dabbling in art: the fact of collaboration absolutely altering any deterministic or foregone conclusion, the fundamental open-endedness of the research, as opposed to the teleological and instrumental research of previous epochs. Later, after the Pavilion had been completed, Klüver would reiterate this commitment to failure: "we must be able to accept the experiment—the trial, trust people, accept failure, a method not bound to finite pre-conceived ends, but a search for an end which relates to basic moral and factual conditions… The only experiment that succeeds is the one that fails."[183]

As E.A.T. began work on the Pavilion, gradually bringing in more and more participants, any idea by an individual person would inevitably be changed by another. Breer felt that E.A.T. could function as an intermediary between artists and the corporate suits at Pepsi. "I couldn't deal with these company people. I couldn't speak their

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[183] Billy Klüver, "Notes on airplane," 4/26/1970. E.A.T./GRI Box 43, Folder 45. Klüver oft repeated his pronouncement that a researcher "who fails 96 percent of the time is more valuable than one who succeeds more often, because he is involved in truly important experimentation." Klüver, quoted in Douglas Davis, "Billy Klüver: The Engineer as a Work of Art," *Art and the Future* (New York: Praeger, 1973), 145.

language," Breer said.[184] For his part, Klüver was not interested in "simply building a better discothèque."[185] After much hand-wringing, Breer, Klüver, and Rauschenberg gathered a group of artists they felt would be interested; they won the contract from still-dubious executives at Pepsi—by the skin of their teeth. They also won, however, the stipulation that the company would not interfere whatsoever with the design and construction of the work.[186]

Robert Whitman, composer David Tudor, Forrest Myers, and Breer became the initial main players. Klüver brought engineers who had previously worked with artists via E.A.T., including John Pan, an MIT-trained electrical engineer who was working on new digital transmission systems—and could specialize precisely in the kinds of communication technologies that would go on to be central to the pavilion. With Ritty Burchfield and Julie Martin leading coordination and planning, the participants met and worked and planned in various sites, from New York to Osaka, in a temporary office at the Pavilion site [Figs. 4.18, 4.19]. The tension was high. How much independence, Kluver wondered, would an individual artist be willing to give up for one nebulous, common goal?[187] At first, they attempted the so-called Delphic method—essentially a consensus system, in which everyone had to agree or keep meeting until everyone did

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[184] Lindgren, "Into the Collaboration," 9.

[185] Ibid.

[186] "Pepsi-Cola…intends to have [the pavilion] in operation…from March 15, 1970 to and including September 13, 1970…The Pavilion structure is of a rigid and solid construction containing within a hemisphere mirror and special sound and light systems capable of diverse and varied themes and effects as more fully set forth in Exhibit A…E.A.T. represents and warrants that it has the capacity (a) to perform as an exposition programmer and producer ['creative director', 'operator'] for a major corporation exhibiting at an international exposition and (b) to prepare and produce programs for the operation of the Pavilion utilizing its shape, materials and equipment to realize its potential of themes and effects for public display." E.A.T./Pepsi Contract, January 6, 1970. E.A.T./GRI 43.1.

[187] Lindgren, "Into the Collaboration," 7.

agree.[188] Predictably, such meetings resulted in, well, nothing. Rauschenberg finally suggested the notion of an "invisible environment" that would affect all of the senses, taking advantage of the diversity of the participants' fields. One other factor also seemed determinative: everyone agreed that the pre-commissioned, faux-geodesic dome was ugly [Fig. 4.20]. So they wanted to hide it both from the inside and the outside. Gradually, the idea of a mirror dome, the fog, and various light, sound, and sculptural effects arose.[189]

But it is impossible, in fact, to assign points of origin to any one aspect of the pavilion. The fog idea came out of the meetings between Breer, Myers, Klüver, and Whitman, yet it would actually be realized by the young Japanese artist Fujiko Nakaya [Fig. 4.21], who had worked with E.A.T. previously but would now, with the engineer Tom Mee, devise a wholly new form and apparatus—a pure water fog, an enormous atmospheric sculpture that had never been produced before.[190] Whitman had worked extensively with mirrors and even spherical mirrors, but the idea of a full hemispheric mirror dome was equally a product of the group sessions, in which Tudor, for example, played a major part, as he was interested in the acoustical properties of a dome [Fig.

[188] E.A.T., Pepsi Pavilion meeting notes, December 10, 1968. E.A.T./GRI Box 44, Folder 1. See also "Project Meeting Notes, 9/8/69-10/6/69," which works out floor materials, lighting, and experiments with paneled mirror dome. E.A.T./GRI Box 44, Folder 1. See also "Job descriptions," Nov. 25, 1969. E.A.T./GRI Box 45, Folder 1. This document enumerates roles including engineer, program manager, coordinating artist, and tape librarian.

[189] "Responsibilities for the Pepsi Pavilion," June 1, 1969; " Tentative Plan for Pavilion Operations," November 21, 1969, diagrams. E.A.T./GRI Box 43, Folder 14. See also "Work schedule," n.d. E.A.T./GRI Box 45, Folder 7. This document includes extensive diagrams of timetabling and distribution of labor. See also Robert Whitman, "Notes on Pepsi proposal," October 1-2, 1968. E.A.T./GRI Box 43, Folder 35.

[190] Klüver and Pearce argued over whether to use Mee's system or Takenaka's Japanese equipment, ultimately deciding on Mee. Toshiba was contracted for the lighting system. "Decision has been made to accept Tom Mee proposal of Sept 13 for production of fog system." Telex from Klüver to EAT Central, Sept. 19, 1969. E.A.T./GRI Box 44, Folder 4.

4.22]. Moreover, the actual shape, material, and construction of the mirror dome were the outcome of many trials, dead ends, forking paths. The engineers contributed many ideas; fed off the artists; they prompted different ideas in each other. Klüver hired an architect, John Pearce, who would become pivotal to the organization of different, loosely grouped teams.[191] Eventually, a freewheeling combination of ad-hoc artist-to-artist and artist-to-engineer relationships developed in tandem with delegation, elaborate work schedules and programming timetables run by designated program managers that never quite went as planned [Fig. 4.23].[192] The technological trial, error, and realization of initial ideas changed the ideas themselves—and the very form of the work. Like so many E.A.T. collaborations before it, this was a kind of invention without end, a contingent process that defied the modernist teleological logic of scientific progress or instrumentalization.

Extensive research and testing ensued. For example, the group began with the vague idea of a curved mirror; initially, this was to have taken the form of a strip that ran centrally inside of a shell interior—just a vertical band, a section of a spherical mirror. But Klüver decided that nothing less than a full hemispherical mirror would produce the effects they had been discussing; he asked Garmire, the CalTech physicist (who became active in E.A.T./LA) to assist (along with optics engineer John Forkner of PhilcoFord, who had been working with Whitman).[193] After much exploration of a hard-panel mirrored construction versus an inflatable reflective structure, and after numerous bids

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[191] John Pearce, "An Architect's View," in *Pavilion*, 255-265. See also John Pearce Files, E.A.T./GRI 48.12.

[192] See programming and organizational charts for Pepsi Pavilion, 1970. E.A.T./GRI Box 43, Folder 14; E.A.T./GRI Box 44, Folder 29.

[193] E.A.T., "Project Meeting Notes, 9/8/69-10/6/69." E.A.T./GRI Box 44, Folder 1.

from various contractors, the group decided to attempt a full-scale prototype of an inflatable mirrored dome.[194] A top balloon technology firm, Raven Industries, supplied the materials, and members of E.A.T.'s local branch in LA constructed the model in a hangar in the Marine base in Santa Ana, California in September 1969 [Fig. 4.24].[195] Even the marines pitched in. Melinex, a metallized plastic that was 1/1000th of an inch thick, formed the membrane and had to be cut in precise sections, fitted together to extreme tolerances or accuracy, and then inflated to the exact point at which maximum surface tension was achieved—for the best optical effects—without bursting.[196]

The prototype burst with a deafening explosion [Fig. 4.25].[197] After the accident, the material was sent to Raven for repairs, and after three weeks, the prototype was

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[194] E.A.T.'s design thus joined a preponderance of pneumatic architecture at Expo '70. For example, the US Pavilion was a longspan, cable stiffened pneumatic dome (this new structure would be used in numerous American sports arenas constructed throughout the ensuing decade). The US Pavilion also, interestingly, had a reflective component: "The sloping inside of the berm—coated with rippling Mylar, a silver mirror-finished plastic—sparkles independently and reflectedly so that the entire structure is awash with light." See Davis, Brody, Chermayeff, Geismar, de Harak Associates, "U.S. Pavilion, Osaka, Japan: Structure & Exhibits," informational document, 1969. E.A.T./GRI Box 49, Folder 25. On the Fuji Pavilion and the numerous other inflated structures throughout the Expo, see John Canaday, "Esthetics of Expo: Big and Noisy," *The New York Times*, March 16, 1970. "The Fuji Pavilion's enormous pneumatic sausage walls, plus numerous growths and excrescences of inflated plastics throughout the fair, give you the feeling that if you don't like the looks of the world of the future, the most effective weapon against it would be an old-fashioned hat pin."

[195] "Report sent to Pepsi: Mirror dome for LA," July 14, 1969. E.A.T./GRI Box 45, Folder 27. "Material (mylar) from McCordi Corp = $465.00; Fabrication = $3240.00, Raven Industries; Construction: $6000."

[196] "Research and Development Report: E.A.T./Pepsi Expo 70 Project," Ardison Phillips and Envirolab, May 10, 1969. E.A.T./GRI Box 45, Folder 27. Garmire had enlisted the environmental artists David MacDermott and Ardison Phillips (part of the group Envirolab, begun by students at UCLA who had studied with Peter Cook of Archigram), who were already active with E.A.T./LA's Local Group, and would later become involved with Projects Outside Art. Melinex is a polyester film and was a trade name of Imperial Chemical Industries.

[197] E.A.T./LA, "LA Model Explosion," n.d. E.A.T./GRI Box 49, Folder 4. See also *The Great Big Mirror Dome* (1969), directed by Pavilion participant Eric Saarinen, which charts the making of the prototype in LA.

successfully inflated (with positive air pressure), and the first apparitions of the spherical mirror's effects could be glimpsed.[198]

With doubts about Raven, Klüver ultimately went to another contractor, G.T. Schjeldahl, who had successfully built the most well-known inflatable spherical mirror to date: the first telecommunications satellites, ECHO and PAGEOS, designed by NASA and launched in 1964 and 1966 [Fig. 4.26].[199] As I have noted, John Pierce himself had authored an article that inspired these first inflatable, passive satellite designs.[200] But while the satellites worked via their *exterior* surfaces, which reflected and therefore transmitted radio waves as they orbited the Earth, the Pavilion dome relied on the reflective properties of its *interior* surface, a heretofore untested scheme. Sigvar Stenlund, a project engineer on ECHO I and PAGEOS, became the lead engineer for the Pavilion balloon, eventually developing a negative air pressure design, so that the balloon was housed within a plywood shell; when a vacuum was created between the two layers,

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198 Ibid.

199 "Meeting minutes from G. T. Schjeldahl and E.A.T.," Nov. 5-6, 1969. E.A.T./GRI Box 48, Folder 10. Participants discussed the use of PAGEOS as model; fabrication tolerances; material requirements (1/2 mil. Melinex and 5 mil Tuftane); the reflectance of laminated material ("Eye check showed Melinex best reflective surface for experiments."); tear resistance; yield stress; wrinkle resistance; fire retardation; tensile strength, seal strength, etc. See also G. T. Schjeldahl, "Design Recommendations for Air Structure Mirror Dome," November 12, 1969. E.A.T./GRI Box 45, Folder 19. The document describes modeling the pavilion design on ECHO II and PAGEOS. The GRI/E.A.T. archives include informational materials from G. T. Schjeldahl describing their work for inflatable satellites, specifically the PAGEOS Melinex sphere for NASA: "Balloon Platforms for Space Research: How cost and reliability of balloon systems are meeting today's need in … Astronomy / Meteorology / Geophysics / Satellite Testing." E.A.T./GRI Box 45, Folder 19. "PAGEOS, a 100 ft. balloon designed and manufactured by Schjeldahl, was launched by NASA in a circular polar orbit 2600 miles above the earth. It will be photographed from 41 stations to establish geographic position of any point on earth to an accuracy of 32 feet or less." See also "Memo of meeting with Schjeldahl Company, Minneapolis, Minnesota, May 20, 1969." E.A.T./GRI Box 45, Folder 19. Attendees included Klüver, Karl Friberg, and four representatives from Schjeldahl; the group even discussed simply obtaining a used balloon from NASA to conduct the simulation in LA: "NASA has PAGEOS balloon, 100 feet, in stock. Perhaps will give free." Klüver made the request, which went unfulfilled; see letter from Billy Klüver to Dewey Clemmens, Langley Research Center, Langley Station, Hampton Virginia, May 22, 1969. E.A.T./GRI Box 48, Folder 1.

200 See John R. Pierce, "Orbital Radio Relays," *Jet Propulsion* 25 (April 1955): 153-157; William J. O'Sullivan, "Notes on Project Echo" (MS), n.d.

the balloon's normal air pressure caused it to inflate.[201] Pearce's architectural cross section shows the constituent layers of the structure and the subterranean entrance [Fig. 4.27]**.** The group undertook actual construction in Osaka with a Japanese contractor, Takenaka, with whom much trial and error and negotiation also took place.[202]

If the spherical mirror repurposed telecommunications technology to different ends, the fog was an invention without immediate industrial application. Although the fog idea had transpired in the initial meetings in New York, Nakaya had already been experimenting with steam and vapor; her father was a preeminent snow and cloud scientist.[203] So she became a natural fit to lead the conception of the fog. Elsa Garmire found a cloud physicist in LA, Tom Mee, who joined the effort.[204] A fog was rather easily produced using chemicals; but Nakaya insisted on pure water, an extremely difficult proposition.[205] The energy it would take to achieve the pressure necessary to

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[201] G.T. Schjeldahl, "Design Recommendations for Air Structure Mirror Dome," November 12, 1969. E.A.T./GRI Box 45, Folder 19. See also Letter from Elsa Garmire to John Pearce, Feb. 18, 1970. E.A.T./GRI Box 48, Folder 1.

[202] "The 120-foot-high, white-domed Pepsi-Cola Pavilion is designed and constructed by Takanaka/Mitsui Group, the largest building contractors for Expo '70. Tadashi Doi is the architect and T. Fujiwara is the architectural supervisor." E.A.T., draft for Pepsi Pavilion hostess manual, n.d. E.A.T./GRI Box 44, Folder 4. On the negotations with Takenaka, see "Mirror Meeting [2] with Billy Klüver, Komoguchi, Kubo, Nakayima, Ueda at Takenaka Office," 10/18/69. Indeed, Takenaka is noted as arguing that the "E.A.T. specifications are too severe." E.A.T./GRI Box 44, Folder 4.

[203] Fujiko Nakaya, "'FOG' Report III," May 9, 1969. E.A.T./GRI Box 46, Folder 7.

[204] Mee conducted a series of experiments before construction to test different possibilities for generating the fog. Letter from Tom Mee to Friberg, June 21, 1969: "[T]he state of the art is such that sufficiently accurate calculations cannot be made and the only way of arriving at a decision as to which system would best meet the needs is to conduct a series of fog-making experiments." E.A.T./GRI Box 46, Folder 10.

[205] Nakaya, "Investigations into Methods of Fog Production," *Techne* 1, no. 2 (November 1970): 8-9, 11-12. "There are several types of artificial fog: water fog, chemical fog, oil fog, or smoke. My choice was based on what I felt were the three most important requirements of the fog for our purpose:

1. Visibility—it should scatter enough light to reduce considerable the visibility of the objects behind, and at the same time, make visible the otherwise invisible dynamics of atmosphere.
2. Tangibility—it should feel soft and cool to the skin.
3. Vulnerability—it should be subject to atmospheric conditions; it should disappear, not persist.

I chose to use pure water fog. It was a purely aesthetic choice."

create water droplets that were small enough to not simply condense and fall right away was enormous, far greater than possible at the Expo site.[206] And so, throughout the spring of 1969, Nakaya worked with scientists at Chiba University and Fukushima Agricultural Research Institute on extensive tests generating fog with steam nozzles and agricultural atomizers. All of these systems, however, used too much energy, which could not be accommodated at the site in Osaka.[207] She then worked with Mee in June in California on various designs using spray, rather than steam, nozzles.[208] They ultimately devised a system of 2,500 tiny nozzles, 1/10,000th of an inch in diameter, which would spray the water droplets and break them up, with the requisite pressure to create a fog.[209] A diagram of the piping layout shows the pattern the system would take following the geometric lattice of the dome [Fig. 4.28]. That fall, Nakaya also pursued extensive wind-tunnel tests as well as analysis, with the Kyoto University Meteorology Department, of the environmental conditions at the fair site [Fig. 4.29]: how would the wind, the

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Nakaya, "Investigations into Methods of Fog Production," 8. Nakaya concludes that what first was an aesthetic choice was in fact guided by, and only made possible through, the functional constraints: "I kept saying I wanted ample fog for the Pavilion—the only design criterion I had for this. I wanted the fog to be there as a medium without directed energy or form of its own. Ample fog would preserve this neutrality. Technical details stimulated me in the process and gave substance to the image I had. I did make one important aesthetic decision in the beginning of the project—to use pure water fog. In the end, however, I could no longer say it was any more aesthetic than practical." Ibid., 12.

[206] Fujiko Nakaya, "Making of 'Fog' or Low-Hanging Stratus Cloud," *Techne* 1, no. 2 (November 1970): 3; this article appeared in an extended and revised version as Nakaya, "Making of 'Fog' or Low-Hanging Stratus Cloud," *Pavilion*, 207-223.

[207] Ibid.

[208] Tom Mee, "Notes and Comments on Clouds and Fog," *Pavilion*, 224-227; Nakaya, "Investigations into Methods of Fog Production," 9.

[209] Ibid.; Nakaya, "Making of 'Fog' or Low-Hanging Stratus Cloud," 3.

temperature, the pressure, affect the fog?[210] Nakaya discovered that Osaka's humid climate would allow the fog to cool the air; the fog would "cascade" around the dome in visible whorls and columns, and she decided to install nozzles all along the edges of the dome facets to amplify these cascading effects [Figs. 4.30, 4.31].[211]

Artists and engineers might work on a specific aspect of the pavilion—the fog, the mirror, the lights, the color or the concrete on the plaza—but they would also inevitably participate in other parts of the project, and each development in one area might affect another [Fig. 4.32]. According to Klüver, "*all decisions had the same intensity*."[212] The process posed a radical equivalence between aesthetic decisions and technological ones, between facture and function. Artists had to think like engineers and vice versa—at the scale of an organization.

Not only the ideas changed in the process. In a peculiar instantiation of Foucault's author function, one aligned not with the mythic production of individuality but rather of equanimity, each participant is shaped by the project: the participants may be seen as *effects*, rather than causes, of the work.[213]

Visitors, too, became effects [Fig. 4.33]. The Pavilion produced perceiving subjects—or, rather, multiple subject positions and shifting experiences. The mirror

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[210] Nakaya, "Making of 'Fog' or Low-Hanging Stratus Cloud," *Pavilion*, 221-222. As Nakaya recounts, she worked with researchers at the (interestingly named) Disaster Prevention Research Institute at Kyoto University to perform the wind-tunnel tests.

[211] Nakaya, "'FOG' Report III." See also Nakaya's undated diagram of the distribution of nozzles across the roof, in plan and section. E.A.T./GRI Box 46, Folder 7.

[212] Billy Klüver, "A Pavilion," essay manuscript, telex to Fujiko Nakaya, May 17, 1970. E.A.T./GRI Box 47, Folder 43. See also Billy Klüver, "The Pavilion," *Techne* 1, no. 2 (November 6, 1970): 1.

[213] I draw on Aden Kumler's rereading of Foucault's author function in terms of patronage. See Aden Kumler, "The Patron Function," in *Power and Agency in Medieval Art*, ed. Colum Hourihane (Princeton: Index of Christian Art, and State College, PA: Pennsylvania State University Press, 2013), 297-319.

dome, first of all, was a *media space*, an apparatus for generating points of view, for proliferating encounters with reflection. But these were not reflections of an ordinary kind. Near-holographic, three-dimensional, inverted reflections had never been produced at this scale; they hovered in space, above visitors' heads, and could be perceived fully in the round—front, sides, and back—if one circled the image, complete with parallax and perspectival distortion [Fig. 4.34].[214]

VIII. Real and virtual

In the language of optics, these were "real images"—images that are produced by the actual convergence of light rays. Real images are distinguished from so-called "virtual images," which we see only because of the *appearance* of converging rays. When we look in a flat mirror, we see a *virtual* image, one that is right-side up and that appears "behind" the mirror [Fig. 4.35].[215] But the "real" images in the Pavilion hung *in front* of the mirrored surface, in the same space as the viewer [Figs. 4.36, 4.37].[216] Rather than returning a body that was vertically oriented, commensurate, with our own, the Pavilion images were remarkably palpable, marvelously illusionistic—and yet inverted, unmoored, uncanny. In other words, these "real" images were not so real after all.

And each individual view was unique and irreconcilable: Each person saw a reflection in a slightly different position [Figs. 4.38, 4.39]. This was because of a phenomenon called spherical aberration—the different parts of a spherical mirror reflect

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[214] Elsa Garmire, "An Overview," *Pavilion*, 173-206; 196-206.

[215] Elsa Garmire, "Calculation of the Optical Effects of a 27.5-m Spherical Mirror," *Applied Optics* 10, no. 12 (December 1971): 2760-2762; Billy Klüver, "Photographic Recording of Some Optical Effects in a 27.5-m Spherical Mirror," *Applied Optics* 10, no. 12 (December 1971): 2754-2759; Garmire, "An Overview," *Pavilion*, 196-204.

[216] Ibid.

to different positions, generating a multiplicity of focal points (rather than a parabolic mirror, which can be adjusted to home in on just one focal point) [Fig. 4.40].[217] "No two people can have exactly the same image world," as Garmire put it.[218] The dome was composed of an "infinity of worlds."[219]

But light did not only reflect once, of course. Because light kept bouncing around the dome, the infinity of worlds dramatically multiplied again: The Pavilion generated an exponential barrage of first-order and second-order and third-order images and so on [Fig. 4.41].[220] For example, walking toward the mirror itself, away from the center, one would see not only a real image or a virtual image but its reflection and then *its* reflection, in turn; reflections of reflections of real images of virtual images and virtual images of real images [Figs. 4.42-4.44].[221]

Conversely, something in the dead center of the pavilion, on the raised platform, would flood the entire dome with its image [Fig. 4.45].[222] Far from any stable mimesis, this dizzying speculum descended into vortices of magnification, distortion, and transience.

This is why, I think, accounts of the mirror dome seem caught in an endless confusion between the real and the virtual, in the broader senses of the words. On the

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[217] Garmire, "Calculation of the Optical Effects of a 27.5-m Spherical Mirror," 2760; Garmire, "An Overview," *Pavilion*, 196-204.

[218] Garmire, "An Overview," *Pavilion*, 199.

[219] Ibid.

[220] Garmire, "Calculation of the Optical Effects of a 27.5-m Spherical Mirror," 2760-2762; Klüver, "Photographic Recording of Some Optical Effects in a 27.5-m Spherical Mirror," 2754-2759.

[221] Ibid.

[222] Kluver, "Photographic Recording of Some Optical Effects in a 27.5-m Spherical Mirror," 2754-2759.

one hand, many spoke of the experience as strikingly embodied, corporeal, material; yet others characterized it as "elusive, non-real, immaterial, virtual, imagistic… the opposite of a real environment of real objects."[223] As the critic Barbara Rose put it, "The experience of an interior space distended, its limits seemingly dissolved, its edges and actual shape ambiguous nearly to a point of incomprehensibility is unlike any other spatial experience created by painting, sculpture, or architecture.... The strangeness of an experience of an intangible space that could not be precisely defined was singular."[224] And according to critic Gene Youngblood, in the Pavilion, "the differences between art and life, the real and the unreal, are being utterly and finally erased. The concept of reality is no longer relevant."[225] This is also why, it seems, that the group ultimately

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[223] "When the mirror is 'turned on' the environment becomes elusive, non-real, immaterial, virtual, imagistic. We have found a Japanese word which covers the effect that the mirror will have on the visitors: KYOZO. Kyozo means an environment which means essentially the opposite of a real environment of real objects." E.A.T., "Report on the live programming of the Pepsi Pavilion: Sept. 22, 1969." E.A.T./GRI Box 45, Folder 1.

[224] Barbara Rose, "Art as Experience, Environment, Process," *Pavilion*, 60-104; 100.

[225] Gene Youngblood, "Technology as Empire," *Los Angeles Free Press*, October 3, 1969, 25. Youngblood's account is nothing less than a narration of simulacra: "Art as experience has become art as existence in the phenomenal world. We no longer ask what is real; we ask why it is real.…In television's elaborate movie-like subjective-camera 'simulation' of the first moon landing the history of subjective art, with its emphasis on content, came into total confront with the history of objective art and its emphasis on process. As we saw the event, reality was not half as 'real' as the simulation because it was the reality of a process of perception. We were seeing nothing but videospace; the simulated reality turned out to be only the reality of a simulation.…Civilization is entering its High Tech stage so that future technology can exist on a supra-mundane metaphysical level of pure information. There have been some fascinating examples of this trend recently in the new information-oriented technological art, but none so radically unprecedented as the spherical mirror developed by the West Coast branch of Experiments in Art and Technology (EAT) for the Pepsi Pavilion at Expo '70 in Osaka. I've never seen anything so spectacular, so radiantly sensuous, so transcendentally surrealistic as this giant womb-mirror.… the overwhelming, almost frightening experience of entering the mirror: a shocking phenomenon occurs inside this shimmering space that was not anticipated by anyone involved: actual three-dimensional graphic images float in space.… The effect is mind-shattering. One is overwhelmed with a sense of vertigo. One is unable to walk in a straight line. It's there and it's not there. Incredible phantasmagorias of color and light whirl insanely about the entire environment. You approach the wall and it comes out at you, massively, ephemerally: you reach out to touch it and grab air. The effect is utterly unlike anything I've ever experienced. MacDermott and Phillips admit that their biggest problem now is how to deal with the space visually. There simply are no parameters for human activity in this kind of environment.… Through aesthetic decisions as to the uses of technology the differences between art and life, the real and the unreal, are being utterly and finally erased. The concept of reality is no longer relevant."

rejected projected images: They would not enable such extreme fracturing of perception and multiplicity of points of view. Rather than the static projection of images or the rapid-fire projection of information to be scanned, the mirror dome's reflections—and the performances commissioned inside it—were ever-changing, transpiring in lived time but also somehow exceeding it.[226]

This was not a conquest of the real, but an escape from the real. The mirror dome was, to put it another way, a form of simulacrum. For the simulacrum, as Michael Camille has argued, rests on subject position—a false likeness that appears as such because of where and how we are viewing it, versus a copy or an icon, which is "other but like" [Plato] … or because, in Gilles Deleuze's formulation, there is *no* subject position, no privileged point of view, "except that of the object common to all points of view."[227]

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[226] Others had proposed projected images for the Pavilion—from Electric Circus to Hollywood effects firms—many of which involved projected images and rapid-fire, sensory overload. These would be more akin to the fast scanning of information/control seen in the Eames's multimedia World's Fair pavilions; in Stan VanDerBeek's Movie Drome; Warhol's Exploding Plastic Inevitable; and even the flashing projected images of the Philips Pavilion or Disney's Circarama. See, for example, a proposal from Petersen Company, Hollywood, April 10, 1969: "A Suggested General Technique Treatment for A EXPO-70 Special—Designed to Stand On Its Own or to be Adapted to Either of the General Theme Treatments Covering Pepsico's Participation Which Have Been Submitted," submitted to NBC. E.A.T./GRI Box 45, Folder 1. The proposal's evocation of a "Machine-gun rapidity" of inundation of images recalls VanDerBeek's notion of "visual velocity": "Image multiplicity—The simultaneous appearance on the screen of more than one image.…compartmentalization of the screen area to accommodate different scenes…The conscious and the sub-conscious of the viewer absorb the images and their information on a mental peripheral basis for later recall, sorting and integration. Obviously, when the screen can carry, and the mind can absorb more than one image simultaneously, the normal time requirements for communication have been compressed"; "Capsulization—this involves images being presented individually, but with machine-gun rapidity in an audio rhythm pattern—all in the context of the Gestalt configuration for quick storage by both the conscious and sub-conscious. Later, the images are sorted, arranged sequentially, and absorbed in the mind of the viewer to achieve composite understanding. Again, when the mind can absorb fleeting images, each summarizing whole areas of information, the normal time requirements for communication have been compressed. Beyond its primitive stage this is an intricate and very advanced technique—most exciting."

[227] Michael Camille, "Simulacrum," in *Critical Terms for Art History*, 2nd ed., eds. Richard Shiff and Robert S. Nelson (Chicago: University of Chicago Press, 2003), 35-48;37. Camille proceeds to brilliantly read Baudrillard and Debord's notions of simulacrum against the grain. See Jean Baudrillard, "Simulacra

It is no coincidence that the telecommunications satellite provides the morphology for the mirror dome. Indeed, the Pavilion is an inversion of the satellite mirror: the reflective surface as a communicative relay *outward* is here flipped inward, to an *interior* of illusion and transformation [see Fig. 4.25]. And the interior itself is suffused with a wireless broadcast network of its own, a web of radio waves and receiver handsets [Figs. 4.46, 4.47]. This inversion betrays, I think, a fundamental anxiety about the loss of the subject position in the global network. It betrays a deep-seated anxiety about the loss of *resemblance* itself, the disappearance of tangible reality within the amplifications and waves and networks of modern telecommunications.[228]

But the Pavilion does not pose, as salvation, a vision of a seamless global village—a utopian communications network, as so many works of expanded cinema or Pop art would. Nor does it simply attempt a return to presence, to some stable real, lamenting the loss of authenticity or truth. Rather, the Pavilion plunges into illusion and phantasmagoria, into "another order of reality entirely" [Fig. 4.48].[229] As simulacrum, it maintains resemblance only to better *undermine* resemblance's "hold over the real," as Camille has so beautifully put it.[230]

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and Simulacrum" (1981), in Baudrillard, *Selected Writings*, ed. Mark Poster (Stanford: Stanford University Press, 1988), 166-184.

[228] One might say that the Pavilion explores the limits of likeness, resemblance, and analogy rather than index, representation, or copy, to echo Kaja Silverman's recent meditation on the question of analogy and photographic representation. See Kaja Silverman, *The Miracle of Analogy* (Stanford: Stanford University Press, 2015).

[229] Camille, "Simulacrum," 44.

[230] Camille, "Simulacrum," 46.

So if the Pavilion is usually glossed as spectacle—as an ungraspable alienation, an image apart, the distortion that is ideology[231], a false consciousness, an illusion of encounter—it is because, in many ways, it is.[232] But in the Pavilion, spectacle is *heightened*, pushed to its limits: It becomes a means by which, to return to Camille, illusion tips over into delusion, semblance into dissemblance.[233]

Where the mirror pushes illusion over into simulacrum, to a vertiginous loss of reference, the fog turns seeming evanescence into a resolutely physical, material, experience [Figs. 4.49-4.51]. Nakaya did not want a wafting ether; she wanted it to occlude, to be tangible, "feel soft and cool to the skin," she wanted "a fog to walk in, to feel and smell, and to disappear in."[234] It should also be vulnerable to atmospheric conditions—making visible the otherwise invisible dynamics of the atmosphere, a "negative sculpture" of the environment, as she called it, an eliciting or bringing forth of

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[231] Debord, *Society of the Spectacle*, 150-51.

[232] Branden W. Joseph and Gloria Sutton, in very different ways, have advanced critiques of the Pepsi Pavilion that describe it in terms of pure image or simple spectacle. See Joseph, "Plastic Empathy: The Ghost of Robert Whitman," *Grey Room* 25 (Fall 2006): 64-91; and Gloria Sutton, *The Experience Machine: Stan VanDerBeek's Movie Drome and Expanded Cinema* (Cambridge, MA: MIT Press, 2015), 156-166. For Joseph, the Pepsi Pavilion is a "temple to the narcissistic self," citing the case in which the image of an individual floods the interior—thus aligning with Vanderbeek and McLuhan's notions of a global village, in which the other is fully absorbed into self, without remainder; as the culmination of the rhetoric about expanded cinema as pure instantaneity and presence. But I would argue that this does not account for the radical multiplication and distortion of the reflected image, of the "real" and "virtual" image, all reflected and multiplied again in second-, third- and multiple-order images. And I would also argue that, unlike VanDerBeek's Movie Drome, the Pavilion was in fact the precise opposite of environments that rely on the projected image; instead, the Pavilion produced "real" and "virtual" images, reflected in real time; it did not produce speed and "visual velocity" but slowness; it did not induce the viewer to take a static position (often lying down) but a perambulatory one; finally, the Pepsi Pavilion is not anti-illusion, but rather pushes illusion to its limits. In this sense, I would caution against false binaries of real/imaginary, which the Pavilion undoes in favor of a multiplicitous subject position.

[233] Camille, "Simulacrum," 45.

[234] Nakaya, quoted in Lindgren, "Into the Collaboration," 41.

the moisture already in the air.[235] This was, as I have outlined, an extremely difficult proposition. In practice, the conditions were so cold at first that, according to Nakaya, the condensation was extreme and it was practically raining! The fog was so thick, entering it meant one got drenched, one could not see one's hand in front of one's face.[236] (The first day, the Expo authorities thought the fog was smoke and called the fire department.)[237]

Within the fog, one would also encounter Breer's 7-foot-tall *Floats*, as they were titled—kinetic fiberglass capsules moving so slowly as to be barely perceptible—huge and obdurate, but reversing course when anything or anyone bumped into them [Fig. 4.52].[238]

This entirely immersive disorientation, this destabilization of experience, was also a kind of negative materialization of the mirror dome's unmooring of vision. Indeed, the floor inside the mirror dome was another tactile foil to the shimmering expanse above; it was divided into sections that were textured with different materials—gravel, grass, carpeting, Japanese stone, wood, and so forth.[239] A vast arsenal of sound effects were

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[235] Fujiko Nakaya, interview with the author, September 10, 2014.

[236] Ibid. See also "Atmospheric Disturbance: Michelle Kuo and Julian Rose on Fujiko Nakaya at the Glass House," *Artforum International* 53, no. 3 (November 2014): 131-133.

[237] Calvin Tomkins, "Outside Art," *Pavilion*, 105-171; 141. Reprinted from *The New Yorker*, October 3, 1970, where it was published as Tomkins, " Onward and Upward with the Arts: E.A.T."

[238] John Ryde, "Float Project: Target Specifications," June 12, 1969. E.A.T./GRI Box 45, Folder 31. See also letter from Robert Breer to John Pearce, June 6, 1969. E.A.T./GRI Box 45, Folder 31. On the design and assembly of the Floats, see letter from Ryde to Breer, Klüver, and Sebastian Hiraga (of Pepsi-Cola Japan), November 20, 1969. E.A.T./GRI Box 45, Folder 31. On the audio system (tape cartridges and speakers) for the Floats, see letter from Larry Owens to Ryde, August 21, 1969. E.A.T./GRI Box 45, Folder 31.

[239] E.A.T., diagrams of floor layout according to material, texture, and other variables, n.d. E.A.T./GRI Box 46, Folder 6.

programmed by Tudor, Toshi Ichiyanagi, and Gordon Mumma, with additional programming submitted by artists from Terry Riley, LaMonte Young, Tony Conrad, Pauline Oliveros, and Anna Halprin.[240] Choreographer Remy Charlip and artists such as Tony Martin contributed laser, light, and performance programs, all generated from magnetic tape recordings, controlled via a central console, an interface and conduit for these flows of information [Fig. 4.53].

> "It is the responsibility of the four resident programmers to estimate and understand the methods whereby 90% of the visitors will stay for a time period shorter or equal to the average visiting time. (15 minutes). The idea of the pavilion has always been that people should be able to walk through and experience the environment at their own pace. However, for obvious reasons these stays for the average visitor cannot be very long. We want, however, to leave the possibility open that a few per cent of the visitors can stay longer if they so wish.…
>
> Responsibility for inducing the visitors to leave the pavilion after the average visiting time is over lies completely with the programmers. This responsibility should be understood by the programmers before they accept the role of resident programmer. The homogenous nature of the programming implies that *any visitor can come in at any point in the program and see the full cycle without feeling that he has seen something that begins and ends*."[241]

This was in stark contrast to Pepsi's vision of an automated, iterative experience, as well as the use of motion sensors to register and regulate crowd flow in other pavilions.[242] As Nakaya underscored, "PepsiCola has always insisted from the beginning on automatic

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[240] See Pepsi Pavilion programming proposals, 1969-1970. E.A.T./GRI Box 48. See also E.A.T., "Report on the live programming of the Pepsi Pavilion: Sept. 22, 1969." E.A.T./GRI Box 45, Folder 1.

[241] Ibid. Emphasis added. Pavilion Live Programming Worksheets diagrammed the workflow. E.A.T./GRI Box 44, Folder 34. See also letter from Peter Poole to programmers, Jan. 20, 1970: "Most programs will be semi-automatic; that is, they will involve programming cards, light programmer tape, and master programmer tape; but will also require the presence of someone at the console to introduce alterations and modifications whenever necessary. Each day. The programmers work out amongst themselves who does this, and for how long. At the moment we cannot anticipate how much console operation time will be necessary each day. Of course this will vary with the program." E.A.T./GRI Box 44, Folder 34.

[242] For an analysis of Expo 70 and technologies of automation and cybernetics, see Thomas Daniell, "Bug Eyes and Blockhead," *Log: Observations on Architecture and the Contemporary City* 36 (Winter 2016): 34–47.

programming, repeat of 10-20 minute program, which obviously conflicted with our notion of changing environment."[243]

The Pavilion becomes a profound exploration of the material and the immaterial. In it, the "primacy of mediation has replaced primacy of representation," to echo Bruno Latour: a network of technological tools and aesthetic objects and mutating subjects, all troubling the very notion of real and representation, things and beings, inert matter and active anima.[244] But this upending of object/subject dualities is not about leveling, flattening things and beings into sameness. It is about *specificity*: the differentiation and multiplicity of all these phenomena, the experience of individuation, now set in stark relief.

The Pavilion produced completely *new* experiences—and its instigation of conflicting and shifting subject positions and object relations does nothing less than point to an alternate world, a kind of science fiction, in which new networks might function as "communications systems that are based *not on notions of authenticity* but *on the parameters of positioning vision itself* (who is looking and from where, rather than what are they looking at, and is it real or imaginary?)."[245] The Pavilion thwarts any simple binary of imaginary wholeness or fragmentary real. Rather, the Pavilion pushes the boundaries of each—in an exploration of likeness, recognition, and simulation**.** And in contrast to the "self-indulgent play" of Baudrillard's hall of mirrors, as Camille puts it,

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[243] Letter from Fujiko Nakaya to Billy Klüver, May 22, 1970. E.A.T./GRI Box 47, Folder 44. These comments are part of Nakaya's editorial recommendations for Klüver's "A Pavilion" manuscript (which was published in various versions in *Techne*, *Bijitsu Techo* and then *Pavilion*).

[244] Latour, *We Have Never Been Modern*, 131-138. See also Latour, "On Technical Mediation—Philosophy, Sociology Genealogy," *Common Knowledge* 3, no. 2 (Fall 1994): 29-64.

[245] Camille, "Simulacrum," 47; Donna Haraway, "A Cyborg Manifesto," in Haraway, *Simians, Cyborgs, and Women: The Reinvention of Nature* (New York: Routledge, 1991), 161. Emphasis added.

the Pavilion engages simulacrum, technology, and the imaginary as powerful forces.[246] It "forsakes dualisms *for a remapping of relations of power*." And science, as Camille argues, is the very "site of simulacra."[247]

In a way, the Pavilion, and the loss of orientation and reference therein, is an experience of media—an experience of the *network*, which is non-spatial, existing outside of classical Cartesian space and linear historical time. Moreover, the Pavilion is an attempt to *remap* the network, to rearrange its coordinates, to reconfigure the *dispositif*.[248] These new relations between individual and network are manifested through a stunning loss of hierarchies between soft and hard, mechanical and informatic, figure and ground, chance and control.

But this dream of a reconfigured world was not to be. It was cut short by Pepsi itself: the company men were shocked by E.A.T.'s blowing through of budgets and, moreover, by the experimental and alienating quality of the performance, sound, and light programming.[249] Suffice to say, after a month, relations broke down, and in April 1970 Pepsi ejected E.A.T. from the Pavilion, replacing Tudor's microtonal compositions with

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[246] Camille, "Simulacrum," 46.

[247] Camille, "Simulacrum," 47. See also Jean Baudrillard, "The Precession of Simulacra," in *Art after Modernism: Essays on Rethinking Representation*, ed. Brian Wallis (New York: New Museum of Contemporary Art, 1984), 253-281. Emphasis added.

[248] See Giorgio Agamben, "What Is an Apparatus" ("*Che cosè un dispositivo?*," 2006), in Agamben, *What Is an Apparatus? And Other Essays*, trans. David Kishik and Stefan Pedatella (Stanford: Stanford University Press: 2009), 1-24.

[249] Toward the end of March 1970, disputes with Pepsi start to occur over the second overhead charge bill and E.A.T.'s accounting, their attempts to get salaries paid, etc. See E.A.T. telexes between Osaka and New York, March 17-19, 1970. E.A.T./GRI Box 47, Folder 14. By April, disputes arose between Whitman and other E.A.T. artists and Sebastian Hiraga (of Pepsi-Cola Japan) over control of certain Pavilion performance aspects. See telex from Robert Whitman to EAT CENTRAL (the code name adopted for E.A.T. headquarters in New York), April 14, 1970. E.A.T./GRI Box 47, Folder 24.

the dulcet strains of Disney's "It's a Small World."[250] One "rogue" engineer, Larry Owens, stayed behind; Nakaya and others smuggled out E.A.T.'s programming tapes.[251]

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[250] The Pavilion thus went from E.A.T.'s chosen theme, "World Without Boundary," to "It's a Small World." Extensive telex correspondence details the negotiation and Pepsi's ouster of E.A.T. By April 21, 1970, Klüver wrote to their lawyer, Robert Mulreany: "Julie: Please forward the following telex to Robert Mulreany: I understand that Perry Keats [Pepsi's lawyer] has sent you a letter concerning the termination of the Pavilion. But negotiations will continue with Russ Mooney and Allan Pottasch. In the meantime we are using tapes and hard wired cards in the Pavilion. I would appreciate that you contact PC [Pepsi-Cola] New York and confirm that the design and content of these belong to EAT or others to avoid misunderstanding.… Pavilion was programmed as usual today by EAT. Programs were: *Pepscillater* by David Tudor, *Songs of Vanishing Whales* by Harry Harper, *Shadow Left on the Moon* by Rikuro Miyai. A new program was introduced by Pauline Oliveros and Lynn Lonidier. Fog tests were conducted all day by Fujiko, Carl and Peter." Telex from Billy Klüver to Julie Martin and Robert Mulreany, April 21, 1970. E.A.T./GRI Box 44, Folder 14. Martin annotated the telex with the following handwritten note: "They don't like esthetics…They are trying to push us out…Collins complains we can't get anything done." Mulreany and Keats subsequently negotiated over the termination: "The following letter was received by Robert Mulreany: 'April 20, 1970 / Dear Bob, / Your client has informed us it has withdrawn its offer to perform programming services at the Pepsi Cola Pavilion at Expo 70 in Osaka Japan for 185,000 dollars. Your client has further rejected our counter-offers. In view of this, this letter constitutes formal notice that the services of your client for programming of the Pavilion will not be needed effective immediately. / Very truly yours / W. Perry Keats / Counsel / Pepsi Cola Japan Ltd.' Mulreany drafted this reply for your consideration: 'Dear Perry / I have your letter of April 30, terminating the services of E.A.T. in connection with the operation, programming and maintenance of the Pepsi Cola Pavilion at Expo 70, Osaka Japan. Your letter does not state the facts as I understand them. / At the request of, and with authority from, your client, E.A.T. was engaged to, and in fact has been, operating, programming, and maintaining the Pepsi Cola Pavilion since before the opening of Expo 70. We will expect your client to honor all commitments made by E.A.T. prior to April 21, 1970, in the performance of its duties on your behalf and to pay a reasonable fee to E.A.T. for the services rendered by it.'" Letter draft, Robert Mulreany, April 21, 1970. E.A.T./GRI Box 44, Folder 14.

[251] Nakaya reported: "I walked out of the Pavilion at 11pm with Richard and student assistant and driver through the only exit left open. Keats and Collins stopped us and asked if we were leaving the pavilion as of tonight. Richard answered we were not in the position to answer such questions. They asked if we had any Pepsi property such as tapes 'mainly tapes' Perry Keats repeated. I said the bag I had contained only what I brought this morning with me. They fingered through my bag and repeated the question. I mumbled that I did not have to go through this and walked through. Richard was again questioned to which he answered they were all personal property and he did not carry anything such as tapes etc. Perry Keats asked if we were leaving the pavilion for good and I answered I was going to Grand Heights to send some Telex and I may come back or may not … I was so angry that I walked out ahead of Richard and others who were still detained. As I opened the door there was a cleaning man …who was just coming in with a pile of tapes which he found on the ground. He said, 'Are these tapes yours? I found them lying there and brought in Keats and Collins were ten feet away from me but were busy checking Richard. Those were the tapes Peter threw out the window after the Pavilion closed and doors sealed (lock broken so that it could not be opened from inside)…I just said 'yes' and grabbed the tapes and walked to the car. Those were the floor loop tapes and they are safely home … We still have more tapes in the Pavilion and we will try to get them out. Pauline Peter Carla Ardison Kosugi Ritty are still at the Pavilion. We don't know what's happening there but we will let you know." Telex from Fujiko Nakaya to EAT CENTRAL, April 24, 1970. E.A.T./GRI Box 44, Folder 14.

By mid-May, Nakaya surreptitiously reported on Pepsi's takeover (spearheaded by Sebastian Hiraga of Pepsi-Cola Japan) of the programming: "I know the fog is not there now the system is out of order…As for creepys [the Floats] I hear that they are turning the creepys area into a gogo plaza in the evening…" Telex from Nakaya to Klüver, May 15, 1970. E.A.T./GRI Box 47, Folder 41.

Afterward, E.A.T. would continue, and its network would continue to grow for several years, as we shall see; but the Pepsi Pavilion remained the largest single collaboration of the organization. Meanwhile, back in 1962, Bell Laboratories had already moved into its brand new building in a new town in New Jersey, designed by Eero Saarinen [Figs. 4.54, 4.55]. Many E.A.T. engineers were still based in the older Murray Hill facility, but it was becoming clear that what had been an extraordinary environment of testing and failure and quixotic science was by then leveling out—the fantastic involutions of the Pavilion mirror dome now flattened into a single gleaming plane, the vast curtain wall of the Bell complex dubbed "The Biggest Mirror Ever."[252]

"Creepies are now bow-wowing, and cockadoodling. All creepies now have animal sounds. They have made waiting areas (one step lower than creepies plaza) between creepies plaza and snack area into a discoteque in the evenings with red light flashing (Hiraga's choice)…There are no laser display in clam room because of technical problem. Student said that Miyata has been back to fix it but couldn't (power fractuation problem or something) and Larry also spent long time trying to fix it but in vain. Hiraga is planning to have shadow pictures with flash…going on every once a while… in the clam room and some other attraction in there. He is going wildly happy to implement his ideas. Student says he is operating the whole thing. They don't plan to have any artists as programmers…They are on endless tape and repeat cycle is about 5 minutes…" Telex from Nakaya to EAT CENTRAL, May 16, 1970. E.A.T./GRI Box 47, Folder 41.

[252] "The Biggest Mirror Ever," *Architectural Forum* 126, no. 3 (April 1967): 33-41; 37. The Holmdel curtain wall was, in fact, the first large-scale application of two-way vacuum-coated mirrored glass—a two-way mirror. See Reinhold Martin, *The Organizational Complex*, 210-211. It was blindingly reflective—opaque—during the day, then completely transparent at night, paralleling, in a totally different register, the opacity, transparency, and reflection of the Pepsi Pavilion. The building itself emblematized the monumental research facilities being constructed at the time: "Saarinen's industrial laboratories were an incarnation of the new face of corporate R&D—shrines to basic research—and far bigger than any university." Scott G. Knowles and Stuart W. Leslie, "'Industrial Versailles': Eero Saarinen's Corporate Campuses for GM, IBM, and AT&T," in *Science in the American Century*, eds. Sally Gregory Kohlstedt and David Kaiser (Chicago: University of Chicago Press, 2013), 260.

CHAPTER 5

BEYOND CONTROL:

AUTOMATION HOUSE

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Automation is inseparable from accident. Such an assertion may seem surprising, since the rise of technological automation after World War II is typically understood as the vast implementation of *control*. From thermostats to computers, industrial production to information processing, automated systems aim at the sweeping simulation and regulation of cognition and action.[1] But aims are not always met: Unpredictability, error, and malfunction are bound to the proliferation of control systems themselves. This turbulence is constitutive of the *risk society*, as defined by sociologist Ulrich Beck—a

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[1] "Control," as we have seen, is the leitmotif that spans industrial production to artificial intelligence, from the postwar fields of operations research and cybernetics to that of organizational theory. It is also, of course, the premise for Gilles Deleuze's formulation of a "society of control," which I have specifically discussed in relation to cybernetics in the previous chapters and will take up further in the last portion of this chapter. On the origins of postwar control science, see S. Bennett, *A History of Control Engineering 1930-1955* (London: Peter Peregrinus, 1993); and James R. Beniger, *The Control Revolution: Technological and Economic Origins of the Information Society* (Cambridge, Mass.: Harvard University Press, 1986). In 1965, sociologist Daniel Bell outlined the basis of automation in terms of "Control," a sweeping technological and epistemic phenomenon: "The Age of Automation," he wrote, "is part of a social transformation in which new attitudes about the world are being formed…The heart of these attitudes lies in the idea of 'Control,' the growing awareness and knowledge of processes which allow us to regulate the wide variety of 'systems' which are operative in the world: machine systems, economic systems, social systems, and eventually, perhaps, political systems. Feedback mechanisms allow us to control machine systems; planning devices (whether used by corporations or by government) allow us to anticipate economic change and assess the consequences; organizational analysis can be used to locate strains or disjunctions in complex social systems, be they hospitals, prisons, universities, voluntary associations, or corporations; new intellectual tools, such as simulation or game theory, give us some means of providing a more rational foundation for political decisions." Daniel Bell, "Preface," Sir Leon Bagrit, *The Age of Automation: The BBC Reith Lecture Series 1964* (New York: Mentor Books, 1965), xi-xii. The term *automation* itself was coined at Ford Motor Company in 1947; key early texts on automation, control engineering, and their socioeconomic implications include: John Diebold, *Automation: The Advent of the Automatic Factory* (New York: Van Nostrand, 1952); Diebold, *Beyond Automation: Managerial Problems of an Exploding Technology* (New York: McGraw Hill, 1964); Landon Goodman, *Man and Automation* (Harmondsworth, Middlesex: Penguin, 1957); and *Automation and Technological Change*, ed. John T. Dunlop (New York: American Assembly, Columbia University, 1962). On the distinction between automation and automata and the relationship between automata and interactivity, see Erkki Huhtamo, "From Cybernation to Interaction: A Contribution to an Archaeology of Interactivity," *The Digital Dialectic: New Essays in New Media*, ed. Peter Lunenfeld (Cambridge: MIT Press, 1999), 96-111.

condition in which "risks arise precisely from the triumph of the instrumentally rational order."[2] Technological rationality manufactures threats that inadvertently escape its own tools of probabilistic measurement and control. Whether in markets, war, politics, or ecology, such effects both spring from and destabilize automated systems; indeed, they drastically undermine the very premises and institutions of late modernity. What would it mean to come to terms with automation and its uncertainties? This was the question behind Automation House, a peculiar architectural structure at 49 East 68th Street in New York that opened to the public in March 1970 [Fig. 5.1].

Behind the statuesque façade of a six-story Colonial Revival house, built by the august architectural firm of Trowbridge & Livingston in 1913-14, a stunningly incongruous system was inserted into the building. When the doors of Automation House opened in 1970, one would have seen a complete renovation of the interior: A flexible structure with a network of audiovisual and telecommunications equipment laced the walls, charged by the equivalent of a city block of electrical power coursing through its cables and circuits. It was an uncanny experience—perhaps best captured in the slow, acedic takes of Gordon Matta-Clark's *Automation House*, 1971, a combination of video and 16-mm film produced and shot in the building, in which mirror reflections, glass partitions, television screens, and elevator doors fuse and recombine in a seemingly

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[2] Beck writes, "The category of risk stands for a type of social thought and action that was not perceived at all by Max Weber. It is post-traditional, and in some sense post-rational, in the sense of being no longer instrumentally rational (*post-zweckrational*). And yet risks arise precisely from the triumph of the instrumentally rational order." Ulrich Beck, "The Reinvention of Politics: Toward a Theory of Reflexive Modernization," in *Reflexive Modernization: Politics, Tradition and Aesthetics in the Modern Social Order,* ed. Ulrich Beck, Anthony Giddens and Scott Lash (Cambridge: Polity Press, 1994), 5. For Beck's primary elucidation of the "risk society," see Ulrich Beck, *Risk Society: Towards a New Modernity*, trans. Mark Ritter (London: Sage Publications, 1992).

endless reflexivity [Fig. 5.2]. We see a dynamic architectural and informational system tremble and splinter.

I. The Machine Stops

Automation House was the result of an unlikely alliance between two non-profit organizations, the American Foundation on Automation and Employment (AFAE) and E.A.T. If, as we have seen, E.A.T. aimed to "catalyze" unexpected outcomes in both art and technology—now more than ever perceived as rarefied and specialized disciplines—then theirs was a venture apparently far from the world of organized labor and trade unions. Yet from the beginning, E.A.T. saw industrial labor as a key arena in which to negotiate increasingly explosive and unpredictable relations between technology and society. In its ensuing engagement with labor organizations and industrial management alike, the group's overture to collaborative activity diverged from its neo-avant-garde counterparts: it was not only concerned with the negation of individual (romantic, bourgeois, humanistic) authorship in favor of an aesthetics of administration.[3] Nor was it aligned with mimesis or parody. Instead, E.A.T. attempted to actively *alter* and *repurpose* the structure of systems of production and communication—and the progressively immense, omnipresent, and flexible conditions of technocratic labor.

E.A.T. recognized that postwar technologies had become inseparable from the logic of large organizations, as manifested in corporations, universities, government, the military, and an industrial complex (or, as C. Wright Mills famously described it, a newly

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[3] On Benjamin H.D. Buchloh's seminal formulation of an "aesthetics of administration" in postwar conceptual art (and its relation to tautology and mimesis), see Buchloh, "Conceptual Art 1962–1969: From the Aesthetics of Administration to the Critique of Institutions," *October* 55 (Winter 1990): 105–143.

“permanent wartime economy”) joining all of these sectors.[4] The group thus sought to intervene at each internal level of organization—including the shop floor, research laboratory, middle management, and executive administration—even as these hierarchies were being fundamentally reconfigured. Collaboration could not just take the form of a one-to-one interaction between artist and engineer, but had to account for the magnitude and complexity of industrial institutions in order to have actual effect. Size mattered: There had been over forty participants in *9 Evenings* in October 1966; over the next several years, E.A.T. grew to include 5,000 members.[5] As I have argued, the sheer numbers had suggested that collaboration could take place on an unprecedented scale. In 1967, E.A.T. launched its ambitious program to place artists in residence at various industrial research laboratories, match engineers and artists for specific projects, and create an "'underground' in industry."[6] But not only would the organization of thought and invention be of concern; the organization of *production as a whole* was at stake. Looking again at the group's remarkable early organizational chart from 1967, it is

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[4] C. Wright Mills, *The Power Elite* (Oxford: Oxford University Press, 1956), 215. See also the other two texts in Mills' trilogy on American political, military, and economic power: Mills, *White Collar: The American Middle Classes* (New York: Oxford University Press, 1951); and Mills, *The Sociological Imagination* (New York: Oxford University Press, 1959). For an extrapolation of Mills' ideas roughly contemporaneous with the activity of E.A.T., see: Seymour Melman, *The Permanent War Economy* (New York: Simon and Schuster, 1974). More recently, Reinhold Martin has analyzed the postwar expansion of the military-industrial complex into architecture, design, and aesthetics; see Martin, *The Organizational Complex* (Cambridge: MIT Press, 2003).

[5] As discussed in Chapter 2, ten artists, over thirty engineers, and numerous others who assisted in the production—not to mention hundreds of volunteer performers who participated in Rauschenberg's piece, *Open Score*—took part in *9 Evenings*. On the collaboration and production of *9 Evenings*, see also *9 Evenings: Art, Theatre, and Engineering*, ed. Catherine Morris, exh. cat. (MIT: List Center for the Visual Arts, 2005).

[6] *E.A.T. News* 1, no. 1 (January 15, 1967): n.p.

apparent that "Industrial Relations" figured at the very center [Fig. 5.3].[7] The diagram maps an operative flow circulating between laboratories, professional groups, E.A.T. staff, and artists: Nothing less than direct relations with industry in all its facets would suffice.

E.A.T.'s concerted effort to engage industrial management structures and organizational networks resonated with an American labor sector in crisis over the implications of automation.[8] When Klüver and Rauschenberg met with Theodore W. Kheel—a prominent New York labor lawyer and mediator and president of the American Foundation on Automation and Employment[9]—in 1967, Kheel recounted, "Klüver, Rauschenberg, and I had lunch together, and before the meal was over, I realized that there was an identity of purpose between us. We were all interested in using technology to help the individual."[10] Kheel had served as the executive director of the federal government's National War Labor Board from 1944-1949 (overseeing a staff of 2,500 who were hearing 150 labor disputes a week), and he had famously presided over high-stakes negotiations such as the New York City newspapers' strike of 1962-63 and the

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[7] *E.A.T. News* 1, no. 1 (January 15, 1967): n.p. The flow chart was originally presented at the first organizational meeting of E.A.T. in New York on December 14, 1966.

[8] The unemployment rate jumped from 5.5% to 6.7%; it receded to 3.5% by 1969. For specific assessments of the impact of automation on U.S. labor and employment in the 1960s-70s, see Wassily Leontief and Faye Duchin, *The Impacts of Automation on Employment, 1963-2000: Final report* (New York: Institute for Economic Analysis, New York University, 1984); Eva Mueller, *Technological Advance in an Expanding Economy* (Ann Arbor, MI: Institute for Social Research, University of Michigan, 1969).

[9] Interview with Julie Martin, November 21, 2006, Berkeley Heights, New Jersey; see also Norma Loewen, "Experiments in Art and Techology: A Descriptive History of the Organization" (Ph.D. diss., New York University, 1975), 117-119. It is likely that John G. Powers, the lawyer, art collector, and president of the Aspen Institute for Humanistic Studies, introduced Klüver and Rauschenberg to Kheel. Powers was appointed Chairman of the Board of Directors for E.A.T. in 1967.

[10] Theodore W. Kheel, cited in Renata Adler, "Automation House," *The New Yorker* XLVI, no. 4 (March 14, 1970): 30-32.

1964 U.S. railroad walkout (at President Lyndon B. Johnson's request). He founded the AFAE in 1962 in response to the alarming spike in American unemployment in 1961.[11] Like other public figures of the time, Kheel had a taste for publicity and an early flair for press persuasion, but it is clear that he was intently focused on technological systems on the workplace. Kheel and the AFAE intended to preemptively confront profound changes in modes of production.[12] Indeed, if automation had become one of the most urgent problems of the day, it was precisely because its effects were uncertain. Manufacturing jobs as a percentage of total employment in the U.S. dropped nearly five percent from 1960 to 1970, but it was unknown to what extent other types of employment would offset this decline.[13] Automation encompassed not only mechanical systems but informational and communicative ones as well. Changes in the technologies of work, the extent of the replacement of humans by automated processes, and the skills required to manage these processes were taking place, yet remained unpredictable in both scope and kind. Unemployment, fiscal volatility, and dehumanization were widespread fears: would the body of the worker be forsaken for or straitjacketed by the machine, the carnal

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[11] "Labor Peacemaker Theodore Woodrow Kheel," *The New York Times*, October 11, 1965, 46. See also "Arbitration Opinion," Local 100, Transport Workers Union of America vs. the New York City Transit Authority, 1963; Theodore Woodrow Kheel Arbitration Papers, #5024, Kheel Center for Labor-Management Documentation and Archives, Cornell University Library.

[12] Kheel was a partner in the law firm of Battle, Fowler, Stokes & Kheel. On Kheel's biographical information and approach to labor mediation, see Theodore W. Kheel, *The Keys to Conflict Resolution* (New York: Basic Books, 1998).

[13] Manufacturing productivity also declined in the late 1960s, but rebounded in the early 1970s. Gerald A. Epstein and Juliet B. Schor, "The Rise and Fall of the Golden Age," *The Golden Age of Capitalism: Reinterpreting the Postwar Experience*, eds. Stephen A. Marglin and Juliet B. Schor (Oxford: Oxford University Press, 1991), 75.

made carceral?[14] Kheel aimed to contend the deep anxiety concerning these unknowns and their potentially negative consequences.

During the October 1967 E.A.T. press conference at Rauschenberg's Lafayette Street loft in New York, Klüver and Kheel announced that their groups had entered into partnership [Fig. 5.4]. Both organizations would make their executive headquarters in a new building, dubbed Automation House.[15] As the third issue of the group's newsletter, *E.A.T. News* [Fig. 5.5], explained in November 1967, "When complete, Automation House will provide facilities for seminars, meetings, bull sessions, performances, demonstrations and presentations of works of art resulting from the collaboration between artists and engineers."[16] The goal was greater access to and knowledge of automation across the social sphere; just as artists might develop alternate models of automated systems, engineers and technicians might attend a job training seminar or join a workshop on experimental video. The AFAE would also assist E.A.T. in administration and fundraising. The latter accordingly declared "Labor" as a first priority:

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[14] For a succinct explanation of these debates, see: Bagrit, *The Age of Automation: The BBC Reith Lecture Series 1964*; J. James Miller, "Automation, Job Creation, and Unemployment," *The Academy of Management Journal* 7, no. 4 (December 1964): 300-307.

[15] *E.A.T. News* 1, no. 3 (November 1, 1967): 1. See also Billy Klüver and Robert Rauschenberg, "Statement" (preparatory document for October 1967 meeting), October 1967, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 11, Folder 1. Kheel also provided access to senior management figures with whom E.A.T. hoped to enter into dialogue; "Mr. Klüver feels that it wasn't until Mr. Kheel came on the scene in June that the proposed program began to make headway. It was then that the enormous practical difficulties of reaching presidents and boards became less imposing." John J. O'Connor, "Art & Technology Make it Official," *The Wall Street Journal*, October 11, 1967, 16. O'Connor also emphasizes the uniqueness of such broad support from both industrial management and labor: "Until now, support of industry for the arts has followed rather safe lines of donations toward already rather well established individuals and groups. With E.A.T. the commitment is toward experiment and research, an unknown quantity. That industry, and not only management but labor, is demonstrating its support is a sign that the future might not be that predictable after all." Ibid.

[16] *E.A.T. News* 1, no. 3 (November 1, 1967): 1.

> "The support E.A.T. has received from the labor movement may be the beginning of new possibilities for the many projects of artists that are large-scale like the *9 Evenings*. Such large projects involving new technology to a great extent create new working situations that rely on and involve the cooperation of labor. Conversely E.A.T. can contribute to the labor movement's direct contact with contemporary art."[17]

Formal support from the AFL-CIO's new Scientific, Professional, and Cultural Employees Council was announced, as was an alliance with the International Association of Machinists and Aerospace Workers, Transportation Workers Union, and National Maritime Union, all of the AFL-CIO, and Local 3, International Brotherhood of Electrical Workers Union.[18] Records show that at this early stage, already over four hundred artists and one hundred engineers had joined E.A.T. as members: The group boasted considerable reach (and internal, corporate-style "news bulletins" to boot). As Klüver would later claim, in 1969, "industry must sponsor this collaboration because no other sector of society can do it. The growth has been too fast for us to handle. Something like 40 or 50 local groups all over the world are now more or less affiliated with E.A.T., and this means that thousands of artists and thousands of engineers are involved."[19] By March 1970, they were to count 2,500 artist members and 2,000 engineer members.[20] In short, E.A.T. had reached the status of a complex organization.[21]

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[17] *E.A.T. News* 1, no. 3 (November 1, 1967): 3. The newsletter introduced the AFAE as a parallel organization: "The American Foundation on Automation and Employment is a non-profit organization whose aims are to encourage the use of automation by solving the employment problems it creates and to demonstrate what labor and management can accomplish in their own and the public interest by working together." Ibid., 8.

[18] E.A.T., press release for conference, October 17, 1967, Museum of Modern Art Archives, E.A.T. Klüver Files, Document #56. See also Anon., "Labor, Industry Encourage Merger of Art, Technology," *AFL-CIO News*, October 21, 1967, 2; Anon., "Technology Art Group Gets Labor, Industry, US Backing," *Electronic News*, October 16, 1967, 6.

[19] Billy Klüver, "Artists, Engineers, and Technology," *Technological Change and Human Development: An International Conference, Jerusalem, April 14-18, 1969,* ed. Wayne L. Hodges and Matthew A. Kelly (Ithaca, NY: New York State School of Industrial and Labor Relations and The American Foundation on Automation and Employment, 1970), 343.

The joint effort between the organizations demonstrated how pressing the issues of automation, labor, and collective action were to E.A.T.; as cultural historians including Anson Rabinbach, Pamela M. Lee, Erkki Huhtamo, and Reinhold Martin have shown, the problem of automation resonated throughout the postwar cultural sphere.[22] In 1967, the situation was articulated by none other than Guy Debord, who devoted one of his numbered entries in *The Society of the Spectacle* to automation:

> "Automation, which is at once the most advanced sector of modern industry and the epitome of its practice, confronts the world of the commodity with a contradiction that it must somehow resolve: the same technical infrastructure that is capable of abolishing labor must at the same time preserve labor as a commodity—and indeed the sole generator of commodities … new forms of employment have to be created. A happy solution presents itself in the growth of the tertiary or service sector…"[23]

Perhaps more than any other undertaking in the art of this time, the Automation House project crystallized the bitter argument over automation, labor, and the insecurity of these terms. The supposed "coming of postindustrial society" (as sociologist Daniel Bell, who had in fact become a member of E.A.T. in 1968, called it) would not, in fact, come quietly.[24] The ascent of automation in industrial production

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[20] *E.A.T. Information*, March 18, 1970, 1.

[21] E.A.T., "Growth of E.A.T. National Membership," *Experiments in Art and Technology: A Summary,* Appendix VII, April 1969, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 44, Folder 22.

[22] See Pamela M. Lee, *Chronophobia: On Time in the Art of the 1960s* (Cambridge: MIT Press), 108-110; Huhtamo, "From Cybernation to Interaction: A Contribution to an Archaeology of Interactivity"; Martin, *The Organizational Complex*. Jean Tinguely's *Metamatics* and Gustav Metzger's concept of "Auto-Destructive Art" were just two of the pointed explorations of the implications of automation from the late 1950s to the mid-1960s.

[23] Guy Debord, *The Society of the Spectacle* (1967), trans. Donald Nicholson-Smith (New York: Zone Books, 1994), 31.

[24] Daniel Bell, *The Coming of Post-Industrial Society* (New York: Basic Books, 1973). See Daniel Bell, membership form, October 13, 1968, Box 10, Folder 3.

coincided with volatile labor unrest in the decades after World War II.[25] Historian David F. Noble has called this period of turmoil "The War at Home," when American government and corporate management viewed labor disturbances as a major internal security threat, a domestic manifestation of the peril posed by communism abroad.[26] The advent of Computer-Numerical-Control (CNC) and automatic data processing (ADP) in manufacturing and information processing in the late 1940s was directly linked to the containment of this internal danger.[27] Moreover, the mainframe computer arose as a tool for "*organizing* rather than performing physical work," as Paul Edwards has written; they were *information* machines.[28]

The postwar push for automatic control thus coincided with an attempt to concentrate the power of production in management and not labor—to reinforce and secure institutions at a point when they had become so complex and chaotic as to defy

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[25] Between 1945 and 1955 there were over forty-three thousand strikes in the U.S., involving twenty-seven million workers, parallel to the introduction of large-scale automated processes. "Dimensions of Major Work Stoppages, 1947-1959," *Bureau of Labor Statistics Bulletin* 1298 (Washington, D.C.: U.S. Government Printing Office, 1961).

[26] David F. Noble, *Forces of Production: A Social History of Industrial Automation* (New York: Alfred A. Knopf, 1984). Indebted to the work of Lewis Mumford and C. Wright Mills, Noble's study also extrapolates from the seminal analyses of automation and deskilling in Harry Braverman, *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century* (New York and London: Monthly Review Press, 1974). Braverman had argued that the introduction of new technology deskilled workers, but he concluded that the main source lay not in the changing relation between workers and their machinery, but in the increased control by management that was being made in the name of technical efficiency.

[27] Noble, *Forces of Production*, 244-46. The concept of "Numerical Control" was initially developed by the U.S. Air Force after World War II with the goal of an automated manufacturing system capable of producing components for aircraft and weapons. The MIT Servomechanism Lab, in partnership with a commercial helicopter rotary blade manufacturer, developed the Numerical Control system that led to numerically controlled milling machines and contemporary CAD (Computer-Aided Design) systems—integral to precision cutting and forming of metals and other materials. See Francis J. Retijles, *Numerical Control: Making a New Technology* (New York and London: Oxford University Press, 1991), 134-40.

[28] Paul N. Edwards, *The Closed World: Computers and the Politics of Discourse in America* (Cambridge: MIT Press, 1996), 28.

earlier modes of organization.[29] Yet by the late 1950s and early 1960s, this effort met with growing opposition. The implementation of industrial automation triggered massive conflicts and numerous strikes.[30] The structure of middle management itself was in upheaval: as an AFAE study of 1965 determined, "the full impact of automation on middle management had only just begun and … by 1975 not only would their numbers be materially reduced but their jobs would be so completely changed that training for middle management would call for entirely new forms of instruction."[31] A wrench had been thrown into the Fordist production cycle, one that would ironically allow—yet never completely cede to—new modes of lithe and immaterial labor.[32]

Collective bargaining, that core tactic of industrial modernity (first developed during the Industrial Revolution in the late nineteenth century, but a mainstay of Keynesian economics of the 1920s and '30s and its emphasis on market regulation),

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[29] Noble, *Forces of Production*, 56-57.

[30] Numerous strikes, including sustained unrest at General Electric in 1963-65, typified the clash between labor and management in the first half of the 1960s. In 1965, President Johnson formed the National Commission on Technology, Automation, and Economic Progress, which quickly issued a report downplaying the unrest in the face of a growing "service sector." See Milton Derber, "Collective Bargaining: The American Approach to Industrial Democracy," *Annals of the American Academy of Political and Social Science* 431 (May 1977): 83-94; and Noble, *Forces of Production*, 262.

[31] "American Foundation on Automation and Employment," Automation House advertising supplement, *The New York Times*, February 1, 1970, 5. See also *Automation and the Middle Manager: What Has Happened and What the Future Holds*, ed. Theodore Kheel (New York: American Foundation on Automation and Employment, 1965).

[32] It is too striking to ignore the parallel between an era of mechanization built on thermodynamic, probabilistic models of energy and the fluid technologies and systems that would historically follow. In his canonical study of human labor and modernity, Anson Rabinbach has shown how Taylorism and Fordism sought to harness the thermodynamic model of nature as a form of mechanized labor power in the early twentieth century; moreover, in the postwar West, "The attempt to replace social conflict with the calculated management of *risk* is still at the core of the contemporary welfare state. It is precisely this element—the future of the risk-free society—that has most recently come into question in contemporary European and American debates on the future of the social state." See Anson Rabinbach, *The Human Motor: Energy, Fatigue, and the Origins of Modernity* (Berkeley: University of California Press, 1992), 293-295. Emphasis added.

likewise faced serious challenges in the growing displacement of labor from centralized sites to dispersed networks.[33] Indeed, the very rise of the large-scale managerial class in the postwar period was supplanting the power of unions and the role of external mediation in industry.[34] By the time Kheel and the AFAE organized a special conference on "Technological Change and Human Development" in Jerusalem in 1969, participants repeatedly asserted that in the face of the transformation of job classifications (and the resulting obsolescence of trade unions) and the growth of multinational corporations, a different model of negotiation was needed, one at the global level.[35] Klüver and Rauschenberg themselves attended the conference. Klüver delivered a paper that argued for "direct access" and contact between individuals—not only artists—and the "closed economic systems" of contemporary industry.[36] He went so far as to argue that the artist "acts as a kind of prototype of man's future access to all the possibilities of technology in terms of changing environments," seeking to harness the egalitarian possibilities of newfound labor flexibility.

[33] See Beatrice Webb, *The Cooperative Movement in Great Britain* (London: Swan Sonnenschein & Co., 1891). On the development of economic models of collective bargaining (and its impact on wage levels) in the latter half of the twentieth century, particularly Ian McDonald and Robert Solow's theory of efficient bargaining of 1981, see Ben J. Heijdra and Frederick van der Ploeg, "Trade Unions and the Labour Market," *The Foundations of Modern Macroeconomics* (Oxford: Oxford University Press, 2002), 187-212.

[34] Alfred D. Chandler, Jr., *The Visible Hand: The Managerial Revolution in American Business* (Cambridge: Harvard University Press, 1977), 478-483; 492-494.

[35] Peter Parker, "The Role of the International Company," and Benjamin C. Roberts, "Concluding Panel," *Technological Change and Human Development: An International Conference, Jerusalem, April 14-18, 1969,* ed. Wayne L. Hodges and Matthew A. Kelly (Ithaca, NY: New York State School of Industrial and Labor Relations and The American Foundation on Automation and Employment, 1970), 281-304 and 360-361.

[36] Billy Klüver, "Artists, Engineers, and Technology," Hodges and Kelly, eds., *Technological Change and Human Development: An International Conference, Jerusalem, April 14-18, 1969*, 342-346.

In fact, from the moment of the initial design, Automation House was also designated as headquarters for the Institute for Collective Bargaining and Group Relations, which was headed by Lane Kirkland, a former secretary-treasurer of the AFL-CIO, and dedicated to the revision of the concept of negotiation itself in order to adapt to changing modes of labor organization and communication. Engineers and scientists—some newly unionized under the aforementioned AFL-CIO council, others members of profession groups such as the IEEE—joined electricians, machinists, and executives, all of whom had to confront disparately evolving sectors of work and resources. (Members of the International Brotherhood of Electrical Workers had even assisted in the production of *9 Evenings*; Klüver claimed, somewhat hyperbolically, "one could not tell who was an artist and who was an electrician."[37]) This was a threshold moment in the discourse of labor, one in which the hardscrabble protests of Teamsters would not yet have been economically and geographically displaced by the conference-room conversations of Google coders. The two would actually have seemed rather alike. E.A.T. and AFAE aspired to negotiate this continuous and messy overlap between material and immaterial labor and their competing demands.[38]

The cooperative and automated domain of printmaking was a fitting field for an early ingress into industrial processes. In April 1968, E.A.T. actually partnered with Local 1, Amalgamated Lithographers of America—the printing union—on a pilot project

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[37] Ibid., 345. Klüver added, "Again language problems are enormous, but once both camps get to work on a project they quickly come to understand one another." Ibid.

[38] Despite exaggerations to the contrary, industrial labor has not been overwhelmingly displaced by the service sector; for example, as of January 2009, manufacturing accounts for 81.7% of U.S. goods exports, and represents approximately 14% of U.S. gross domestic product. "Manufacturing Biweekly Update, Industry Competitiveness and Regulatory Analysis," International Trade Administration, US Department of Commerce, February 2009, http://ita.doc.gov/td/industry/otea/ocea/mbu/index.html.

dubbed “The Quarry,” wherein artists worked with the latest lithographic press technologies [Fig. 5.6]. Rauschenberg, Bochner, Milton Glaser, Brice Marden, Forrest Myers, Claes Oldenburg, and Jack Tworkov all produced prints with the developing technical systems at the ALA Lithographic Center facilities in New York. Presses, cameras, electronic color scanners, and other new equipment was made available to the artists—including nothing less than the same microscopic photolithography technologies that had been used to invent the first semiconductor device: the etched silicon chip or integrated circuit, the basis of all modern electronics and electronic data storage (i.e., computing). An advisory board of E.A.T. and ALA representatives jointly selected the participating artists and connected them with engineers and “journeymen lithographers,” as they were called. In turn, artists would “educate engineers and technical and industrial personnel so that a realistic attitude toward the artist is developed,” defusing tensions and misprisions surrounding the mandarin province of aesthetics.[39] Likewise, in May 1969, the group proposed a “large-scale project” to be undertaken through the AFL-CIO SPACE Committee—the union’s division of aeronautics and aerospace engineers and workers—“that involves members of labor unions in collaboration with artists and engineers.”[40] This was to remain unrealized. But, at the time, it appeared to be a logical progression from the exchange with the lithographers’ union, in which the negotiation between disparate languages and skills could be seen as a model for communication

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[39] E*.A.T. News* 2, no. 1 (March 18, 1968): 4-5. See also E.A.T., “Agreement with ALA,” February 2, 1968, n.p., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 41, Folder 10. Rauschenberg’s print *Quarry* (1968) was the project’s inaugural work. An offset lithograph dominated by vivid layers of vermilion and cyan, it juxtaposed these hues next to segments of yellow and green in a circular color wheel in the bottom right quadrant, a reflexive acknowledgment of the four-color separation system.

[40] “Plans for 1969-1970,” *E.A.T. Proceedings*, no. 9, May 19, 1969, 16.

between those economic or disciplinary castes supposedly reified in opposition to one another.

For E.A.T. and the AFAE, then, the merger between art and technology constituted a new kind of conflict resolution. "For me," said Kheel, "This is the biggest mediation I've ever undertaken."[41] Communication was paramount in negotiating this progressively diversified and decentralized realm. As the curator Jasia Reichardt wrote in 1968 in an essay titled "E.A.T. and After," "The really valid and imperative contribution [of E.A.T.] would be to facilitate communication…one doesn't have to probe very deeply to discover that the majority of artists and engineers have no language in common. Any real collaboration in the future depends on the evolution of a common language today."[42] Yet underlying the union of E.A.T. and the AFAE was the disintegration of the traditional collective—the failure of a Habermasian system of communicative action and consensus, of a physically consolidated public sphere. As Beck claims (in a remarkable departure from his sociological forbears Tönnies, Durkheim, Bell, and Habermas), late industrial society produces "deep-seated institutional crises": "Key institutions (such as political parties and labour unions, but also causal principles of accountability in science and law, national borders, the ethic of individual responsibility, the order of the nuclear family, and so forth) all lose their foundations and their historical legitimacy."[43] This is because "[I]ndustrialism in its

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[41] Henry R. Lieberman, "Art and Science Proclaim Alliance in Avant-Garde Loft," *The New York Times,* October 11, 1967, 49.

[42] Jasia Reichardt, "E.A.T. and After," *Studio International* CLXXV (1968): 236-37.

[43] Ulrich Beck, "Self-Dissolution and Self-Endangerment of Industrial Society: What Does This Mean?" in *Reflexive Modernization: Politics, Tradition and Aesthetics in the Modern Social Order*, 178. Beck argues that "classical sociology" from Tönnies to Habermas—their respective diagnoses of social disintegration and loss of community in modernity—does not sufficiently account for the profound collapse of social

advanced stage in the second half of the twentieth century is increasingly producing effects that can no longer be encompassed or covered by the calculus of risk and insurance. Rather, these latter confront the technical and social institutions of the 'precaution state' (F. Ewald) with threats that nullify, devalue and undermine all calculations to their very foundations."[44] Indeed, the proposed collectivity of E.A.T. and the AFAE was not defined through established institutions, discursive norms, or stable individual subjects.[45] Rather, it was defined *negatively*, in terms of a shared risk—that of automation. Automation House was born of this incipient breakdown of the institutions of industrial modernity and their legitimating structures.

II. Building Automation

The initial plans for Automation House grappled with such acute collapse and contradiction. E.A.T.'s L.J. Robinson (Klüver's colleague from Bell Labs, who had also worked on *9 Evenings*) and Rauschenberg worked with architect Richard D. Kaplan on

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institutions themselves: "The secondary problems, so the argument goes, do not impact on the institutions, organizations and subsystems; they do not threaten the latter's claims to monitor and regulate, nor the self-referentiality and autonomy of the subsystems…Now this preordained harmony of control is of course the fairy tale, the innocent faith, of the sociology of simple modernization." Ibid., 179. On the blindness of these previous sociological models (both Marxist and functionalist) toward the incalculability of contemporary threats and risks, see Ulrich Beck, *Ecological Politics in the Age of Risk* (Cambridge: Polity Press, 1994).

[44] Beck, "Self-Dissolution and Self-Endangerment of Industrial Society: What Does This Mean?", 182. See also François Ewald, "Risk and Insurance," *The Foucault Effect: Studies in Governmental Rationality*, eds. Graham Burchell, Colin Gordon, and Peter Miller (Chicago: University of Chicago Press, 1991), 197-210. The sociologist Ewald outlines the rigorous development of the "technology of risk" via actuarial science and insurance in the nineteenth century—the rationalization of risk through social distribution (i.e., with insurance, the individual's liability is spread amongst the collective) and its commodification (risks and securities can be valued, purchased, and traded). For Beck, the "risk society" occurs when this rationalization is increasingly undercut by its own side effects, and actuarial risks progressively resist quantification or the assignation of metrical value.

[45] Both Ulrich Beck and Anthony Giddens have extensively discussed the fracturing of individual subjectivity in late modernity and risk society; see Ulrich Beck and Elizabeth Beck-Gernsheim, *Individualization* (London: Sage Publications, 2002); and Anthony Giddens, *Modernity and Self-Identity: Self and Society in the Late Modern Age* (Cambridge: Polity Press, 1991).

this first proposal in November 1967. Their design aimed at a “maximum amount of flexibility and surveillance with the least number of technical personnel.”[46] Utterly elastic *and* utterly regulated: the scheme paradoxically based complete adaptability on surveillance, on an internal relay of information connected to a broader network of (both public and privatized) telecommunications. An appropriately schizophrenic array of activities was to take place in the building, from job training, group debates, and labor negotiations to performances and exhibitions.

Automation House would therefore be structured by an open plan with flexible, movable partitions. An auditorium seating eighty was to occupy the basement level, containing the latest in audio and projection equipment.[47] The first and second floors would make use of audio, coaxial, and power cables for projection, display, information storage and retrieval equipment (linking Automation House with libraries to supplement the building’s own “library of taped information”), public address and private listening facilities, and multimedia exhibitions.[48] Robinson envisioned the third and fourth floors containing office space, conference rooms, “and possibly a small computer.”[49] The top floor would be a fully equipped film and television studio and function as a “control center” for the building. The plan even called for the building’s very own “microwave

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[46] “Preview: Automation House, New York City,” *Architectural and Engineering News* 10, no. 3 (March 1968): 77.

[47] L.J. Robinson, “Technical Criteria for Information System: Automation House,” September 13, 1967, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 41, Folder 4.

[48] Kaplan proposed that in the future, the information retrieval system would allow a “computer hookup” with other libraries: “We could request information stored in a computer at Syracuse which would flash an image via coaxial cable to a screen at Automation House. Or it could provide a printout.” Kaplan, cited in “Preview: Automation House, New York City,” 78.

[49] *E.A.T. News* 1, no. 3 (November 1, 1967): 9.

tower," the inclusion of closed circuit television for every area, an "electronic receptionist with messages flashing from [the] 'brain' in control room," "video telephones," and remotely controlled projectors throughout—a "total information system," as Robinson called it.[50]

Yet what was normally clandestine was turned inside out. Surveillance itself became the focus of attention: Television monitors were to publicly broadcast live footage of current activities happening throughout the building. Video telephones and the electronic secretary would play back the real-time events of the space.[51] This inversion transformed the modernist transparency of interior and exterior *à la* Mies or Corbusier into a circuit of feedback. Control was put on display. Against linearity, recursivity provided the model.

This reflexive vision of Automation House expanded in a second plan in 1968. That summer, Kheel decided to switch to the younger, more experimental (and less costly) architectural firm of Lehrecke & Tonetti, with Rauschenberg and Robinson overseeing the project.[52] Their new design was depicted in renderings in the November 1968 issue of *Interiors* magazine [Figs. 5.7, 5.8]. Roger Whitehouse's Archigram-esque portrayal of the plan was contrasted with the building's extant beaux-arts façade [Figs. 5.9, 5.10]. Editorial language, based on the descriptions of Lehrecke & Tonetti, reiterated the goal of a supple yet ordered system: "the architectural challenge is

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[50] "Preview: Automation House, New York City," 76-78; Robinson, "Technical Criteria for Information System: Automation House," n.p.

[51] Robinson, "Technical Criteria for Information System: Automation House," n.p.; "Preview: Automation House, New York City," 77.

[52] Although Lehrecke & Tonetti had only formed their practice roughly a year prior, each principal had impeccable modernist credentials, coming from the firms of Philip Johnson and S.O.M., respectively.

obviously total flexibility, a totally controlled environment."[53] And closed-circuit television would make physically separate events simultaneous through "total-building reception."[54] Adjustable partition walls were now accompanied by an all-encompassing ceiling-grid system of 2' x 2' "Alumastrut" (lightweight aluminum) modules [Figs. 5.11, 5.12]. The grid would route wiring of both high and regular voltages. All equipment could plug in and move along tracks in the grid; the lattice would carry movable partitions and "exhibition panels," clip-on light fixtures (supplying both "standard" and "exhibition" lighting), projection screens, and frames for hanging automated slide projectors, television sets, and works of art (whether "flat or three-dimensional").[55] The ceiling became a mechanism for holding "not only paintings and sculpture but all conceivable motorized, lit, cycled, and projected multi-media applications."[56] And the mobility of the aluminum tracks would have resonated, for example, with the proposed display of Rauschenberg's *Solstice* (1968) on the street level (just immediately beyond the reception area), a work whose frame of automated airport sliding doors was set on a luminous pedestal, each Plexiglas sliding door silkscreened in color and kinetically responsive to motion sensors on the floor.[57] In this sense, the modular systems of corporate office architecture were extended to experimental and multimedia use. Interior grids for lighting, ventilation, and partitioning had been famously introduced in structures

[53] Olga Gueft, "Automation House: Confronting Tomorrow's Problems Behind Yesterday's Façade," *Interiors* 128, no. 4 (November 1968): 117.

[54] Ibid., 117.

[55] Ibid., 119.

[56] Ibid., 117.

[57] Ibid., 120-121; Robinson, "Technical Criteria for Information System: Automation House," n.p.

such as Eero Saarinen's General Motors Technical Center in Warren, Michigan (1948-1956); but now this framework also proffered networks of communication and performative effect.[58] Modularity here proffered not only flexibility in shape and scale but in function (thereby providing an exception to Peter Blake's landmark debunking of modular buildings, for one).[59] The plan for Automation House consequently seemed poised to become the apotheosis of what Reyner Banham concurrently called the "well-tempered environment": full environmental control, rendering the built envelope nearly irrelevant. For Banham, architectonic "hardware" was becoming secondary to the "software" of habitability and action—the heirs to nineteenth-century innovations in energy (the power grid, the electric dynamo), heating, cooling and ventilating, artificial illumination, and acoustics (indeed, all the "flows" so foregrounded in Rauschenberg and Klüver's *Oracle*), the outgrowth of architecture as a series of "plug-in," "clip-on" services.[60]

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[58] On the development of the interior grid in postwar corporate architecture, see Martin, "The Physiognomy of the Office," *The Organizational Complex*, 80-121; and Alexandra Lange, "This Year's Model: Representing Modernism to the Post-war American Corporation," *Journal of Design History* 19, no. 3 (Autumn 2006): 233-248. On modular architecture at IBM from 1956 to 1975, see John Harwood, *The Interface: IBM and the Transformation of Corporate Design 1945-1975* (Minneapolis: University of Minnesota Press, 2011), 111-159.

[59] Peter Blake, *Form Follows Fiasco: Why Modern Architecture Hasn't Worked* (New York: Little, Brown, 1977), 33.

[60] Reyner Banham, *The Architecture of the Well-Tempered Environment* (Chicago: University of Chicago Press, 1969). Banham had already outlined this concept in his famous essay, "A Home Is Not a House," *Art in America* 53, no. 2 (April 1965): 70-79. As he wrote in 1965, "When your house contains such a complex of piping, flues, ducts, wires, lights, inlets, outlets, ovens, sinks, refuse disposers, hi-fi reverberators, antennae, conduits, freezers, heaters—when it contains so many services that the hardware could stand up by itself without any assistance from the house, why have a house to hold it up?" Ibid., 70. Banham's argument followed in many ways from Siegfried Giedeon's *Mechanization Takes Command*, but, as Banham wrote, instead of a conclusive statement, his concepts were a "tentative beginning of a field of study," a portion of "what Giedeon left unsaid." Banham, *The Architecture of the Well-Tempered Environment*, 15.

Two "software"-related inversions occurred in this redesign of Automation House and its actual construction in 1969-1970. First, the overhead grid transferred the orientation of physical action from the floor to the ceiling. Second, the audiovisual "control room" for the entire building was now sited in the basement rather than the top floor, as a plan published in *Architectural Forum* shows [Fig. 5.13].[61] Such structural malleability and decentralization were redoubled in the surfaces and screens throughout Automation House itself. Double-glazed sliding windows with operable blinds shielded the interiors and created two-way and one-way mirror reflections. Heavier loads had also necessitated the strengthening of floors; the weakest point was the stairwell, so Lehrecke & Tonetti enclosed it in a tube, using the surfaces created by this enclosure as projection screens for slides [Fig. 5.13, bottom left]. The fiberglass elevator shell, which the architects claimed was the first of its kind, was painted neon yellow. Fluorescent tubing at the edges of both the elevator cab and stairwells made each appear to float in a levitating glow.[62] (Prior to construction, the design had stipulated "'super-graphics' or brilliant coats of paint" for outer doors as well as instrument/switch panels; this plan was abandoned).[63] The incandescent and responsive space provided myriad experiences—aesthetic, educational, discursive, and administrative—in one immersive stroke.

We have seen similarly totalizing experiences before, most remarkably in architect Cedric Price and theater director Joan Littlewood's Fun Palace (1961-64). The E.A.T. team and Lehrecke & Tonetti would have been familiar with the project, which

[61] "Humanizing Automation," *Architectural Forum* 133, no. 1 (July-August 1970): 74-75.

[62] Ibid., 74.

[63] Gueft, "Automation House," 119.

was never built but famously proposed a fantastically flexible and immaterial space—a "learning-machine" of closed-circuit televisions, computers, catwalks, and escalators that would constantly adapt to users.[64] Moveable walkways and enclosures were to be clipped and hung to a grid superstructure. It was an automated and nearly invisible armature, an erector set for the cybernetic age. And Gordon Pask's "cybernetic theater," which would have occupied the Fun Palace, was the apotheosis of Price's elastic atmosphere: a theatrical venue in which audience members could interact with actors, changing the events onstage via "intelligent" personal computing stations. Yet in this sense, as Mary Louise Lobsinger has argued, such a system of infinite choice and modulation was actually synonymous with an instrument of observation and control.[65] The Fun Palace thus resembled the adaptable, regulated systems simultaneously being promoted in postwar corporate architecture—what Reinhold Martin has called "the organizational complex." The design tactics of corporations such as GM, IBM, and of course AT&T Bell Laboratories, as Martin, John Harwood, and others have shown, fit into larger efforts at systems integration. Throughout the 1950s and '60s, they adopted self-organizing and self-similar structures in both management and architecture (such as the grid and the

[64] Cedric Price, "Fun Palace," unpublished document, 1965, Fonds Cedric Price, Canadian Center for Architecture, Montreal, Accession no. DR1995:0188:001-527. See also Reyner Banham, "People's Palaces," *New Statesman* 68 (August 1964): 191-192. Multiple instances of correspondence exist between E.A.T. and members of various experimental architecture groups, such as Archigram and Zomeworks. See Peter Cook and Steve Baer, E.A.T. project files, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 41, Folders 21-27.

[65] Mary Louise Lobsinger, "Cybernetic Theory and the Architecture of Performance: Cedric Price's Fun Palace," in *Anxious Modernisms*, ed. Sarah Williams Goldhagen and Réjean Legault (Cambridge, MA: MIT Press, 2000), 119-140. As Lobsinger argues, the Fun Palace charted the "emergence of an ephemeral subjectivity through the theatricality of communication"; the "implicit consequence of the project: an institutional critique of Welfare State-administered culture." Lobsinger, 122. See also Gordon Pask, "The Architectural Relevance of Cybernetics," *Architectural Design* 39 (September 1969): 496.

network) that strove to maximize equilibrium and efficiency—to regulate entropy through pliable and anithierarchical modes of organization.[66]

Automation House doubtless shares much with these responsive, "well-tempered" environments. It seems aligned with the kind of "counterarchitecture" espoused in the postwar corporate design systems of Eliot Noyes at IBM, for example, in which corporate architecture was to provide a "an enclosure organized over and against the surrounding, disorganized environment" outside, as Harwood has described.[67] And the goal of complete flexibility through architectural and information systems parallels the way in which, as Rabinbach has argued, communication overtook the physical rationalization of the body in the postwar period as the focus of strategies of productivity.[68] If the early twentieth-century body had essentially been converted into an energy-transforming machine, with the application of thermodynamic laws of energy to the needs of capitalist modernization and industrialization, now the body was the site for the transmission and transformation of information.[69] Moreover, Beck has pointed out that with "automation, the increasing fluidity between work and non-work," and the "spatial deconcentration of labor," "the place of the visible character of work, concentrated in factory halls and tall buildings, is taken by an invisible organization of the firm."[70]

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[66] Martin, *The Organizational Complex*, 80-122, 156-182.

[67] Harwood, *The Interface*, 13.

[68] Rabinbach, *The Human Motor*, 295-298. And as Kheel emphasized with the Automation House design in 1970, "Actually, our biggest problem here was persuading the builders to make it flexible enough." Kheel, cited in Adler, "Automation House," 30.

[69] Rabinbach, 52-83. On these late nineteenth- and early twentieth-century models of energy and labor and the operations of exchangeability and convertibility inherent in capitalist modernization, see Jonathan Crary, *Suspensions of Perception: Attention, Spectacle, and Modern Culture* (Cambridge, MA: MIT Press, 1999), 320-321.

[70] Beck, *The Risk Society*, 142.

The designers of Automation House likewise fixated on the weightless execution of communication and control, the body as informational flow, in the face of automation. An enormous advertising supplement for Automation House [Figs. 5.14-5.15] appeared in an edition of 1,800,000 in the February 1, 1970 edition of *The New York Times*, proclaiming:

> "While machine age tools may give [man] more control over his environment than ever before, they sometimes leave him powerless to control his fate…Automation House can function 24 hours a day, 7 days a week. Within its four walls and through its electronic outreach, it has the capacity to become a major seat of learning. The many activities at Automation House, each separate and distinct, blend into a sympathetic and interrelated collage of communications."[71]

Internal ads by Tishman, the contractor for the building, similarly trumpeted: "Here, technology is studied and employed as a means to help solve the human problems brought on by technology itself."[72] It is in this respect that Automation House recalled the designs of both Price and corporations such as Bell and IBM—envisioning an anti-architecture that would redress a projected lack of technological control, an apparatus that would be able to monitor and to manage—and then ultimately evaporate into a self-regulating, integrated, and invisible structure of authority.

III. Performing Automation

But when Automation House opened in March 1970, the actual use of the space departed from a dematerialized architecture of control. In the events that took place there, one would have confronted resolute physicality and obdurate sensation: Not transparency, but frustrated perception. Indeed, the projects and artworks that unfolded

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[71] "Automation House: A Philosophy for Living in a World of Change," advertising supplement, *The New York Times*, February 1, 1970, n.p.

[72] Automation House: A Philosophy for Living in a World of Change," advertising supplement, *The New York Times*, February 1, 1970, n.p.

over the next several years exceeded the initial parameters of Automation House. Alongside meetings, classes, and administrative activities, these performances and installations provided a perplexing counterpoint. They were to stretch the functionalities of the audio and video facilities at Automation House, an extensive system helmed by a group of mixing consoles in the control room, as Klüver demonstrated at the opening. The inaugural exhibition at the space was "The Magic Theater," organized by Ralph T. Coe and originally presented in May-June 1968 at the Nelson-Atkins Museum of Art in Kansas City.[73] Many of the show's works made use of systematic programming only to dismantle or surpass it in sensory experience. Boyd Mefferd's *Strobe-Lighted Floor* (1968) [Fig. 5.16], for example, dislocated the visual apprehension of color and distance. The artist lined a carpeted gallery floor in Automation House with a grid of spaced square lucite insets. Each overlaid a strobe light that was triggered by capacitor overflow at random intervals. Jane Livingston's description of the piece in her 1968 *Artforum* review is worth quoting at length:

> "The lights were placed beneath colored filters, but appeared white in actually looking at the flash—only the after-image took on color. On first entering the room, my impression was that the lights emanated from walls, ceiling and floor, and even when I had become oriented in the location of the light sources, it was impossible to look at them, or to discover by looking at any particular spot in the room precisely what was happening...at a given moment. In short, what Mefford [sic] presented was a way of seeing (retinal images) that does not relate to looking directly at an object or objects."[74]

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[73] On the exhibition as originally installed at the Nelson-Atkins Museum, see: Ralph T. Coe, ed., *The Magic Theater* (Kansas City: The Circle Press, 1970).

[74] Jane Livingston, "Kansas City," *Artforum* VII, no. 1 (September 1968): 66-67. Although Livingston is describing the Kansas City installation, the perceptual effect described by critics reviewing the Automation House venue cite similar reactions. See Nancy Moran, "Art and Technology Merge at Exhibit," *The New York Times*, March 3, 1970, 43; Hilton Kramer, "Art: Landscapes of Button and Cohen," *The New York Times*, March 7, 1970, 26. In the same issue of *Artforum* that contained Livingston's review, Jack Burnham had lauded Mefferd—and specifically *Strobe-Lighted Floor*—as an exception to the trivializing aspects of kinetic art of the time, citing Mefferd in a trajectory of compelling work from "Bob Breer's first show of 'Floats' (1965), Robert Whitman's laser show of 'Dark' (1967), and most recently, Boyd

In the same way, Terry Riley's *Time-lag Accumulator* (1968) [Fig. 5.17] offered a kind of aural parallax, a dissociation of sound from source: The work deployed a tape-delay device which Riley and a Parisian sound engineer had first developed in 1963 for his *Music of the Gift*, creating polyphonic layers of sound through live looping using tape recorders and a keyboard.[75] Yet for this particular piece, Riley designed an architectural enclosure within which the tape-delay would unfold and undergo further distortion through reverberation and echo. And in place of a keyboard, the sonic input came from the sound of spectators moving through a series of twelve glass, aluminum, and mylar chambers in a hexagonal, honeycomb-like arrangement, geometrically rhyming with the gridded struts on the ceiling of Automation House.[76] As viewers passed through one chamber, their voices were recorded and then replayed after a delay of up to two minutes in another non-adjacent chamber, as Riley's preliminary block diagram shows [Fig. 5.18]. The structure quickly became a maze of displaced sound, the acoustic complexity mounting as one moved through the space.[77] In fact, an earlier rendering of the piece shows a near-infinite progression of polygonal chambers, signaling Riley's intent to have

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Mefferd's "Strobe-Light Floor' [sic] (1968)." Jack Burnham, "Systems Esthetics," *Artforum* VII, no. 1 (September 1968): 32. Mefferd exhibited a similar work as part of the Art & Technology exhibition in the American Pavilion at Expo 70 in Osaka, which also opened in March 1970.

[75] Program for "The Magic Theater at Automation House," 1970, Vasulka Archive, The Daniel Langlois Foundation for Art, Science, and Technology, Montreal, Accession no. VAS B42-C3-3K; Robert Schwarz, *Minimalists* (London: Phaidon, 1996), 36. On Riley's work with tape loops in 1960-61, see Keith Potter, *Four Musical Minimalists: La Monte Young, Terry Riley, Steve Reich, Philip Glass* (Cambridge: Cambridge University Press, 2000), 98.

[76] Douglas Davis, *Art and the Future* (New York: Praeger, 1973), 75-76; and Anon., "Transistorized Tunnel of Light," *Time* 91, no. 23 (June 7, 1968).

[77] Davis, *Art and the Future*, 75-76.

layered the noise in as dense and multiplicitous a formation possible [Fig. 5.19].[78]

The profuse kinetic and audiovisual effects of Robert Whitman's *Vibrating Mirror Room* (1968), a simpler version of his *Pond*, created for the Jewish Museum later that year, was the result of a collaboration with optics engineer Eric Rawson and may be seen as a kind of preliminary test of the spherical mirror subsequently constructed for E.A.T.'s Pepsi Pavilion in 1970.[79] (Unfortunately, no extant photographic documentation survives.) A stretched mylar reflective panel lined a darkened room. Two additional mylar mirrors, one square and one circular, stood slightly in front; each mylar panel vibrated in programmed sequences, throbbing and pulsating as an equally stuttered barrage of strobe lights and sonic crackles and thumps assailed the spectator. It was a "black-draped funeral fun house… A screaming oscillator sadistically shivered the viewer's eardrums," as a reviewer in *Time* magazine hysterically described it.[80]

These works overrode the self-regulating structures at Automation House—both the perceptual norms of its users as well as the mechanical and architectural systems in place. The other pieces in the exhibition—by Stephen Antonakos, Howard Jones, Stanley Landsman, Charles Ross, and James Seawright—likewise deployed responsive effects and sensory disorientation.[81] Moreover, they seemed to chart a spectrum of experience from disorder to control: On the one hand, Landsman's *Walk-In Infinity*

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[78] George Ehrlich, "'The Magic Theatre' Exhibition: An Appraisal," *Art Journal* 29, no. 1 (Autumn 1969): 41. Erlich specifically reviews the New York installation.

[79] Eric Rawson and Robert Whitman, "Report on a Light Sculpture Using Varifocal Mirror," n.d. E.A.T./GRI Box 27, Folder 18. See also Eric Rawson, "Pond," *TECHNE* 1, no. 1 (April 14, 1969): 10.

[80] Anon., "Transistorized Tunnel of Light," *Time* 91, no. 23 (June 7, 1968). See also Livingston, 67.

[81] On the roster of artists and layout of the exhibition at the Automation House venue, see: Program for "The Magic Theater at Automation House," 1970.

Chamber (1968) reflected and multiplied 6,000 points of light via a mirror-glass floor and walls, dazing viewers with an illusion of quasi-infinite and amorphous space [Fig. 5.20].[82] On the other, Seawright's *Electronic Peristyle* (1968) erected a circular structure twenty-one feet in diameter and bordered by columns; a false floor lay underfoot, in the center of which was a control unit [Fig. 5.21]. The viewer would enter an environment in which their movements generated patterns of sound, light, and wind emanating from the columns. Yet as Seawright described of the piece, "The longer the viewer is involved, the more he is able to see what he is controlling and what he isn't."[83] The work was geared to individual spectators, compelled to interact with the piece in a particular way in order to fully experience it: "The more people that get in this sort of piece, the less chance there is for any comprehension of the phenomena as they relate to the individual viewer in the framework of the system. It really works best with only one person."[84] Of course, even Seawright's regulated system more often than not played host to multiple participants and the unpredictable flux of public audiences. From the *Infinity Chamber* to the *Electronic Peristyle*, then, "The Magic Theater" proffered rudimentary environments exerting flexible control and surveillance—yet as the works transpired, they also fell to disruption and instability, disturbing any seamless management or even manipulation of viewers.[85]

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[82] *The New York Times* dubbed Landsman's piece the "hit of the show." See Nancy Moran, "Art and Technology Merge at Exhibit," *The New York Times*, March 3, 1970, 43.

[83] James Seawright, "Phenomenal Art: Form, Idea, and Technique," *On the Future of Art*, ed. Arnold J. Toynbee (New York: Vintage, 1970), 77-93, 91. On Seawright's *Electronic Peristyle*, see also Davis, *Art and the Future*, 75-76.

[84] Seawright, "Phenomenal Art: Form, Idea, and Technique," 91.

[85] Livingston even commended Mefferd's work in response to this perceived dynamic of controlled response versus surprise: "Unlike most of the other environments in the exhibition, the spectator was not

Programming at Automation House continued to test the parameters of transparent control and occluded sensation. In July 1970, Rauschenberg displayed his "Currents" series there, densely layered, monochromatic silk screens of newspaper clippings from January and February of that year [Fig. 5.22]. A print series of "record-breaking dimensions—54 feet long and about 6 feet high," as John Canaday wrote, the set presented overwhelming strata of information and noise, drawing an explicit connection between Rauschenberg's interest in the material detritus of collage and print media and of newer forms of telecommunication, in which the contingency of "news" was borne out as if in the extreme lateralization of a newsreel or spool of data.[86]

The next performance series, "Intermedia at Automation House," focused on composers and artists who specifically sought to explore sensory limits via electronic and computerized means. The program of twelve events began on October 13, 1970, and continued until April 1971. At the helm was Thais Lathem, an effusive and matronly figure who *The New York Times* dubbed "Multimedia's Mother of Them All" (nod to Frank Zappa's Mothers of Invention surely intended).[87] Lathem had recently become director of the Electric Circus Foundation. With her musical advisor, electronic composer Morton Subotnick, she had founded the Electric Ear series at the Electric Circus in St. Mark's Place, New York, in 1968. Lathem brought composers Terry Riley, Pauline Oliveros (both had worked with Subotnick at the San Francisco Tape Music Center), Salvatore Martirano from the University of Illinois at Urbana, Lukas Foss and

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compelled to move in any specific way, or to 'play' the work, in order to fully apprehend it." Livingston, "Kansas City," 66.

[86] John Canaday, "Rauschenberg Art: Chance to Catch Up," *The New York Times*, July 10, 1970, 16. See also Robert Rauschenberg, *Currents* (New York: Castelli Graphics, 1970).

[87] Donal Henahan, "Multimedia's Mother of Them All," *The New York Times*, April 13, 1969, D17.

David Rosenboom from SUNY Buffalo, and the Pulsa group of installation artists from Yale, transforming the discotheque-like event into a hotbed of new music and environmental installation.[88] Pulsa, for example, described their interactive project as including "delayed and real-time events, feedback, and communication…video projections, amplified sound systems, a signal synthesizer, a switching matrix, and various lighting conditions… investigating unknown combinations of events and creating unique events within the system."[89] At Automation House, Lathem aimed to conduct "experiments" like these in the cross-section between industry and the arts, a "history of experimental art in the United States, from Milton Babbitt to the newest in computer technology," as she explained it.[90]

Lathem therefore invited a veritable who's-who of electronic and early computer music: Babbitt, Rosenboom (known for his "live computer mix" performances); LeJaren Hiller of Buffalo (who had recently established the first computer music facility in the US, at the University of Buffalo; there, he also completed *HPSCHD* in 1969 with John Cage, an exploration of microtonality with a fifty-two channel tape-orchestra, 208 computer-generated tapes, and seven live harpsichordists); Subotnick; the Pulsa group; and composer Kenneth Gaburo (of the University of Illinois and James Tenney's

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[88] Ibid. On the composers listed here, particularly Riley, Mumma, and Oliveros, see Robert Ashley, *Music with Roots in the Aether: Interviews With and Essays About Seven American Composers* (Köln: MusikTexte, 2000).

[89] Pulsa, "The City as an Artwork," in *Arts of the Environment*, ed. Gyorgy Kepes (New York: Braziller, 1972), 220. For a broader assessment of the work of Pulsa, See Yates McKee, "The Public Sensoriums of Pulsa: Cybernetic Abstraction and the Biopolitics of Urban Survival," *Art Journal* 67, no. 3 (Fall 2008): 47-67. McKee ultimately assesses the legacy of Pulsa in terms of nongovernmental politics and the group's effectiveness in this realm.

[90] Anon., "Art Experiments in Mixed Media Will Be Traced," *The New York Times*, October 13, 1970, 52.

professor).[91] In November 1970, electronic composer Gordon Mumma performed *Communication in a Noisy Environment* with David Behrman, Anthony Braxton, Robert Watts, and Leroy Jenkins [Fig. 5.23].[92] Mumma, who was a resident composer for the Merce Cunningham Dance Studio (as Behrman would become in 1970) and co-founder of the Cooperative Studio for Electronic Music in Ann Arbor, Michigan (arguably the first electronic music facility in the US), clearly drew on the legacies of Cagean indeterminacy, improvisation in free jazz (for which Braxton would have been the seminal representative here), and Watts's ludic strategies (which had been foundational for Fluxus).[93] Over three floors in Automation House, with televisions and loudspeakers relaying broadcasts from each level to the other, improvised instrumentals joined flashing images on the walls. A closed-circuit "quintet" with the building thereby ensued, in which saxophone, double-reed horn, violin, and other traditional instruments triggered semi-automatic electronic operations controlling frequency, amplitude, phasing, and image projectors in the output. The environment was obscured even further, however, by

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[91] Grace Glueck, "Electro-vangelist," *The New York Times*, October 4, 1970, 120. On *HPSCHD*, see Stephen Husarik, "John Cage and LeJaren Hiller: HPSCHD, 1969," *American Music* 1, no. 2 (Summer 1983): 1-21. Many other participants listed were highly active in the art, music, and performances worlds; Pulsa, for example, had recently shown in the Museum of Modern Art, New York, exhibition "Spaces" in 1970, for which they created an outdoor environment employing computerized sensors that responded to heat, light, sound, and movement. See "*Spaces*, December 30, 1969-March 1, 1970," Exhibition File #917b, Museum of Modern Art Archives, New York.

[92] Raymond Ericson, "Study of Noise Takes Art Form," *The New York Times*, November 22, 1970, 80.

[93] Mumma had, for example, collaborated with Cage and Tudor for Cage's *Variations V*, 1966, in Hamburg, and he and Tudor composed, programmed, and performed the music for Cunningham's *Rainforest*, 1968. See Gordon Mumma, "Electronic Music for Merce Cunningham Dance Company," *Choreography and Dance* 4, no. 3 (1997): 51-58.

smoke billowing from fire extinguishers—an unintentional accoutrement caused by shorted circuits.[94]

But the crossed circuits, so to speak, did not end there. In December 1970, another performance was organized by Rosenboom in order to create a "group dynamic, bio-electronic encounter situations for performers and audience member." For *Ecology of the Skin*, electroencephalograph brain signals of up to ten participants triggered the electronic processing and mixing of music played by keyboard performers.[95] Moreover, the signals also controlled electric currents that would then induce "phosphenes" for the participants—stimulating the retina to experience the perception of light when no light is actually entering the eye.[96] And the quantitative impact each individual's brainwave signals had on the sound output was determined by a statistical measure of the amount of time their brain spent per minute on producing alpha waves.[97] Rosenboom's piece was thus in many ways a hyperbolic extension of choreographer Alex Hay's use of biological signals—heartbeat, EEG signals, voltage generated by his muscles—to produce sound effects in *Grass Field*, his 1966 piece for *9 Evenings*, or of earlier works that sought to act *on* bodies, such as the audiovisual stimulus of Tony Conrad's film *The Flicker* of

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[94] "Programs, Intermedia Institute of Automation House," n.d., Vasulka Archive, The Daniel Langlois Foundation for Art, Science, and Technology, Montreal, Accession no. VAS B42-C3; Ericson, "Study of Noise Takes Art Form," 80.

[95] David Rosenboom, ed., *Biofeedback and the Arts: Results of Early Experiments* (Vancouver: Aesthetic Research Centre of Canada, 1975), 56-63.

[96] Ibid. See also "Press Conference for *Ecology of the Skin* and Biofeedback and the Arts," videotape, 1970, collection of Julie Martin. Lathem moderated the press conference and a range of artists and physicians participated.

[97] David Rosenboom, *Extended Musical Interface with the Human System* (San Francisco: Leonardo Monograph Series, 1997), 103.

1965 and Brion Gysin's "Dream Machine."[98] If the likes of Hay, Conrad, and Gysin had generated one-way effects (body signals producing electronic sound or films producing sensory stimuli), Rosenboom made use of a full biofeedback loop, in which biological signals generated electronic effects that then fed back to those subjects as retinal stimulation.[99] Yet the outcome was by no means a tidy cycle; participants reported feeling disoriented, discomfited, and halted the event.[100]

Like the aftermath of *Communication in a Noisy Environment*, the effects of the multimedia piece spilled beyond the designated arena of action: Inadvertent consequences upstaged the main event. Even as Automation House represented the dream of an automated world of choice—one that unmistakably resembled a network of power—such plans were waylaid. Event after event, the performances thematized and enacted the perceptual and functional dissolution of systems, whether in surprising clouds of smoke or in participatory aesthetics and biofeedback experiments gone awry. Automation became the very mirror of accident. Risk was shown to be both cause and consequence of control. If, as Anthony Giddens has observed, "The idea of risk is bound up with the aspiration to control and particularly with the idea of controlling the

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[98] On Conrad and Gysin's engagement with biological and perceptual stimulation, see Branden W. Joseph, *Beyond the Dream Syndicate: Tony Conrad and the Arts after Cage* (New York: Zone, 2008).

[99] Alvin Lucier is generally known as having first worked with brainwaves to generate electronic sound, working with the physicist Edmond Dewan in 1964, and presenting the resulting piece, *Music for Solo Performer*, at the Rose Art Museum at Brandeis University in 1965, paving the way for his seminal feedback work *I Am Sitting in a Room* (1970); Lucier was in close contact with E.A.T. as well. In 1968 in Kansas City, Manfred Eaton was also simultaneously working on electronic circuits that would manipulate biological signals; in 1971, Eaton published his tract on biologically generated forms of performance. See Manfred Eaton, *Bio-Music: Biological Feedback Experiential Music System*s (1971), (Millerton, NY: Something Else Press, 1974). Shortly after his work on *Ecology of the Skin*, Rosenboom founded the Laboratory for Experimental Aesthetics at York University in Toronto, specifically focusing on the use of brainwaves and other biological signals; Cage, LaMonte Young, David Behrman, and Marian Zazeela, among others, would all be frequent participants. See Rosenboom, *Biofeedback and the Arts*, 84.

[100] Rosenboom, *Biofeedback and the Arts*, 72.

future"—that is to say, a contingent universe was the foundation for control systems (it is what is to be controlled, managed)—Automation House modeled, even performed, the way in which risk itself becomes a byproduct that upstages and overturns the intentional result.[101]

IV. Televising Automation

Beyond the perceptual or formal disruption of automated systems, E.A.T.'s programming at Automation House was to unfold as a broader incursion into the automation of information: the field of television. When E.A.T. finally moved its official headquarters to Automation House in June 1971, their first major endeavor was artists' television programming and new forms of public telecommunication. Media, in this sense, were explored as a series of contingent networks, socially and historically specific aggregates of events and actions. And television was a media that might induce mediation, a mode of transmission that could serve to negotiate between disciplines, senses, classes, individuals and masses—just as E.A.T. had dubbed itself a "transducer," a type of automated system that converts one type of energy into another (such as a microphone, which converts a sound wave into an electrical signal; or a light bulb, which converts an electrical signal into light energy). It bears noting that another perfect example of a transducer is television.[102]

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[101] Giddens, "The Politics of Risk Society," *Conversations with Anthony Giddens: Making Sense of Modernity*, eds. Anthony Giddens and Christopher Pierson (Stanford: Stanford University Press, 1998), 209. On risk as unintentional byproduct, see Beck, "The Reinvention of Politics: Toward a Theory of Reflexive Modernization," *Reflexive Modernization: Politics, Tradition and Aesthetics in the Modern Social Order*, 5. For a very different reading of Automation House, see Turner, "Romantic Automatism: Art, Technology, and Collaborative Labor in Cold War America," op. cit.

[102] *E.A.T. News* 1, no. 1 (January 15, 1967): n.p.

The group sought to build out the video facilities at Automation House into a veritable television studio and center, but also to place artists at the commercial networks' research labs. As early as November 1967, E.A.T. had proposed artists' residencies in television research at CBS Foundation, at the initiation of CBS Corporation itself.[103] This initiative thus predated several seminal "firsts" in the history of "television art" and "video art": the first exhibition of "video art" in a museum, "The Machine as Seen at the End of the Mechanical Age" at MoMA in 1968 (which, as chronicled in Chapter 3, E.A.T. co-organized with Pontus Hultén); what is commonly known as the first exhibition devoted to television, "TV as a Creative Medium," at the Howard Wise Gallery in the U.S. in 1969; the landmark broadcast on WGBH, "The Medium is the Medium," in March 1969; and Otto Piene and Aldo Tambellini's famous "Black Gate Cologne" broadcast on WDR (Westdeutscher Rundfunk) in Cologne in 1968.[104] (Indeed,

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[103] *E.A.T. Proceedings*, no. 9 (May 19, 1969): 10.

[104] On these early initiatives in video art and their relationship to network television and electronic democracy, see "TV as a Creative Medium, exhibition brochure (New York: Howard Wise Gallery, 1969); David Joselit, *Feedback: Television Against Democracy* (Cambridge: MIT Press, 2007); on "Black Gate Cologne" and the relationship between video art and abstraction, see Christine Mehring, "Television Art's Abstract Starts," *October* 125 (Summer 2008): 29-64; and *New Artists Video: A Critical Anthology*, ed. Gregory Battcock (New York: EP Dutton, 1978). For an exemplary statement of the conflicted artistic motivations for participating in "TV as a Creative Medium," see Paul Ryan, letter to Howard Wise, March 2, 1969, Paul Ryan Papers, 1943-2008, Archives of American Art, Smithsonian Institution. This is not to obscure the even earlier roles of artists such as Lucio Fontana or K.O. Götz in experimenting with television and radar, which Mehring, Anthony White, and others have brilliantly chronicled. Mehring draws on Raymond Williams's canonical book *Television* (1974) to read these early precedents as an exploration of "the inherent duality in television between its definition as a mass medium and its purely technical and formal possibilities…[television art's] history actually begins with the latter." (Mehring, 32.) I would, however, argue that there is still no "purely technical and formal" set of possibilities inherent to television—since, as Friedrich Kittler would say, such distinctions between form and content are no longer tenable in television. They do not apply to the electronic signal, nor to the televisual network of transmission. Indeed, so-called "technical" or "formal" aspects (the qualities of scan-line resolution and the rasterized image of the cathode ray tube, for example) are beholden to the electronic signal, and thus were always already couched in the communicative requirements and parameters of the military, industrial, and governmental entities within which they developed (this would include the telephone, film, and recording industries; Bell Telephone Laboratories, for example, was instrumental in some of the first low-frame-rate television transmissions in 1925 and 1927). There were certainly uneven and disparate technologies in competition with each other throughout the history of television; as Williams himself wrote, "The invention of television was no single event or series of events. It depended on a complex of

as noted in Chapter 3, Piene and Tambellini had both been in communication with E.A.T. and applied for membership in 1967, the same year that they opened the Black Gate Theater, an "Electromedia" venue, in New York [in March]).[105]

In January 1969, representatives from RCA had approached E.A.T. to serve as advisor in establishing an artist-in-residence program at the David Sarnoff Research Laboratory in Princeton, New Jersey.[106] E.A.T. proposed to launch two artists' residencies at the laboratory—originally inquiring about artists' exploration of color television, liquid crystal displays, and other developing technologies. After extended negotiation with William Webster, vice president and director of the research laboratories, E.A.T. proposed that a poet and a visual artist (Jasper Johns, although this never transpired) be installed at residencies, and eminent Fluxus and concrete poet Emmett Williams (also an original member, with Daniel Spoerri, of the Darmstadt circle of poetry) took up a residency at RCA that summer to use their advanced computers and display systems to work on "interactive computer poetry."[107] The project was a

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inventions and developments in electricity, telegraphy, photography and motion pictures, and radio." But this heterogeneity does not mean that televisual technologies and systems were divorced from communicative "content" and instrumental purpose: the technical apparatuses and networked infrastructures that would have been available at any one time would have still been linked to the distinct circumstances for which they were produced, even if the aims were not unified. Williams himself continued, "in each of these stages [television] depended for parts of its realization on inventions made with other ends primarily in view." Raymond Williams, *Television* (1974), (London: Routledge, 2003), 7. See also Friedrich Kittler, *Optische Medien* (Berlin: Merve, 2002), 316. On the early (and international) history of television, see R.W. Burns, *Television: An International History of the Formative Years*, (London: IEEE History of Technology Series, 1998); Stephen Herbert, *A History of Early Television* (London: Routledge, 1997). For a detailed discussion of the sociological dimensions of television networks in Europe, see Pierre Bourdieu, *On Television*, trans. Priscilla Parkhurst Ferguson (New York: The New Press, 1998), 36-37.

[105] See Elisa Tambellini, "The Gate Theater," *artscanada* (October 1967).

[106] Letter from Billy Klüver to William Webster, Vice President and Director, RCA Research Laboratories, March 14, 1969; Letter from RCA to Peter Poole of E.A.T., July 18, 1969, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 41, Folder 17.

[107] E.A.T., *President's Report*, October 1, 1969, 3.

continuation of Williams's poem programmed on an IBM 7090 computer in 1966, "IBM Poem" (whose structure he had originally formulated in 1956); the process entailed randomly generated words and letters following a recursive structure.[108] While no finished piece resulted, in Williams's residency the television screen and computer screen assumed a significant parallelism: he envisioned the former not as a passive, one-way transmitter but as a responsive interface in which conventions of poetic writing and reading could be dislodged.

This model of linguistic interactivity was hardly the endpoint envisioned by E.A.T., however. In addition to its artist's residency project at RCA, E.A.T. proposed to the corporation an actual independent research facility where artists could collaborate closely with television research engineers and scientists, psychologists, anthropologists, and sociologists to explore new forms of television. In the summer of 1969, E.A.T. sent questionnaires to approximately fifty artists using television in their work, inquiring as to their needs and interests in technical knowledge and facilities. In a report generated from the questionnaire results, artists cited lack of freedom in experimentation, the limits of operating regulations, and little access to those actually designing television equipment—disciplinary or bureaucratic obstacles above all:

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[108] For "IBM Poem," Williams used a FORTRAN program to randomly generate twenty-six words (although the poet allows that he may have manipulated the outcome from time to time) and then associate each of them with a letter of the alphabet to create "an alphabet of words." A three-letter title was chosen, and the first line of the poem was determined by substituting words for letters in the title. Letters of words in one line were then used to generate subsequent lines. Emmett Williams, *A Valentine for Noël* (New York: Something Else Press, 1973). The same year as Williams's residency at RCA, in 1969, Williams's Fluxus colleague Jackson MacLow would work on his computer poetry project, "PFR-3 Poems," for the 1970 Art and Technology exhibition at LACMA. Similar experiments in "auto-poems," although with an arguably more aestheticized tenor, were advocated by Abraham Moles in his *Art et Ordinateur* (Brussels: Casterman, 1971). Computer poetry at Bell Labs had already been pioneered in a series of workshops by James Tenney, who, as discussed in Chapter 3, was artist-in-residence there from 1962 onward and would become involved in E.A.T. (He was instrumental in bringing Carolee Schneemann, then his partner; Alison Knowles and other members of Fluxus; and Minimalist composers into contact with the engineers at Bell.)

"Many artists expressed frustration at not being able to realize ideas and experiments *because of interpersonal, rather than economic or technical limitations*. One opinion frequently voiced was that much more can be done with existing equipment than is done by most TV studios; many of the artists would welcome an opportunity to develop fresh techniques with existing equipment. Another group was dissatisfied with the limitations of existing equipment and presented ideas for new hardware, e.g. TV systems combined with other materials and equipment such as radio, lasers and liquid crystals."[109]

The parameters of the facility were based on the requests posed in the artists' questionnaires and on what many of them deemed to be missing from television workshops at the government-owned, non-cable stations KQED and WGBH.[110] Proposals were solicited and received from artists, ranging from Nam June Paik to Les Levine to Tony Conrad to Bruce Conner.[111] Indeed, as Conner wrote in his application to work with color videotape mixing and programming ("somewhat in the same way light shows operate"),

"I am not working with TV techniques now. 3 years ago I did a 17 minute program at KQED directing the poet Michael McClure using 3 Cameramen, sound man, lighting technician, prompter, engineers for sound, picture, and video tape plus a producer who relayed my instructions to everyone else. I was so disappointed in the lack of cooperation (FCC rulings don't permit that—was what I was told when I requested some unusual technique. The union doesn't allow you to touch anything. The jargon of the business is a smokescreen to prevent communication). I did not

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[109] E.A.T., "A Report on Artists involved in Experimental Television," in "Final Proposal Submitted to RCA for a Research Laboratory in Entertainment Programming," Feb. 23, 1970, n.p., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 95, Folder 2. Emphasis added.

[110] E.A.T., "Draft Proposal for projects to RCA," January 29, 1969, n.p., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 40, Folder 14. The document cites John Cage, Robert Creeley, Hugh Davies, Richard Feliciano, Allan Kaprow, Steve Reich, and Alfons Schilling as possible candidates for artists' residencies. See also: Letter from Billy Klüver to President, RCA, David Sarnoff Research Center, Princeton, NJ, Feb. 23, 1970, n.p., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 95, Folder 2.

[111] E.A.T., "Final Proposal Submitted to RCA for a Research Laboratory in Entertainment Programming," Feb. 23, 1970, n.p., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 95, Folder 2. The RCA proposal further emphasized that "The public presentation would emphasize the activity as a research project, rather than as a project to develop advanced methods for television production." Ibid.

> attempt to do any more work with TV. I would like to see your report…(Is anyone starting a workshop-seminar to give the secrets to filmmakers all about TV?)"[112]

To redress this need and the inadequacies of existing television workshops at KQED and WGBH, by 1970 E.A.T. had also proposed several plans for an internal experimental video and television workshop at Automation House, utilizing its audiovisual facilities. In July 1970, E.A.T. submitted a proposal to the New York State Council on the Arts for a "Television Software Capability Development Program," which would add staff members in order "to develop a capability for initiating, administering, and funding collaborative experimental projects involving artists, engineers and other professionals to develop television software for both entertainment and instruction"; they wrote,

> "The United States is the only country that can launch synchronous satellites within the next ten years; and the policy of the U.S. government, the World Bank and the UNDP appears now to hold that the inability to create programming is a serious obstacle to these agencies assuming responsibility for funding satellite TV projects. E.A.T. shares the opinion with others concerned with video communication that experimentation with hardware and software aspects leading toward both entertainment and instructional programming is of vital importance."[113]

Such a laboratory would draw explicitly on E.A.T.'s model of experimentation: "Our projects evolve from the interaction among artists, engineers, scientists and other professionals concentrating on developing experimental projects that are usually carried on outside the usual laboratory or studio situation. Engineers and scientists contribute directly to software aspects of television."[114] Later, in December 1970, E.A.T. updated

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[112] Bruce Conner, "Application to E.A.T. Video Workshop," 1969, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 40, Folder 14.

[113] E.A.T., "Television Software Capability Development Program," July 15, 1970, E.A.T. Documents, The Daniel Langlois Foundation for Art, Science, and Technology, Montreal, Accession no. d 9844, C10-8.

[114] Ibid.

their proposal to a more specific program, "Artists' Utilization of Video Facilities at Automation House," which called for a four-week artist-in-residence program for eight artists at Automation House to generate an experimental videotape, "not [to] be used for commercial purposes," as well as a two-week audiovisual workshop there for artists to explore visual and audio technologies, directed by David Tudor and Lowell Cross.[115] "We are convinced," they wrote, "that artists placed in this open-ended situation will produce material which will make a significant contribution to the utilization of multi-input, multi-output video systems."[116]

Although these grant proposals remained unfunded, E.A.T. managed to sustain a serious center for artists to produce video and engage with technical specialists. They also continued to pursue participation in broadcast television production and transmission, proposing an "Artists' Television Programming at Automation House" program on March 22, 1971.[117] In February, E.A.T. had invited over forty artists to submit concepts for one-to-two hour programs to develop and broadcast over UHF or cable television, "part of our larger concern to develop methods for low-cost no-cost programming."[118] The determination of E.A.T. to participate in the formation of

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[115] E.A.T., "Artists' Utilization of Video Facilities at Automation House," December 7, 1970, 1-2, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 40, Folder 14; also cited in Loewen, 362.

[116] Ibid.

[117] E.A.T., "Artists' Television Programming at Automation House, Project Proposal," March 22, 1971, n.p., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 96, Folder 9.

[118] Billy Klüver, letter to artists inviting them to participate in Artists and Television, Feb. 11, 1971, n.p., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 96, Folder 1. Letters were sent not only to artists active in video but others, including Videofreex, Keith Sonnier, Michael Snow, Richard Serra, Lucas Samaras, Ed Ruscha, James Rosenquist, Raindance Corporation, People's Video Theater, and Pauline Oliveros.

television networks was such that Klüver went to Washington: Klüver actually appeared before the Federal Communications Commission and delivered a "Report on Cable Television" on March 26, 1971, to address the FCC's hearing on proposed cable access television, or CATV, rules—a body of regulations that was to govern the relationship between broadcast corporations and cable television. During this period, "cable television" was essentially analogous to what is now known as community access television—theoretically available to any individual or group wishing to broadcast from a government-subsidized cable television studio on a first-come, first-served basis.[119] Utilizing coaxial cable rather than over-the-air radio wave transmitters and receivers, cable was technically a form of closed-circuit television that essentially had a longer cable between recorder and monitor. This was the broad promise of cable, a system that might allow a more democratic form of programming and the potential for two-way communication, since the equipment needed to record and transmit television was far more portable and less costly (although the dream of mass-distributed studios remained unrealized).

At stake was the scope and ease of public access to television broadcasting. Klüver argued for a diversification of cable television that was both wide reaching and highly specialized: "the optimum goal for cable television is a multi-channel, multi-purpose, open-access system which will satisfy both mass and individual needs."[120] Such a

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[119] F. Leslie Smith, *Perspectives on Radio and Television: Telecommunications in the United States* (New York: Harper & Row, 1985), 128-29; Thomas Streeter, "The Cable Fable Revisited: Discourse, Policy, and the Making of Cable Television," *Critical Studies in Mass Communication* 4, no. 2 (June 1987): 174-200; Harvey Levin, "Television's Second Change: A Retrospective Look at the Sloan Cable Commission," *The Bell Journal of Economics and Management Science* 4, no.1 (Spring 1973): 343-365.

[120] Billy Klüver, "Oral Presentation on Proposed CATV Rules Presented Before the Federal Communications Commission," March 26, 1971, 1-6, Museum of Modern Art Archives, E.A.T. Klüver

mixture might infiltrate the monopolistic structure of commercial television. Cable television thus had the potential to become, as Klüver argued, a discursive field that included minority groups and cultures—one in which a film on Navajo rug weaving would be able to garner as much air time as Warhol's twelve-hour film of one shot. It was the artist that would lead television to alternate possibilities: "At this point no one knows what cable television will look like ten years from now, or what its programming content will be. In breaking through into these new areas we are all amateurs; and in this situation the artist may be the best amateur."[121] This was typical E.A.T.: Rather than inaugurate its own overtly guerilla-style or pirate cable station—as generally advocated in the pages of the activist journal *Radical Software*, or as groups such as Raindance or Videofreex would ultimately attempt to do—they went straight to the source of actual regulation and governance in support of decentralizing and opening up that system from within.[122] In July 1971, public access channels were finally inaugurated in New York—

Files, Document #222. The text of Klüver's presentation was also reprinted in *Radical Software* 1, no. 4 (Summer 1971): 25.

[121] Klüver, "Oral Presentation on Proposed CATV Rules," March 26, 1971, 6. See also E.A.T., "Artists' Television Programming at Automation House, Project Proposal," March 22, 1971, n.p.: "We feel it is very important for the artist to have a direct role in producing material for television not only for the broadcast industry but also for the emerging cable industry. As channel space increases, important questions of the further social use of television arise. Our contention is that esthetic assumptions and biases limit the uses to which the medium is put. The esthetics of the television medium have been institutionalized and determined by the structure of commercial interests and engineering habits. The artist has had no say about the use of his work on television. So far, we have only seen programs about contemporary artists, not programs made by them."

[122] While sympathetic to the aims of those associated with *Radical Software*, Videofreex, and Raindance—and in fact working with them from time to time (Videofreex, for example, submitted proposals for E.A.T.'s video workshop, as noted below)—these groups' vision for a fully open use of cable television was far more antagonistic and oppositional in strategy than that of E.A.T. They generally opposed the operations of Sterling and Teleprompter, for example, as simple commercializations of cable. Their hopes for televisual democracy lay in disturbing the existing system from the outside—witness Videofreex's launching of its pirate television station, Lanesville TV, in March 1972. This was the first unlicensed and illegal television station in the US. See Parry Teasdale, *Videofreex: America's First Pirate TV Station and the Catskills Collective That Turned it On* (Hensonville, NY: Black Dome Press, 1999). On Raindance and *Radical Software*'s engagement with CATV (and its hopes for CATV as a kind of two-way, feedback

an event that E.A.T. had originally intended to coincide with the "Artists and Television" program.[123]

Numerous artists had submitted project proposals. These ranged from perceptual experiments to structuralist investigations of the "medium" to factographic uses of documentary footage. But none of the projects could be reduced to ideas simply transposed from film or photography or painting: the array of proposals exploited the sheer pliability of television, exhibiting interest in its capacity to generate abstract forms—but also its ability to record indexically and its communicative or transmission capabilities. Television was foregrounded as a "medium" that, as Samuel Weber has argued, could only be defined by its very hybridity, its *im*purity—precisely because it was, in Raymond Williams's formulation, a system "primarily designed for transmission and reception as abstract processes."[124] Nam June Paik, for instance, suggested a project with his longtime collaborators Shuya Abe and Charlotte Moorman to create one program that would explore a "sound-image collaboration" and another depicting the "California landscape"; while Ed Ruscha and Mason Williams applied to produce a thirty-minute

system parallel to CCTV), see Joselit, *Feedback*, 85-132; Paul Ryan, "Cybernetic Guerilla Warfare," *Radical Software* 1, no. 3 (Spring 1971): 1-2; and William Kaizen, "Steps to an Ecology of Communication: Radical Software, Dan Graham, and the Legacy of Gregory Bateson," *Art Journal* 67, no. 3 (Fall 2008): 86-108.

[123] David Othmer, *The Wired Island: The First Two Years of Public Access to Cable Television in Manhattan* (New York: Fund for the City of New York, 1973), 38.

[124] Samuel Weber, "Television: Set and Screen," *Mass Mediauras: Form, Technics, Media* (Stanford: Stanford University Press, 1996), 117-121; Raymond Williams, *Television: Technology and Cultural Form* (New York: Schocken 1975), 25. On the relation between televisual networks and the emergence of the Edisonian system of quantification and distribution of signals, information, and energy, see Jonathan Crary, *Suspensions of Perception: Attention, Spectacle, and Modern Culture*, 31.

program, a "movie set in car," in which "Girl picks up a hitch-hiker and talks non-stop on subjects such as politics, earthquakes, pollution …factual funny too" [Fig. 5.24].[125]

In contrast to these abstract compositions and deadpan vignettes, Richard Serra proposed two tapes made on location in the Bronx and in Bedford Stuyvesant, "non-narrative" films that would "attempt to allow the peoples of the indigenous communities to in effect make their own film. Human interest, social realism and propaganda will be avoided" [Fig. 5.25].[126] The Videofreex collective proposed a "Videofreex mix" program that would combine live footage with a "collage of tapes covering the areas in which we remain constantly interested (informational, educational, political, experimental, and erotic tapes, and tapes covering music, theatre, events, 'people at home,' and alternate culture groups)" [Fig. 5.26]. The project would be an opportunity to shift away from their work in half-inch videotape to the portable "mini-cam" using two-inch videotape, which boasted higher image quality.[127]

Robert Irwin's proposal was perhaps the most ambitious. He submitted a project in collaboration with Dr. Edward Wortz, the psychologist from Garrett Aerospace Corporation's environmental sciences department, with whom Irwin had worked on his well-known anechoic chamber experiments on sensory deprivation at UCLA in 1969

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[125] Nam June Paik, "Information Sheet for E.A.T. Artists' TV Programming Project," February 9, 1971; Ed Ruscha, "Information Sheet for E.A.T. Artists' TV Programming Project," February 9, 1971; both reproduced in "Artists' Television Programming Project: Artists' Proposals," March 1, 1971, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 96, Folder 5.

[126] Richard Serra, "Information Sheet for E.A.T. Artists' TV Programming Project," February 9, 1971, reproduced in "Artists' Television Programming Project: Artists' Proposals," March 1, 1971, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 96, Folder 5.

[127] Videofreex, "Information Sheet for E.A.T. Artists' TV Programming Project," February 9, 1971, reproduced in "E.A.T. Artists' TV Programming Project: Artists' Proposals," March 1, 1971, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 96, Folder 5.

[Fig. 5.27].[128] Their programming aimed to examine the "sub culture of Art" and "its restructuring of our systems of consciousness to identify the read outs of non objective thought placed at the base of our psyche and the resulting impact on our social structure and order," in comparison to "genetic" explanations for the "impact of non objective thought."[129] Without further explanation, we cannot know the exact form such programs would take; but it is clear that Irwin conceived of television as a testing ground for cultural and natural ("hard-wired") theories of perception and cognition.

All of these proposals held television to be a malleable tool that could operate in *both* highly localized and decentralized planes. A chart shows the planned allocation of monetary resources and scheduling for production costs and studio facilities among prospective participants [Fig. 5.28]. Such flexible specialization was emblematic of a nascent kind of destandardized labor. Niche programming and local cable networks testified to the erosion of a "collective" audience—to the redefinition of television as thoroughly imbricated in a global web that could scale up or down with precipitous ease.

Two public access channels, Sterling Manhattan CATV and Teleprompter CATV, were finally introduced in New York in July, at which point E.A.T. continued to seek funding for the project proposals, but failed to win grants for such a costly undertaking (a proposal for a telex-based interview series on "Cable Television and the Artist" also went

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[128] On the Irwin/Wortz UCLA project (with James Turrell), which developed as a result of curator Maurice Tuchman's commissions for the "Art and Technology" exhibition at the Los Angeles County Museum of Art in 1970, see Lawrence Wechsler, *Seeing is Forgetting the Name of the Thing One Sees* (Berkeley: University of California Press, 1982), 128-130. See also "Correspondence with Ed Wortz," November 1968-January 1970, Robert Irwin Papers, Getty Research Institute, Accession no. 940081, Box 31.

[129] Robert Irwin and Ed Wortz, "Information Sheet for E.A.T. Artists' TV Programming Project," February 9, 1971, reproduced in "Artists' Television Programming Project: Artists' Proposals," March 1, 1971, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 96, Folder 5.

unfunded).[130] However, that autumn of 1971, E.A.T. was able to launch a smaller-scale programming endeavor, in which artists' videos and films would be formatted for television (16mm films were converted to half-inch color videotape, for example) and broadcast on the new channels.[131] It was the first series of artists' works to be broadcast over public access cable channels.

The program was estimated to have cost approximately $4,800, and funding was promised from a group of galleries (Bykert, Castelli, Fishbach, Pace, and Reese-Paley) and individual donations, paving the way for a grant of $4,500 from the New York State Council on the Arts in February 1972.[132] A young staffer, Carlota Schoolman, led the project; she had previously worked for the Sloan Commission on Cable Communications (an independent, nonprofit research initiative of the Alfred P. Sloan Foundation) and was to continue her work in television production at Automation House (and with other video artists' groups) until 1974, as a collaborator with numerous artists.[133]

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[130] E.A.T., telex, "Cable Television and the Artist," June 18, 1971, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 96, Folder 4. (Recipients of the telex included John Cage, physicist and Nobel laureate Murray Gell-Mann, anthropologist Margaret Mead, Nelson Rockefeller, Meyer Schapiro, RCA President Frank Stanton, and variety-show host Ed Sullivan.)

[131] E.A.T., "Television for Artists," October 21, 1971, n.p., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 96, Folder 8. See also Billy Klüver, "Letter to Artists Working on Artists and Television Project," October 22, 1971, E.A.T. Documents, The Daniel Langlois Foundation for Art, Science, and Technology, Montreal, Accession no. d10189; C13-21; 251.

[132] "Announcement, Video Education Research Project," October 22, 1971, n.p., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 40, Folder 1. See also Loewen, 373.

[133] Carlota Schoolman, interview with Kathy High, "Video History: Making Connections Conference," October 16-18, 1998, Syracuse University. Transcript accessed online at: http://www.experimentaltvcenter.org/history/pdf/HighKInterview_2_2571.pdf. As Schoolman recounts, "I graduated from NYU, and I went to work for something called the Sloan Commission on Cable Communications. And they were studying the new cable industry. And so I was very aware of the fact that part of this whole process was that there were going to be public access channels. And one of the directors at the Sloan Commission suggested to me that I go and talk to Experiments in Art and Technology when the commission ended, because they were housed at Automation House, [with] Ted Kheel … And there was a television studio in the basement at Automation House. And … Billy Klüver and Julie Martin, they

The first program that E.A.T. broadcasted—on September 9 and 10, 1971, via the public access channels "D" of Sterling Manhattan and "C" of Teleprompter—was titled "Shinohara: The Last Artist," a video (on 1/2" tape) covering Japanese artists living and working in New York, produced for Japanese television by independent filmmaker Rod McCall.[134] This early testament to the internationalization of the art world was soon followed by programming with closer ties to expanded cinema and experimental video. From November 2 to December 29, 1971, E.A.T. broadcast the "Artists and Television" program on Sterling Manhattan and Teleprompter.[135] Works by Michel Auder, John Chamberlain, Nancy Graves, Joan Jonas, Les Levine, Lucas Samaras, Richard Serra, Michael Snow, Keith Sonnier, and Andy Warhol with Michael Netter were shown, one hour-long program presented twice each week (Tuesdays and Wednesdays at 9 p.m.) for nine weeks [Figs. 5.29, 5.30]. E.A.T. organized free screenings of the Tuesday night programs at both Automation House and Max's Terre Haute restaurant, since not all viewers were cable subscribers (subscription costs were approximately five dollars a month).[136] This panoply of emerging video artists and filmmakers was thereby able to

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hired me. I was so belligerent and so naive at the same time, but they hired me to help them put together a public access cable series that was going to be broadcast from Automation House. It turned out it didn't work like that at all. It never did become an [satellite] uplink. But they also invited me to work in the studio down there. And I had actually begun to apply for funds from the New York State Council on my own, to produce works by artists. And so all of that kind of came together for me at Automation House, through Experiments in Art and Technology."

[134] E.A.T., press release, September 9, 1971, n.p., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 96, Folder 7.

[135] E.A.T., "Report on the Artists and Television program on public access cable television channels in Manhattan," March 7, 1972, n.p., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 96, Folder 12. See also letter from Billy Klüver to "Artists Working on Artists and Television Project," October 22, 1971, E.A.T. Documents, The Daniel Langlois Foundation for Art, Science, and Technology, Montreal, Accession no. D10189, C13-21; 251.

[136] Ibid. On cable subscription pricing, see also Anon., "A Community Antenna or Cable Television system (CATV) consists of… ," *Radical Software* 1, no. 1 (Spring 1970): 2.

bring their work—often recorded with low-cost portable video cameras using half-inch tape, such as the Sony Portapak—to the new outlet of public access cable. As their project report stated, E.A.T.'s objective was first and foremost "to get art on t.v.": "Little of the work done by artists using 1/2" [tape] video equipment ever reaches an audience beyond the relatively small gallery-going public. The public access cable television channels are (in terms of the established television medium) the only immediate outlet for 1/2" material."[137] In a somewhat ironic combination of old and new communications technologies, E.A.T. took out advertisements in daily newspapers, including the *New York Times*, to promote the shows [Fig. 5.31].[138]

While early artistic initiatives in television have often been dismissed as simply transferring experimental film, video, and performance to the small screen—rather than engaging with the structures of network television—E.A.T.'s "Artists and Television" program showed that the very act of transposition from film to television entailed a significant act, casting a deliberate light on the assorted sensory and systemic qualities of network television. Thus it spanned a panoply of approaches: Auder and Netter/Warhol's pieces, for example, each drew on melodrama and variety show formats (which Warhol had already appropriated—or perhaps we should simply say *took*—for his lesser-known 16-mm film *Soap Opera* of 1964); Levine's *Open Art Hearings* was akin to straight documentary coverage of students and teachers meeting at an art school in

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[137] E.A.T., "Progress Report on the Artists and Television program on public access cable television channels in Manhattan," Dec. 20, 1971, n.p., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 96, Folder 12.

[138] See, for example, the advertisement for Michael Snow, *The New York Times*, Novermber 2, 1971; for Nancy Graves and Lucas Samaras, *The New York Times*, November 9, 1971; and for Les Levine, *The New York Times*, November 17, 1971.

Chicago; whereas Jonas and Serra's pieces addressed the visual and sonic capacities of video and television.

In this, the diversity of programming was again the target, against the perceived homogeneity of what FCC chairman Newton Minow had in 1961 dubbed the "vast wasteland" of commercial television.[139] As Kheel said, "…virtually everyone but advertisers have been cut off by commercial television. So we've established at Automation House what is essential to PAT [public access television]—a broadcast and video tape recording center. If you want to put something on television, we're making it possible. Public access television has infinite possibilities. You can tailor programs for an audience of known dimensions."[140] All the works being broadcast had been made between 1969 and 1971; most not expressly for the E.A.T. project, but each artist worked with Schoolman and others to convert their piece to television-readiness (for example, as noted above, from half-inch tape or 16mm film) at the Automation House facilities with assistance from Sterling channel engineers.[141] The first series, in November, featured Snow, *Back and Forth*, originally a 16mm film, on November 2-3; Graves, *200 Stills, Goulimine, Izy Boukir* and Samaras, *Self*, on November 9-10; Levine, *John and Mimi's Book of Love*, on November 16-17 (this was censored at the last minute, as discussed below); Levine, *Open Art Hearings*, on November 17-18; Warhol and Netter, *One Hour of Tape*, on November 23-24; Sonnier, *Untitled* ("Half-Inch Color Videotape"), on

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[139] On Minow and the cultural program of the FCC in the 1950s, see Lynn Spigel, *TV By Design: Modern Art and the Rise of Network Television* (Chicago: University of Chicago Press, 2008), 7.

[140] Martin Cohen, "The Electronic Soapbox," *Lithopinion* 7, no. 3 (Fall 1972), 33. *Lithopinion* was the "graphic arts and public affairs journal" of Local One, Amalgamated Lithographers of America.

[141] E.A.T., "Progress Report on the Artists and Television program on public access cable television channels in Manhattan," Dec. 20, 1971, n.p.

November 30-December 1. The second series, in December, broadcast Auder, *A Natural Childbirth*, on December 7-8; Jonas and Serra, *Veil*, and Jonas, *Blue Wind*, on December 14-15; Chamberlain, *Cocaine Blues*, on December 21-22; Polk, *Untitled* and Serra, *Color Aid*, on Dec. 28-29.[142]

If Auder's work chronicled the birth of his child (with Warhol superstar Viva) at the hospital, Gregory Corso reading a poem, and Brigid Polk on the phone—foreshadowing his subsequent work with Warhol on numerous films and videos—Warhol and Netter's piece cut from two male models posing for a still photographer, to Eric Emerson and Geri Miller singing and dancing, to two female models posing for a still photographer. Climactic, arch, and uneventful moments follow one another in monotonous succession. With incredible prescience, both programs focused on the "liveness" of television, its manufactured immediacy and instantaneity, a kind of "reality television" *avant la lettre*. At Automation House, these television programs were accompanied by the simultaneous projection of closed-circuit television within the building, which charted the activities of its inhabitants moment-to-moment and day-to-day—further reinforcing the surveillance-like qualities of Auder and Warhol/Netter's videos while highlighting the frisson between recorded and live events.

In another vein, both ethnographic genres and the careful arrangement of shape and motion of dialectical montage are evidenced in Graves's twenty-minute *Izy Boukir*, originally a 16mm film, in which we see nearly abstracted stills and close-ups of camels in Morocco wandering the souk and the desert in herds, a continuation of footage of the

[142] E.A.T., program schedule, "Artists and Television," October 1971, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 96, Folder 8. See also Grace Glueck, "It's Les! It's Lucas! It's a Teletrip!", *The New York Times*, November 7, 1971.

Sahara in *200 Stills* and *Goulimine*. And in Snow's *Back and Forth* (whose title was also denoted simply as "<->") [Fig. 5.32], the interior of a prefab classroom (and the view through a window within the room) comprises the entire visual field of the film; Snow had set his camera to swing back and forth between two fixed points, accompanied by loud metronomic claps, to render the camera's arc as a palpable agent external to the spectator (i.e., it is not "our" eye moving through the depicted cinematic space). The horizontal movement accelerates until the screen is a blur; then a vertical pan begins, decelerating gradually over the course of the film. As the critic Manny Farber wrote, "it's a perpetual motion film that ingeniously builds a sculptural effect by insisting on time-motion to the point where the camera's swinging arcs and white wall field assume the hardness, the dimensions of a concrete beam."[143]

These works, however, acquired very different resonances when transferred to video and transmitted via the public access channels. For Warhol and Netter's piece, Schoolman's project report stated, "[E]ngineers at Sterling attempted to deal with problems of transmission by volunteering their time to manually control the transmission…The clarity of the tape is extraordinary for 1/2" video. But there were problems in the transmission, and the image was lost approximately every 45 sec. On Sterling (it played perfectly on Teleprompter)."[144] Auder's piece suffered even heavier losses: "Very bad transmission. Unwatchable …Tearing and break up of image on

[143] Manny Farber, "Film," *Artforum* 8, no. 5 (January 1970): 81-82.

[144] E.A.T., "Report on the Artists and Television program on public access cable television channels in Manhattan," December 20, 1971 (revised March 5, 1972), n.p., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 96, Folder 12.

Sterling."[145] In this way, the smooth anomie that would have been characteristic of the films ceded to faulty transmission, a pronounced visual and aural effect of interruption and decomposition. Similarly, the distortions of color television technology (just beginning to find widespread application in the late 1960s) affected the broadcast of Snow's *Back and Forth*; although there were no resolution problems in transmission, the report stated, "the color on t.v. had very little relation to that on the movie," appearing "washed out" and thus flattening the effect of spatial and physical solidity in the original film.[146] Graves's films, on the other hand, "transmitted well and looked beautiful on t.v." Each of these works, then, acquired a new valence when broadcast together in all their heterogeneity. This was not the crystal-clear communication sought by both commercial networks and by proponents of electronic democracy such as Raindance. The programs spotlighted the thick interference and arduous mediation endemic to but normally masked by television: They assumed the contingencies of televisual transmission.

It was Richard Serra who would continue to probe the full implications of such transformations. His seminal 16mm film *Color Aid* (1970-71) [Fig. 5.33] had been broadcast during the "Artists and Television" program; a decisive work within Serra's filmic oeuvre, the piece had an uncharacteristically long duration of approximately twenty-three minutes, compared to the shorter, related *Hand Catching Lead*, *Hands Tied*, or *Hands Scraping* (all 1968). Each of these films focused on hands performing various repeated actions, a serialization and decentering of activity and composition that, as

[145] Ibid.

[146] Color television technologies themselves were largely developed at Bell Labs, Philco, and RCA by the 1940s, but color television sets did not overtake sales of black-and-white sets until 1972. See Albert Abramson, *The History of Television 1942 to 2000* (Jefferson, NC: McFarland, 2003), 74.

Buchloh has articulated, resulted in a dedifferentiation and dedramatization of the normally identificatory spectatorship of film.[147] *Color Aid* features a close-up of monochromatic sheets of colored paper. A hand repeatedly reaches into the frame and pulls away the top sheet, with each motion revealing a new colored field underneath. The allover dispersal of action and prefabricated color bared the constituent device (film's discontinuity of twenty-four frames per second, against the deception of continuous motion; its emulsion and projection of color as mediated rather than pure index; the monochrome defamed as handiwork) in the fashion of structuralist film.

Broadcast over television, however, the film's near-infinite succession of surfaces and their removal—a never-ending shallow depth—became a kind of object lesson in the illusory proximity and spatial intimacy of television, always already farther away than it appears, endlessly concealing the layers of distance that remain between viewer and recorded image.[148] Moreover, the E.A.T. program report noted that the "color was very washed out from the transfer [to videotape]," thereby exhibiting the visual loss entailed in televisual recording and display (video recording scans optical images—*samples* them, in other words—to convert them to one-dimensional electromagnetic signals for transmission; the monitor then converts electric signals into light, with further sampling entailed) versus the much richer resolution of 16mm film.[149] But the airing of *Color Aid*

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[147] Benjamin H. D. Buchloh, "Process Sculpture and Film in Richard Serra's Work" (1978), *Neo-Avantgarde and Culture Industry* (Cambridge: MIT Press, 2001), 421-427.

[148] In the same way, Serra and Jonas's 16mm film *Veil* (1971) would have acquired another, specifically televisual register of meaning when converted to video and broadcasted: the piece features Jonas (in homage to Kenneth Anger's 1949 *Puce Moment*) lying on the floor and slowly unveiling layer upon layer of richly patterned fabrics; eventually, she reveals her face underneath. Echoing the televisual "wipe" cycle, here the piece also becomes a kind of cipher for the manufactured propinquity of television.

[149] E.A.T., "Report on the Artists and Television program on public access cable television channels in Manhattan," December 20, 1971 (revised March 5, 1972), n.p.

also called attention to the basic *arbitrariness* of televisual color, which was the product of competing color standards (developed by CBS, RCA, and others) since the first color broadcasts in the U.S. in 1951 and which to this day operates under differing formats for different countries and regions (NTSC, PAL, etc.).[150]

The first artists' broadcast on public access cable television, then, introduced a promiscuous alloy of genres. In doing so, it ultimately portended the exponential diversification of privatized cable television, rather than fracturing monopolistic networks or auguring any automatic communications utopia. But it also went further—manifesting the emergent fragility and capriciousness of television's expanding operations, its ontological instability.

It was Serra who seems to have seized on these concerns when he decided to make his first-ever video, *Anxious Automation*, with Schoolman at Automation House that same winter of 1971 [Fig. 5.34]. During the production of the "Artists and Television" broadcast, Klüver, Martin, and Schoolman realized they could launch a bona fide television studio and center for E.A.T. in the extant video facilities at Automation House; this was the first tape Schoolman produced there.[151] The six-minute black-and-white video features the head and torso of Joan Jonas, who is awkwardly half-reclined in front of two cameras in the television studio at Automation House. The screen jumps back and forth between these two cameras, each focused on Jonas. The alternation

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[150] Anal K. Jain, *Fundamentals of Digital Image Processing* (Upper Saddle River NJ: Prentice Hall, 1989), 82. "NTSC" format, for example, has the greatest hue variance and necessitates a tint control, thus garnering the nickname "Never the Same Color Twice"—a phenomenon made plain by visiting any group television set display in an electronics store. See also: Joseph H. Udelson, *The Great Television Race: A History of the American Television Industry, 1925-1941* (Birmingham, AL: University of Alabama Press, 1982).

[151] Schoolman, interview with Kathy High, 1998.

becomes faster and faster as the cameras increasingly zoom in on Jonas, but the two cameras are also set at different, ever-fluctuating distances from her, producing a violent temporal and spatial disjunction. There is a constant, abrupt, and disorienting switch between vantage points—closer and farther, side to side. Meanwhile, Jonas asynchronously taps her head and crosses her arms over her chest and her head. Her arm and elbow motions form geometric configurations, echoed by the horizontally striped background—appearing to ape the mechanistic movements and absurd repetition of automated labor. Despite the frenetically jerking cuts, her motions remain barely readable, as if a limit test for the perception of moving images. We are never quite sure if what we are watching is taking place at the same time in front of each camera: The scenario is reminiscent of shutting and opening one's left and right eye in alternation, but the video's displacement is not only bicameral; it implies a proliferating number of distinct and mutable spectatorial positions in space and in time. Augmenting the movements of the cameras and of Jonas is a soundtrack devised by Philip Glass, who taps off-time onto a microphone off-screen.[152] The recorded piece would have been shown on the closed-circuit monitors within Automation House.[153]

In this way, the decentering principle of Serra's structural films was transposed to the realm of televisual asynchrony, with starkly dissimilar implications. *Anxious Automation* took task-based performance to another register. It replaced the single-frame film with a multiple-camera closed-circuit video—one in which repetitive but irregular

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[152] Glass's contribution is central and, it should be noted, testifies to the way in which the programming at Automation House underscored the fundamental importance of *audio* in video. This provides a powerful counterexample to most histories of video, which have largely concentrated on the visual—whether in the context of documentary photography, formal abstraction, or textual communication.

[153] Schoolman, interview with Kathy High, 1998; Author's interview with Julie Martin, September 19, 2007, Berkeley Heights, New Jersey.

motion, a fragmented and manifold visual field, and temporal discontinuity are brought to bear on the neurotic subject of automation.[154] Whereas Serra's earlier films acted out the processes of "manual (subjective) labor power" and "(objective) physical laws," as Buchloh elegantly put it, such corporeal and natural forces are here confronted by technological control systems. The body's physical rationalization is warped and amplified by the use of television—the ultimate automation of information. *Anxious Automation* does less to disclose the means of its mechanical functioning and more to multiply the chaotic dissonance of the double-channel recording system. And it is precisely the exaggerated, schizoid breakdown of television's "real-time," automatic relay that interpellates the viewer as one more object implicated in the social crisis of automation. The viewer is always catching up to what is "occurring" onscreen, evoking their own perpetual belatedness in the face of unpredictable technological developments and effects.

This cuts against the grain of two major formulations of video art and television, both of which center on the notion of continuous feedback: Here, the work did not evince an ever-present, narcissistic loop of reflection from which the external mechanisms of video are elided. Nor did it enable a therapeutic use of closed-circuit or cable television in which collective electronic activism might be fomented between spectator, recorded subject, and recorder.[155] To the contrary, *Anxious Automation*

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[154] On task-based performance in film and video art between 1968 and 1972—namely, that of Jonas, Serra's early films, and others, see Anne M. Wagner, "Performance, Video, and the Rhetoric of Presence," *October* 91 (Winter 2000): 59-80; Buchloh, "Process Sculpture and Film in Richard Serra's Work," *Neo-Avantgarde and Culture Industry*, 424.

[155] The first is, of course, the formulation offered by Rosalind Krauss in 1976; the second was offered nearly thirty years later by David Joselit. Krauss pronounced, "the feedback coil of video seems to be the instrument of a double repression: for through it consciousness of temporality and of separation between subject and object are simultaneously submerged," whereas for Joselit the feedback loop harbored the

mapped precisely the way in which, as Mary Ann Doane has suggested, television would increasingly come to be defined by the logic of catastrophe—its *dis*continuity, indeterminacy, and link to the real:

> "….catastrophe's discontinuity is embraced as the mirror of television's own functioning, and that discontinuity and indeterminacy ensure the activation of the lure of referentiality. In this sense, television is a kind of *catastrophe machine*, continually corroborating its own signifying problematic—a problematic of discontinuity and indeterminacy which strives to mimic the experience of the real, a real which in turn is guaranteed by the contact with death."[156]

Television and automation are technologies that each reflect and produce discontinuity and indeterminacy.[157] With its doubled, haywire cameras, *Anxious Automation* articulated the points at which such reflection and production could not hold—where television could not contain catastrophe and automatic transmission seemingly spun out of control. It embodied the twinned structures of panic in automation and in television.[158]

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possibility of an acute form of perceptual and political consciousness. See Rosalind Krauss, "Video: The Aesthetics of Narcissism," *October* 1 (Spring 1976): 50-64; Joselit, *Feedback*, 5-42.

[156] Mary Ann Doane, "Information, Crisis, Catastrophe," *Logics of Television*, ed. Patricia Mellencamp (Bloomington: Indiana University Press, 1990), 234. Emphasis added. Not coincidentally, Doane chooses the news coverage of the Cuban Missile Crisis and the stock market crash of 1987 as examples of technological crises *par excellence*, crises mirrored in television's own mode of functioning. Of course, as Doane argues, commercial television has an ever-expanding capacity—an obsession, even—to contain the catastrophe it depicts and parallels, ultimately converting catastrophe into a crucial, predictable, expected presence on television. As suggested above, however, I would argue that Serra's piece interrupted and destabilized the mechanisms of this "catastrophe machine." (In much the same way that she maintains television contains catastrophe, Doane has argued in her more recent work that classical cinema and statistics were deeply aligned, since each "acknowledges the force of contingency and mobilizes chance, but ultimately… overrides both. … chance and order become measurable and hence comparable, compatible." Mary Ann Doane, *The Emergence of Cinematic Time* [Cambridge: Harvard University Press, 2002], 138.)

[157] Serra himself remarked upon the "discontinuous, fragmented time" of television, as quoted in the press release for the "Artists and Television" program: "Serra says the constant interruptions of commercials, please stand by's and frequent, nondescript pauses create an entirely different language and visual system. He believes that these differences in the way a person watches television make it a distinct communication medium—not just another place to show films.'" Richard Serra, quoted in Carlota Schoolman, press release, "Artists and Television," n.d., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 96, Folder 14.

[158] Serra would go on to pursue explicit, oppositional, and often didactic critiques of television rather than exploring its structural and discursive contingencies, abandoning the double camera setup in works like

These endeavors at Automation House did much to unmask burgeoning ideological and formal aspects of television (and of cable television in particular), in the way that Dan Graham, for instance, was beginning to do.[159] But I would argue that above and beyond this deconstructive action, they fully entered institutional networks of production, transmission, and reception. If much video art of the time was just starting to reveal or diagram the ways in which the contingency of feedback was managed and contained by commercial and public television, the televisual projects at Automation House took this situation for granted, perturbing it from within. They had already begun testing the loopholes and apertures puncturing this dynamic system, the disturbances that could not be reined.

Such projects cannot simply be understood as a reaction to naïve fears of dehumanization and automation—and as the fragmentation of their tactics makes evident, they certainly did not attempt to recuperate a unified humanist subjectivity. E.A.T.'s television center at Automation House was, in fact, dealing with an advanced situation of growing contingency, flexibility, and specialization in the sphere of production. Fittingly, they launched an "E.A.T. Television Information Center" in tandem with their

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Television Delivers People (1973, also made with Schoolman), *Surprise Attack* (1973), and *Prisoner's Dilemma* (1974). These latter two works, however, were parodic scenarios of game theory, demonstrating Serra's continuing concern for the high-stakes brinksmanship and zero-sum-game of the Cold War.

[159] Benjamin H.D. Buchloh, "Moments of History in the Work of Dan Graham," *Neo-Avantgarde and Culture Industry* (Cambridge: MIT Press, 2001), 197. In 1971, Graham had staged a version of his work *Project for a Local Cable TV* in a classroom at the Nova Scotia College of Art and Design; it was a stunningly incisive calculation of the limits of televisual communication, staging an open "debate" for the cameras that would nevertheless never become a functioning two-way communicative transmission between those in the televised space and viewers ostensibly watching from home. More to the point, Graham intended the work to be broadcast on cable, but it never reached actual television screens. See *Dan Graham: Works, 1965-2000* (Düsseldorf: Richter Verlag, 2001), 136; Kaizen, 101. As noted in chapter 3, Graham had also applied for and become a member of E.A.T. On his application form, he did not address television but circled "film, holography" and "poetry; information theory—computer speech." Dan Graham, "Artist's Membership Form," 1968, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 6, Folder 41.

open television studio and programming initiatives. The first session took place on November 19, 1971, with engineers and producers from Sterling Cable, CBS, NBC, RCA (which owned NBC at the time), the Corporation for Public Broadcasting, Panasonic, and smaller electronics or communications firms available "to answer questions and talk informally with all interested visitors."[160] Topics covered included editing, mastering, audio, satellites, cables, VHF and UHF (Very High Frequency and Ultra High Frequency, the most commonly used frequency bandwidths used for transmission of non-cable television), and the conversion of Super 8 to video—in short, much of the heterogeneous information needed to getting a television program on the air.

The "Information Center," open studio, and artists' programming would therefore seem to have mirrored any number of contemporaneous, utopian descriptions of automation as the font of autonomy. Chief among these was McLuhan's prognostication

[160] "E.A.T. Television Information Center," November 19, 1971, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 96, Folder 6. "Experiments in Art and Technology has invited the following people… Adrian D. Ettlinger is mainly working with computer applications to television and video editing. Mr. Ettlinger is presently both a Consultant for the Columbia Broadcasting Service and head of Autocue Corporation. Cin Tin Lei is President of C.T.L. Electronics. Presently he is setting-up a production company, editing and screening service designed especially for artists and people working independently in video tape. Robert Nagel was originally a neurophysiologist…He has provided technical assistance to the Pulsa group, David Rosenthal and other artists. At this time he is President of Computer Security Systems, Inc. and is producing the election night reporting system for C.B.S. Sheldon Neimeyer is the Manager of news film and sound at National Broadcasting Company and is a fellow of Motion Picture and Television Engineers. Irving Rosner was with Columbia Broadcasting Service from 1949-1959. He was an assistant and operations engineer in the equipment division of R.C.A. Broadcasting during 1959-1960. Since 1960 he has been head of Rosner Television Systems, which is a systems oriented engineering, consulting, contracting company engaged in specification, design, manufacture installation of audio-visual systems of communication. Phillip A. Rubin is Director of communication research and development for the Corporation for Public Broadcasting, Washington, D.C., and heads research in satellites, cables, VHF, UHF, interconnection, the use of Super 8 and areas of C.P.B.'s concerns. John Sanfertello is Program Manager of Sterling-Manhattan Cable Television, Inc. Originally he was with both Paramount and Columbia pictures. Later he was Assistant Director for WTIC-TV in Hartford, Connecticut and for FILMEX. He is mainly interested in quality production in television equal in standards to filmmaking. George Vaughn has been the Manufacture Agent at Panasonic for the last three years. Previous to that time he was with All-State Communications. Morris Washington is the east regional Manager of video products at Panasonic. Before that he was District Manager at Sony for five years."

for the revolutionary effect of automation: An organically interdependent feedback system based on automation would breed synchrony, simultaneity, ultimate flexibility, and custom-built networks of production and communication.[161] According to McLuhan, the "panic about automation as a threat of uniformity on a world scale is a projection into the future of mechanical standardization..."; these were anachronistic fears.[162] What was really the case was that "the social and educational patterns latent in automation are those of self-employment and artistic autonomy." [163] *Flexibility* was also, as it happened, a catchphrase for activist television groups such as Raindance. The term was specifically championed by the anthropologist and cybernetician Gregory Bateson in *Radical Software* in 1971: Bateson argued that a "healthy ecology of human civilization" would depend foremost on the "flexibility" of behavior and ideas—the increase, distribution, exercise, and application of flexible adaptation, "an uncommitted potentiality for change." [164] (The example Bateson provides is that of an acrobat on a high wire, whose arms and limbs must have great flexibility to adjust and maintain balance; without this flexibility, the ability to move his arms, he will fall.)[165]

Yet it was exactly this mode of flexible agency that would come to be called, in various guises, "post-Fordist," "immaterial," or "flexible" labor. In these readings,

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[161] Marshall McLuhan, "Automation: Learning a Living," *Understanding Media* (Cambridge, Mass.: MIT Press, 1997), 346-359.

[162] Ibid., 359.

[163] Ibid., 359.

[164] Gregory Bateson, "Restructuring the Ecology of a Great City," *Radical Software* 1, no. 3 (Spring 1971): 2-3. Bateson draws upon and modifies the urban planning prescriptions of both sociologist Richard Sennett and architect Christopher Alexander. See Richard Sennett, *The Uses of Disorder: Personality and City Life* (New York: Knopf, 1970); Christopher Alexander, *Notes on the Synthesis of Form* (Cambridge: Harvard University Press, 1964).

[165] Bateson, "Restructuring the Ecology of a Great City," 3.

automation and the neo-avant-garde together created the post-Fordist worker. The rise of automation paralleled the rise of radical tactics in art and labor movements. These tactics aimed precisely to disrupt and overthrow the oppression of wage labor and of the instrumentalization of all spheres of life—an instrumentalization due, in no small part, to sweeping automation. But, as Paolo Virno writes, late capitalism "transformed into a productive resource precisely those modes of behavior which first, made their appearance under the semblance of radical conflict."[166] The destandardization of labor so productive for global capitalism mirrored the very strategies that had been invoked to depose it. Abstract knowledge—"especially scientific knowledge"—becomes the principal productive force, relegating discrete, repetitive labor to a residual position in favor of a productive process that "directly and exclusively calls upon science."[167]

This "post-Fordism," as Virno dubbed it, was predicated on fluidity: turnover, early retirement, and temporary forms of labor. At any moment a technological innovation (such as automation) could intervene, reducing employment. Workers were thus supposedly freed from the shackles of Fordist regimentation. But, Virno asserts, this resulted instead in unlimited flexibility in the use of labor-power, the proliferation of hierarchies, and therefore the "re-establishment of archaic disciplinary measures to control individuals no longer subject to the rules of the factory system."[168] For Virno, this cooptation occurred on the heels of the Italian autonomist protests in the mid- to late 1970s, but it is clear that such mutations in both labor and radical thought were already at

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[166] Paolo Virno, *A Grammar of the Multitude*, (Cambridge, Mass.: Semiotext(e), 2004), 98-99.

[167] Ibid., 100.

[168] Ibid., 101.

work in the 1960s. (Artists and Television certainly hit the boundaries of the control mechanisms of broadcast television, when Les Levine's piece, *John and Mimi's Book of Love*, was censored for its display of nudity—although the report expressed surprise that other programs, some of which had content that would generally be perceived as objectionable by the FCC, were allowed to air.)[169]

One can think of Virno's post-Fordism, in fact, as the apotheosis of modernity itself. It is the nightmare version of what sociologist Zygmunt Bauman has called "liquid modernity," and of the post-Marxian modernity described by Marshall Berman, where all that is solid has indeed melted into air. Post-Fordism represents the ultimate recuperation of modern instability into systems of fluid authority and control.[170] This shift toward lithe and immaterial modes of power is also, of course, the hallmark of Deleuze's control society, in which disciplinary structures have been augmented and then replaced by unbounded, microphysical, and invasive flows: "The disciplinary man was a discontinuous producer of energy, but the man of control is undulatory, in orbit, in a continuous network. Everywhere surfing has replaced the older sports."[171]

Sociologist Richard Sennett, too, has argued that the New Left should have been careful what they wished for: their call for the fragmenting of large institutions has merely given rise to flexibility, instability, migration, and *not* more harmonious forms of

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[169] E.A.T., "Report on the Artists and Television program on public access cable television channels in Manhattan," December 20, 1971 (revised March 5, 1972), n.p. On the content of *John and Mimi's Book of Love*, see also Anon., "Les Levine," *Radical Software* 1, no. 1 (Spring 1970): 22; Douglas Pringle, "Les Levine: Body Control Systems and John and Mimi's Book of Love," *artscanada* (June 1970): 60.

[170] Zygmunt Bauman, *Liquid Modernity* (Cambridge: Polity, 2000); Marshall Berman, *All That Is Solid Melts into Air: The Experience of Modernity* (London and New York: Verso, 1983).

[171] Gilles Deleuze, "Postscript on the Societies of Control" (1990), *October: The Second Decade, 1986-1996*, ed. Rosalind E. Krauss et al (Cambridge, MA: MIT Press, 1997), 443-447; 445. See also Deleuze, "Postscript on Control Societies," *Negotiations, 1972-1990*, trans. Martin Joughin (New York: Columbia University Press, 1995), 177-82.

consensus or community. "Liquid modernity" is exactly what happened, but it did not create more freedom.[172] And it was in large part because of the inability to deal with automation that the promise of non-alienated labor disintegrated, became subject to different yet more thorough modes of control: "The twentieth-century welfare state treated automation ineptly because policymakers… failed to understand how fundamentally automation could change the very nature of the productive process… Not only did government shy away from the enormity of this transformation; labor unions resisted thinking the matter through, focusing on job protection for existing workers rather than on shaping the future workforce."[173]

Yet Sennett then makes a startling exception, citing one lone voice: "The American labor negotiator Theodore Kheel, founder of Automation House, spoke as a prophet in the wilderness when he argued to Western governments that the only 'remedy' for true automation was to make paid jobs out of previously unpaid work…"[174] Kheel's endeavor may have seemed like a post-Fordist solution to a post-Fordist problem. But from such attempts at action, however, the tenuous character of such totalizing, disciplinary systems only became evident: the *loopholes*, the ways in which post-Fordist control systems could *not* sustain seamless, totalizing cooptation and domination. It was

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[172] "Instability since Marx's day may seem capitalism's only constant. The upheavals of markets, the fast dancing of investors, the sudden rise, collapse, and movement of factories, the mass migration of workers… Today the modern economy seems full of just this unstable energy, due to the global spread of production, markets, and finance and to the rise of new technologies." Richard Sennett, "Bureaucracy," *The Culture of the New Capitalism* (New Haven: Yale University Press, 2006), 15-16.

[173] Ibid., 99-100.

[174] Ibid., 99-100.

in this sense that Automation House and E.A.T. seem equally estranged from the bona fides of the New Left, the neo-avant-garde, *and* the control society.

Once more, the television experiment at Automation House underscored the systemic recuperation of flexibility to be fundamentally unstable. Its endeavors came to plot the shifting limits of control systems themselves. Like E.A.T.'s other forays into lecture-demonstrations and informational sessions (as chronicled in Chapter 3), the group's "Television Information Center" attempted to dismantle expert systems and hierarchies of information. E.A.T. hoped to revoke the restriction of technical knowledge to privileged communities. At the same time, such technical information was constantly subject to revision and obsolescence. This was, in other words, a mark of the mounting instability of expertise. Both Giddens and Beck have held this volatility of expert knowledge to be a core feature of postwar risk society. Here, post-Fordist modes of knowledge production and control come undone. Giddens emphasizes science and technology as the epicenter of such flux:

> "The skeptical, mutable nature of science was for a long time insulated from the wider public domain—an insulation which persisted so long as science and technology were relatively restricted in their effects on everyday life. Today, we are all in regular and routine contact with these traits of scientific innovation… We don't, and we can't, know—the same applies to a diversity of new risk situations."[175]

Risk is in some sense a post-rational phenomenon, entailing the massive reconceptualization of the rationality of science, its logic of research, methodology, and

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[175] Anthony Giddens, "The Politics of Risk Society," *Conversations with Anthony Giddens: Making Sense of Modernity*, 204-205.

theory.[176] More broadly, Beck has even articulated profound—and prescient—doubt that neoliberal regimes based on modern rationalization can reproduce themselves at all. The pervasiveness of risk "occurs undesired, unseen and compulsively in the wake of the autonomized dynamism of modernization, following the pattern of latent side effects."[177] The principal factors that drive such endemic instability include environmental disasters, technological risks, and financial and fiscal crises in the global market. And at the heart of fiscal crises are "[U]nemployment, precarious forms of employment, automation and the new manifestations of 'unemployment growth'."[178] This was, after all, the exact point at which massive layoffs of engineers occurred in the US, from 1970 through the middle of the decade, incurred as a result of the major post-Vietnam decrease in defense spending.[179] The larger worldwide economic contraction struck most severely in August 1971, with the collapse of the Bretton Woods exchange standard and the resulting "floating" and devaluation of global currencies, and in October 1973 with the global oil crisis.[180]

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[176] Beck, "The Reinvention of Politics: Toward a Theory of Reflexive Modernization," *Reflexive Modernization: Politics, Tradition and Aesthetics in the Modern Social Order*, 31.

[177] Ibid., 5.

[178] Ulrich Beck, *Power in the Global Age: A New Global Political Economy* (Polity Press, 2005), 80.

[179] See *Science and Engineering Employment 1970-80: Special Report*, eds. Michael F. Crowley et al, (Washington, D.C.: U.S. Government Printing Office, 1981).

[180] See Peter M. Garber, "The Collapse of the Bretton Woods Fixed Exchange Rate System," *A Retrospective on the Bretton Woods System*, eds. Michael D. Bordo and Barry Eichengreen (Chicago: University of Chicago Press, 1993), 461-485; Walter J. Levy, "World Oil Cooperation or International Chaos," *Foreign Affairs* 52, no. 4 (July 1974): 690-713. The collapse of Bretton Woods and the oil crisis also mark, for Jameson, the "end" of the 1960s. But if, for Jameson, this is also the beginning of another epoch, "the transition from one infrastructural or systemic stage of capitalism to another," from imperial control to market penetration—characterized by the newly monstrous reach of a "henceforth global capitalism"—this reading presupposes a more stable and more hegemonic model of late capitalism than has seemingly been borne out. See Jameson, "Periodizing the 60s," 208-209.

E.A.T. indexed the devastating insecurity of the industrial and economic order in its own funding operation. The response to the “Artists and Television” program was enthusiastic, and Schoolman, Klüver, and others at E.A.T. hoped to install even more complete production, recording, and broadcast facilities at Automation House, as well as establish a distribution network for artists’ programs on both commercial and non-commercial stations across the country and perhaps, one day, globally.[181] But additional funding for creating such a distribution system never materialized, nor did the monetary support from the galleries who had promised funds for “Artists and Television” broadcast. E.A.T. had prepared for the contingency of the fiscal situation by launching its own fundraiser to cover the costs of the broadcast. On December 3 and 4 of 1971, they held the “ARTCASH Benefit” for the television center and “Artists and Television” at Automation House. Six artists designed fantastically illustrated bills of various unused denominations: Warhol chose a $1 bill, simply because “I was the first one on the list”; Whitman, $3; Rauschenberg, $12; Tom Gormley (who organized the benefit), $24; Red Grooms, $51; Marisol, $88 [Figs. 5.35, 5.36, 5.37].[182] The notes were offset lithographs

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[181] Julie Martin, “Report draft #2, A report prepared for Experiments in Art and Technology re: Artists and Television Project,” December 25, 1971, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 96, Folder 12. As Martin stated, “I have been contacted and interviewed by Grace Glueck of the *New York Times* (NYT Nov. 7, 1971), Jonas Mekas of the *Village Voice* (Nov. 10, 1971), Denise Hare of *Craft Horizons*, Robert Hughes of *Time Magazine*, Liza Bear of *Avalanche Magazine*, Ruth Rothko, art editor of WBAI in New York…reporters from the *Daily News*, the *New York Herald*, and de Jong of *Artitides* (a French art journal). About 15-20 artists whose work I did not know have contacted me with an interest in either cablecasting their work or gaining access to video equipment. Distribution possibilities have emerged, many of which can be pursued: cable systems outside of N.Y.C., video theatres, television networks interested in experimental material, etc.”

[182] “Artists Statements, Artcash Benefit,” November 1971, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 96, Folder 26; “Fact Sheet on Artcash,” November 18, 1971, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 96, Folder 38. E.A.T. also simultaneously held another fundraiser, “Graphics at Automation House,” with prints by over ninety for sale and on exhibit from December 4-8 at Automation House. See “Graphics at Automation House,” December 4, 1971, E.A.T. Documents, The Daniel Langlois Foundation for Art, Science, and Technology, Montreal, Accession no. D110221; C14-1; 262.

printed on 100% Rag Cranes Bond—the same stock used by the U.S. Treasury, although ARTCASH employed slightly darker colored fibers, after E.A.T. and the printing press it used were threatened with counterfeit restrictions.[183] $5,640,000 in trimmed bills were printed and cut to standard US currency size.

ARTCASH provided a sly counterexample to the monopolistic model of television sponsorship, nodding as well to the unreliability of public and private art funding and to the abstract liquidity of currency itself. If it recalled other artworks exploring the monetary system at the time—from Warhol's silkscreen bill paintings of 1962 to Les Levine's *Profit Systems I* and Robert Morris's *Money*, both 1969, the ARTCASH benefit was a decidedly tongue-in-cheek affair that nonetheless took these exercises to the extreme with mordant acuity. Both Levine's and Morris's works were temporary, short-term injections of money into the stock market (Morris invested $50,000 for a set period of time; Levine bought five hundred shares of Cassette Cartridge Company and sold them after one year). With their brief temporal limits, these works clung to a sliver—however emaciated—within the categorical realm of art and outside that of the market. ARTCASH, conversely, collapsed the distinction between "art objects" and symbolic currency, its bills perversely remaining in circulation forever, their exchange value put to actual use. (Note, too, that it was an automated currency printing press that generated the "money," an aberrant version of both serial silkscreen production and the excess issuing of money by central banks to increase liquidity.) And as Warhol said of his bills—each of which possessed one side that was simply a solid black

[183] "Fact Sheet on Artcash," November 18, 1971; Author's interview with Julie Martin, Berkeley Heights, New Jersey, October 10, 2005.

ground—"I made mine very easy to copy, because everyone should have money."[184] With the specter of implosive stagflation looming, this seemed an all too appropriate solution (or abdication) to the global monetary crisis.

Let us turn back to Matta-Clark's *Automation House*, which was originally filmed in 16mm but then transferred to video, and is a meditation on the spatial and structural aspects of Automation House itself. The piece opens with a shot on the fourth floor, ostensibly opening onto a view of a conference room on the left and an adjacent window view abutting on the right [Figs. 5.38, 5.39]. Yet as figures slowly move into the space, particularly one performer that stretches his hand at the edge of the window, it becomes clear that we are actually seeing a mirror reflection in the left half of the video frame. The image of the interior room is in fact a reflection; Matta-Clark plays on the mirroring of the left and the faint reflection into the actual window on the right, as the performer deliberately places his arm and hand into the real and virtual spaces within the frame—a slow revelation that is nevertheless leaves us in an uncertain viewing position, never quite sure of what we are looking at.

The video then cuts to another floor, the stairwell next to the garden level, and, similar to the opening scene, a view out a window abuts the stairwell [Fig. 5.40]. Yet again, though, this turns out to be an illusion: the view outside is actually a mirror reflection, and as we watch bodies enter the frame and climb down the stairwell, we partially recognize yet struggle to figure out what exactly is occurring within the film frame. In the third scene, this ambiguity is multiplied, as we see an actual room in one

[184] Grace Glueck, "Artists' Designs for Currency Include a $12 Bill," *The New York Times*, November 6, 1971; on Levine and Morris's projects, see also Jean Lipman, "Money for Money's Sake," *Art in America* 58, no. 1 (January/February 1970): 76-82.

half of the frame, and a video monitor that takes up the other half [Fig. 5.41]. The closed-circuit monitor is tracking activity elsewhere in Automation House, a kind of self-referential image that nods to the live, simultaneous images within the building itself. The "split screen" articulated in Whitman's *Two Holes of Water*, for example, is here heightened, precisely because it is also a document of real experience. And in the "actual" side of the frame, we see the elevator, whose doors open and close repeatedly, inserting yet another kind of spatial field into the image. This play on mirrors, windows, opening and closing doors, and video monitors continues throughout the last section of the film/video, in which the lobby becomes the main stage: the entrance doors to the entire building are in the central part of the frame, while a mirror lies to the left, but once again we do not detect this configuration of the image until several minutes into the scene. Matta-Clark thus unveils and amplifies the internal, closed-circuit feedback loop within the infrastructure of Automation House. Communication within the architectural space—whether visual, virtual, or physical—is hyperbolized and fragmented in a continuously unfolding series of deconstruction.

Automation meant global communication; at the beginning of E.A.T., this syllogism was in no small part hopeful. In his 1965 essay "Diary," Cage had predicted a universal and unifying communications system: "Automation. Alteration of global society through electronics so that world will go round by means of united intelligence rather than by means of divisive intelligence (politics, economics)."[185] Yet by the end of the Artists & Television project, as crystallized in Matta-Clark's film, any dreams of the

[185] John Cage, "Diary: How to Improve the World (You Will Only Make Matters Worse)" (1965), *A Year from Monday* (Middletown, CT: Wesleyan University Press, 1969), 17-18.

harmonious automation of communication systems were replaced by recognition of both the dangers and limitations of such a seamless network.

V. Automation Out of Bounds

E.A.T.'s work at Automation House was to grow increasingly attuned to a realm in which the contingency supposedly recouped and managed by post-Fordism was not wholly contained, not totalizing. The group's series of "Projects Outside Art" in 1970-71 further troubled the turbulent advent of automation—not just in the spheres of mechanization and information but in communication, ecology, and individual experience. Yet this move beyond the categorical domain of "art" only served to highlight the ways in which aesthetic concerns subtended and pervaded the social dynamics of risk. An ambitious slew of program proposals addressed the prospects of environmental disaster, the limits of nonrenewable resources, monetary distribution, and, not least, the fraught relation between labor and aesthetic production. The proposals gravitated toward the arenas in which the calculus of risk and insurance—that determining structure for modernity's "taming of chance"—was continually threatened by catastrophe and breakdown.

In March 1969, E.A.T. had proposed a series of exhibitions designed by artists focused on "Technology and the Individual." While the suggested themes were intended to "promote a recognition of the options for the individual presented by the physical capabilities of the new technology," both its social aspects and its corporeal effects, they also touched on the implosions of such possibilities. The categories implied various impieties of the new technological moment, probing everything from biopolitics to surveillance to atomic waste. With titles such as "Variations of the Body: Genetics," "Variations of the Body: Renovation, Transformation, and Extension," "Secrecy or Sharing: New Communication and Information Technology," "Automation: Activity or Work?", "Technology and the Environment: A Simulated Ecosystem," and "Atomic Energy: The Cloud and the Clear Sky," the exhibitions were to be "interactive" and "circulated on a rental basis like prints of a film…easily transportable and adaptable to the greatest variety of extremes of audience and place of installation."[186] The malleable and protean exhibition form would speak to the "variations of the body"—the schizophrenia of the contemporary subject.

While these exhibitions remained unrealized, the rubric was revived in the form of "Projects Outside Art," launched with a poster whose verso was adorned with a rainforest background in December 1969 [Fig. 5.42].[187] The poster called for proposals for "realizable projects in the environment," in addition to a conference on the "interaction between artists and engineers."[188] Possible fields of inquiry ran the gamut of housing, health care, environmental control, transportation, education, transportation, energy production and distribution, gender issues, leisure, and so on; the projects should also be geographically specific. And the jungle image also harked back to Tudor and Cunningham's *Rainforest*, a project that explicitly invoked the dense, rhizomatic, unhierarchical rainforest as a model for interdisciplinary and multisensory experience—and which, as I have noted, Klüver would explicitly state in his manuscript "Rainforest": "The main purpose of Experiments in Art and Technology is to develop, through

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[186] "Technology and the Individual," March 17, 1969, in *E.A.T. Proceedings*, no. 9 (May 19, 1969): Appendix VI, n.p.

[187] E.A.T., "Projects Outside Art," press release, December 8, 1969, n.p., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 59, Folder 36.

[188] Ibid.

experimentation and experience, fluid organizational forms whose model is that of the rainforest rather than the oak tree."[189]

When Automation House opened on March 2, 1970, Klüver and Kheel released a second press announcement, extending the deadline for projects and stipulating that participants take into careful consideration the "utilization of available technology and existing scientific knowledge, recognition of the scale required to make the project effective under existing social and environmental conditions, ecological effects and organizational methods necessary for execution."[190] The optimistic tenor of such language is obvious, but so, too, is the pragmatic and stopgap quality of the group's vision.

Proposals typically espoused a jury-rigged and makeshift intervention into the "environment." The majority of submissions—by June, E.A.T. had received approximately 115—came from architects and planners and delved into the problems of natural resources and sustainability. Many of them were more post-apocalyptic than optimistically Fullerian. Paul Broches, of the Columbia School of Architecture, advocated a "Global Power Supply": The aim was to "explore the potential of the fuel cell (or other ecologically palatable energy source) as a compact, high-powered, efficiently operated, mobile energy source. A modest "economical prototype," Broches hoped, might be developed and enter the consumer market.[191] Forrest Myers put forth an

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[189] Klüver, "Rainforest," Jan. 30, 1970, 1. Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 120, Folder 26.

[190] E.A.T., "Projects Outside Art," press release, March 2, 1970, n.p., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 59, Folder 36.

[191] Paul Broches, "Proposal: Global Power Supply," 1970, n.p., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 59, Folder 2.

enclosed "Home information, communication, entertainment module," a "soundproof fiberglass shell with out-board air purification and conditioning system" to deal with environmental toxins—part of Myers's larger interest in modular architectural units made from tensile structures.[192] Various kinds of do-it-yourself pneumatic structures were laid out by Düsseldorf-based artist Klaus Goehling and New York-based Yukihisa Isobe. The latter based his plans on the striking, giant polyethylene air dome he was simultaneously planning for the first Earth Day in April 1970 and the inflatable, "portable hemispheric projection theater" he had constructed for a multimedia performance with Jud Yalkut, complete with school bus as towing apparatus.[193] Each of these appeared to mount a kind of sensory or physical defense against a devastated and impoverished environment.

Other submissions addressed predicaments in subjectivity and biopolitics. One proposal called for a rehabilitation center for "hard-core heroin addicts in the urban ghetto."[194] J.J. Jehring, the "Senior Scientist and Director" of the (unfortunately-named) "Center for the Study of Productivity Motivation" at the Graduate School of Business at the University of Wisconsin Madison, proposed a far more instrumentalized project of deutero-learning: a "cybernetic environmental educational program," "a specially designed large-scale environment to give individuals a 'feeling' or a 'learning'

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[192] Forrest Myers, "Proposal for Projects Outside Art," n.d., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 59, Folder 14.

[193] Klaus Goehling, "Proposal for Projects Outside Art," n.d., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 59, Folder 8; Yukihisa Isobe, "Proposal for Projects Outside Art," n.d., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 59, Folder 10. On Isobe's traveling inflatable theater and collaboration with Yalkut, see Gene Youngblood, *Expanded Cinema* (New York: Dutton, 1970), 391-392.

[194] Robert Meacham, "Proposal for Projects Outside Art," n.d., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 59, Folder 14.

experience of what it means to function effectively within the 'group' society which is developing."[195]

Other projects were explicitly focused on contained perceptual environments. Agnes Denes—who remains far under-recognized as one of the first conceptualists, uniquely partnering an ascetic bent with lush materialism—proposed a "total auditory perception experiment." This was essentially an acoustic field outfitted with an extensive four-channel sound system to investigate "city-country-forest-desert-underwater-space sounds," "micro-noise—infra/ultra sounds," "noise control," "psychoacoustics," phasing and binaural effects, and so on.[196] In another proposal, Alison Knowles sought to further develop the physical manifestation of her *House of Dust* computer book project of 1967. The text, created with James Tenney, is a key example of the anti-literary linguistic and typographic endeavors of Fluxus and Conceptual art, but less well known is Knowles's subsequent "public quatrain-sculpture," as she called it, which she actually built as two cement structures in New York in 1968 in a housing project with technical assistance

[195] J.J. Jehring, "Proposal for Projects Outside Art," n.d., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 59, Folder 11.

[196] Agnes Denes, "Proposal for Projects Outside Art," June 9, 1970, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 59, Folder 4. See also Agnes Denes, "Matrix of Knowledge," *The Human Argument*, ed. Klaus Ottman (Putnam, Conn.: Spring Publications, 2008), 104-106. Denes's *Rice/Tree/Burial* (1968-1979) is also commonly noted as the first earthwork; throughout her career, she explored the warping of scrupulous order in her map projections of 1973–79, globes topologically twisted into doughnuts and snails, and in her "Pyramid" series, begun in 1970 as Thomas Bayrle-like pyramidal graphs constructed from teeming elements of tiny people or numbers based on Pascal's triangle (a numeric arrangement that, among other uses, serves to chart probabilistic outcomes). It is striking that Denes could so thoroughly confound old oppositions between drawing and diagram—the embodied versus the projected, the direct trace versus the mediated matrix—and that she would actually enact many of these linear forms with living fields or bodies or animals. See my review of Denes's collected writings: Michelle Kuo, "*The Human Argument*," *Bookforum* 15, no. 5 (February/March 2009): 48-49.

from E.A.T. (as discussed in the previous chapter).[197] The "house" was constructed from abandoned materials, the specifications determined by randomly generated information—for example, "southern exposure," "ten pounds of shoes." [198] It was, sadly, subject to arson in 1968, and Knowles planned to move the structure to the new California Institute of the Arts campus in Burbank, California, in 1970, where she was accepting a teaching position. She wrote to E.A.T. to suggest this rebuilding of the *House of Dust* with a multimedia component that would respond to E.A.T.'s call for ventures in the realm of "recreation" and "play."[199]

Such a displacement of participatory aesthetics into the literal detritus of information technology and material culture would be echoed in the proposal from Allan Kaprow. In *Sales Pitch*, a cluster of soundproof cubicles would be linked in a video network, serving as stations for a meditation on democratic communication, advertising, and surplus goods. A diagram shows an extensive set of links between recording sets, live feeds, and delayed playback [Fig. 5.43]. Kaprow's somewhat hackneyed yet fascinating description bears citation at length:

> "5 interconnected video locations capable of sending and receiving messages to and from each other. Every location is equipped with a camera and two monitors. It includes as well about nine push-button and slide controls, one delayed video picture, and around six sound controls, all available for any visitor to operate.

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[197] Alison Knowles, "Request for Technical Services Form," January 23, 1968, n.p., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 9, Folder 11. On *The House of Dust* text, see Benjamin H. D. Buchloh, "The Book of the Future: Alison Knowles' *The House of Dust*," 2007, www.jamesfuentes.com/exhibits_pages/programming%20chance/BBuchloh_text_HouseofDust.pdf; and Alison Knowles and James Tenney, *The House of Dust* (Cologne: König, 1969).

[198] Knowles, "Request for Technical Services Form," n.p.

[199] Letter from Alison Knowles to Jacquelyn D. Serwer, E.A.T. Project Coordinator, July 25, 1970, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 59, Folder 31. Knowles's structure would not be adopted for Projects Outside Art, but she completed the project at CalArts, where it became a kind of performative shell with a sound installation devised by Max Neuhaus.

These permit a person to combine at a particular time any two of five locations on his monitor. This can be done with a variety of special effects. The signals will then appear moments later on the delay-monitor, while new information appears on the real-time monitor. The system also allows one to engage in straightforward two-way communication. In every location, placed behind the visitor-participant and opposite the camera, there is a rear-screen projection of a view of a particular kind of store: musical instruments, shoes, radio and TV sets, orange juice, hats… etc. Real items are provided on tables nearby. The participant is informed before hand that he or she may become a salesman giving a TV 'commercial,' or a buyer or trader of goods, as the case may be, and therefore can actively engage in swapping, pricing, glorifying or criticizing the various offerings of the different locations. With the special effects made possible by the controls at one's fingertips, a shabby pitch or uninteresting product can instantly be transformed into an artistic tour-de-force! The recreational possibilities are considerable."

None of the proposals described above were accepted. Some were simply too costly.[200] Others, such as Kaprow's, were deemed too circumscribed: Klüver and Whitman argued that *Sales Pitch* proposed "a completed work of art" rather than a "prototype for a realizable project in the environment," and thus did not fall within "the boundary conditions" for Projects Outside Art.[201] Indeed, in an epistolary spat of sorts, Whitman criticized the infantilizing nature of Kaprow's project and its absence of "real collaboration."[202]

What, then, did fulfill the aims of Projects Outside Art? Rather than pursuing solutions to certain design problems or delimited events, the initiative reached further and more arduously into investigations of individual agency and the relationship between

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[200] Denes's project, for example, was estimated to cost upwards of $100,000; Klüver nevertheless gave her a list of contacts for potential providers of technical equipment and engineers to work with. Letter from Billy Klüver to Agnes Denes, October 10, 1970, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 59, Folder 31.

[201] Letter from Billy Klüver to Allan Kaprow, October 21, 1970, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 59, Folder 31.

[202] Letter from Robert Whitman to Allan Kaprow, November 7, 1970, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 59, Folder 31.

subjects and systems—a relationship everywhere becoming striated by plurality and discontinuity. The call for proposals itself had stipulated an unusual selection procedure. On the basis of individuals' proposals, a committee would assign the chosen individuals to collaborative teams. The final form of each project "will evolve as the members of the team work together."[203] Put another way, the individual proposals submitted were only starting points for a mutating, combinatorial process. The committee was accordingly hybrid in makeup, including Whitman, Klüver, Martin, E.A.T. staffers Peter Poole and Ritty Burchfield, John W. Pan, "Supervisor of Digital Techniques and Systems Studies" at Bell Labs, and Nicholas Quennell, a landscape architect (who was to collaborate with Alice Aycock, Barbara Kruger, and others on various art projects in the 1980s).

The first undertaking was titled "City Agriculture," a hydroponic roof garden that would serve as a "model for ecological relationships" and might yield mass-produced, sustainable farming within cities. Growing out of a proposal from the Environmental Research Laboratory (E.R.L.) at the University of Arizona, "City Agriculture" intended to design and construct "two closed environment, climate-controlled nutrient feeding vegetable greenhouses" for "power-water-food" production on the roof of Automation House. The structures would be modular, double-skin inflated plastic, light enough to comply with roof weight regulations for New York and mounted on wheels so that they could be moved to take advantage of changing sunlight conditions.[204] The greenhouses were to be completed in six weeks to two months. Initial funding was obtained from the National Endowment for the Arts and remaining funds were to be raised by E.R.L.,

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[203] E.A.T., "Projects Outside Art," n.p.

[204] E.A.T., "Experimental Project in City Agriculture," Sept. 3, 1970, n.p., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 60, Folder 3.

Automation House, and E.A.T. The last had received $1,500 toward a feasibility study for another greenhouse for the roof of Westbeth Artists Community—a low-income housing complex of studio-residences in New York in, of all places, the former Bell Laboratories Buildings, which had just been converted and developed by Richard Meier with the support of Rauschenberg and others in 1968-70—and they were simultaneously investigating other possible urban locations for the garden prototype.[205] The greenhouses could even become sites for soil sampling and analysis to study the correlation between air pollution and plant yield, a possibility in which representatives from the Department of Agriculture expressed interest.[206]

The rooftop sustainable agriculture system was also intended to extend the environmental and communications networks within Automation House below. Funding sources remained inadequate, however, and the project remained hypothetical.[207] But one could hardly escape the discrepancy between the planned proliferation of sophisticated greenhouses throughout the city and the aging, dense, urban encrustations on which they were to sit—futuristic monads compensating for an overgrown infrastructure and exploding population. In this, the project was a direct response to the late-1960s resurgence of theories of "Malthusian catastrophe," dire predictions of food and energy shortages.[208] In the "City Agriculture" plan, Klüver actually cited entomologist Paul R.

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[205] E.A.T., "Report on Activities," February 9, 1971, E.A.T. Documents, The Daniel Langlois Foundation for Art, Science, and Technology, Montreal, Accession no. D10032; C11-18; 215.

[206] Letter from Howard E. Heggestad, Agricultural Research Service, United States Department of Agriculture, to Peter Poole, E.A.T. administrator, February 26, 1971. On Westbeth, see Clemen Bosh, "The Talk of the Town: Westbeth," *The New Yorker*, June 8, 1968, 26.

[207] Author's interview with Julie Martin, November 21, 2006, Berkeley Heights, New Jersey.

Ehrlich's legendary *The Population Bomb*, published in 1968, which predicted that hundreds of millions would die in famines between 1970 and 1985 as population growth exceeded resources.[209] Such fears dovetailed with the rise of the ecological movement and its warnings of the consequences of "manufactured nature," the depletion of resources and the manipulation of ecosystems.[210] And rather than retreat from the urban milieu for the vast landscapes of the West, as did the back-to-the-land movement or many works of land art, "City Agriculture" registered that there was no "outside" to the metropolitan, no organic or posthistorical preserve within which to escape.[211] The rooftop garden focused on ecological sustainability at the moment that "nature" was ostensibly over.

The project was, in fact, closer to Hans Haacke's subsequent joining of the exploration of natural systems with a nascent institutional critique: "City Agriculture" may be seen as a kind of precursor to Haacke's *Krefeld Sewage Triptych* and *Rhine-Water Purification Plant*, both 1972, in which water samples were brought into the galleries of the Museum Haus Lange in Krefeld and analyzed for their chemical content

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[208] Sharon E. Kingsland, *Modeling Nature: Episodes in the History of Population Ecology* (Chicago: University of Chicago Press, 1995), 214-251. Rauschenberg himself designed a poster for the first Earth Day in 1970, in lithograph and chine collé on paper in an edition of 50, at Gemini G.E.L.

[209] E.A.T., "Experimental Project in City Agriculture," n.p.; See also Paul R. Ehrlich, *The Population Bomb* (New York: Ballantine, 1968).

[210] Beck, "The Reinvention of Politics: Toward a Theory of Reflexive Modernization," *Reflexive Modernization: Politics, Tradition and Aesthetics in the Modern Social Order*, 27. See also Ulrich Beck, *Ecological Politics in an Age of Risk* (Cambridge: Polity Press, 1995), 36-57.

[211] The best emblem of the back-to-the-land movement is, of course, Stewart Brand's *Whole Earth Catalog*, published from 1968 to 1972, with which the "City Agriculture" admittedly shares many characteristics (Brand himself was an acolyte of Paul Ehrlich's at Stanford, where the latter taught); on the posthistorical, indifferent, and even transcendent cast of Robert Smithson's works, in particular, see Jennifer Roberts, *Mirror-Travels: Robert Smithson and History* (New Haven: Yale University Press, 2004).

and sources or "purified" through a basic filtering system.[212] But the implication of "City Agriculture," unlike Haacke's pieces, was not to attack the institutional frame of art from within its physical confines, deploying the museum structure as dialectical foil. "City Agriculture" sought, rather, to leave that frame behind. The scope of the project recognized that physical institutions and disciplinary sites were not the only ways in which the ontological status of "art" was conferred. Now the demarcation of "art" was *internalized* within individuals, embedded within viewers' perceptions, competencies, and judgments.[213]

The projects *outside* "art" were to continue to focus on this aesthetic seepage into minds and bodies. E.A.T.'s concomitant proposal for a symposium on "Esthetics" at Automation House, for example, was to address the permeation of "esthetics" into other spheres and the problems encountered in intersubjective collaboration:

> "Many of the important decisions that have to be made are esthetic decisions. Many of the most disruptive and difficult conflicts that arise in these open-ended, multi-disciplinary working situations can be traced to personal or professional esthetic biases. These esthetic commitments are usually hidden, unacknowledged or disguised as something else (economic, political, technical, cultural, psychological, etc.)… The purpose of the symposium is to establish the validity of making esthetic decisions within these situations; to articulate the particular esthetic commitments of different professions; and to explore means for arriving at esthetic decisions and resolving esthetic conflicts (procedures, organizational forms, etc.)." [214]

Participants were to include Noam Chomsky, Meyer Schapiro, John Cage, Lane Kirkland

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[212] See Jack Burnham, "Steps in the Formulation of Real-Time Political Art," Hans Haacke, *Framing and Being Framed: 7 Works 1970-75*, ed. Kasper König (Halifax: Nova Scotia College of Art and Design Press, 1975), 138, 140.

[213] On this transition within the rubric of institutional critique, see Andrea Fraser, "From the Critique of Institutions to an Institution of Critique," *Artforum* 44, no. 1 (September 2005): 281. I am grateful to Scott Rothkopf for many thought-provoking discussions on this topic.

[214] E.A.T., "Esthetics—A Symposium," June 10, 1970, n.p., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 60, Folder 1.

of the AFL-CIO, Vikram Sarabhai of the Atomic Energy Commission of India, and architect Kenzo Tange. Funding was not secured; the symposium did not take place.

Yet it seemed that the symposium's intended topic, the aesthetic conflict arising in collaborative action, was all too sharply borne out in the third Project Outside Art, "Recreation and Play," which was to occur in Los Angeles. Kaprow joined the artist Newton Harrison, architect Douglas Campbell (of the University of California, Berkeley), John Forkner (the optics engineer at Philco-Ford who had previously worked with Whitman), Michael Plesset, a researcher at the Jet Propulsion Laboratory, Jim Anderson, Director of Social and Cultural Affairs, LA County Department of Parks and Recreation, and about five others on a project which grew out of Campbell's initial proposals. The architect's first idea, titled "The Cubic Mile," formed the basis for "Recreation and Play": "… each individual [will be] given a U.S.G.S. [US Geographical Survey] topographic quadrangle, with one cubic mile delineated, and asked to obtain sociophysical information about their particular mile… They will be asked to visit their mile if possible and to send documentation to EAT."[215]

As developed further in collaboration with E.A.T. LA (the Los Angeles satellite of the group) staffers Ardison Phillips and Ruth Baker, "Recreation and Play" would enact a similar survey of sorts in the Owens Valley, just outside Los Angeles. It would develop "means of breaking away from the facility-bound concept of recreation," attempting to understand the relationship between the city and wilderness areas on its perimeter

[215] Douglas Campbell, "Proposal for Projects Outside Art," October 2, 1970, n.p., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 59, Folder 5.

designated as sites for “parks and recreation.”[216] A compulsive documentation of the region and its inhabitants would take place, as participants were to take photographs, films, record interviews, and combine these materials with charts, maps, satellite photography, and ecological statistics to understand the use of the land. A frottage-like picture of the region might emerge, revealing unexpected possibilities for “unbound” recreation but also existing aspects of land use, a politically charged arena to say the least. (It is difficult to resist comparisons to a strain of geography that might tie the nineteenth-century Wheeler Survey to the contemporary charting of desert test sites and the like by the Center for Land Use Interpretation.) Unfortunately, the group fell into sharp disagreement as to the nature and scope of the project—primarily because many of the participants were wedded to their own original proposals.[217] The collaboration’s conflict and failure appeared to graph another terrain—the limits of agonistic participation and its devolution into narcissism.[218]

This engagement with individual experience—both the etiolated dimensions of leisure and the limits of agonism—would take another turn in the final Project Outside Art, the only one that was actually realized: “Children and Communication.” Here, the

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[216] E.A.T., “Projects Outside Art: Recreation,” n.p., Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 59, Folder 1; E.A.T., “Projects Outside Art,” *Techne: A Projects and Process Paper 1*, no. 2 (November 6, 1970): 6.

[217] See the heated exchange between Kaprow, Klüver, and Whitman: Letter from Billy Klüver to Allan Kaprow, October 21, 1970; letter from Allan Kaprow to Billy Klüver, October 24, 1970; letter from Allan Kaprow to Robert Whitman, November 27, 1970, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 59, Folder 31.

[218] In fairness to the participants, it must be said that this is a narcissistic view of authorship that remains deeply embedded throughout the art world: as much as twentieth-century artists have protested the hegemony of singular authorship, they have spent at least as much time reinforcing it—often, today, in the guise of enforcing intellectual property and reproduction rights (and, equally often, enforcing the intellectual property of those very artists of the 1960s and ‘70s deemed to be militating against the market-driven, monographic oeuvre).

development of the subject and its mediation was the focus. Beginning December 18, 1970, the endeavor linked two "children's communication environments," one at Automation House and the other at a community center in Mount Morris Park on 123rd Street in Manhattan. As the preliminary project statement described,

> "Rather than using technology to teach children specific knowledge or skills in the fashion of teaching machines, Children and Communication will enable children to experiment for themselves with modern communications technology… The experience which the children will have with Children and Communication is not pre-determined. Children will be able to enter and leave the project easily and participate in it in a number of ways which they can choose for themselves. Children and Communication is in some ways a game, but it differs from many games in that it does not require any set number to play, and there are no criteria for success or failure in playing except those which a child sets for himself… We feel that this project affords new possibilities for putting children of different backgrounds and geographic locations in contact with each other in a way that will be interesting to the children themselves."[219]

The sites were to be connected via a number of communications devices—closed-circuit television, telex, and picture telephones among them [Fig. 5.44]. Whitman spearheaded the project, designing two tentlike spaces that recalled his use of draped fabric as projection screens in previous works such as his project for *9 Evenings*. The initial plans called for specifically formulated areas within each space: In the "Game Area," a contoured floor was to be divided into ten spaces of different colors and textures. Within each space would be a "Console with a Picture Telephone."[220] The Console controls were to "project either moving or still pictures from a Responsive Television unit or a Slide Projector onto the space on the Mapped Wall corresponding to the space on the

[219] E.A.T., "Children and Communication Proposal," September 24, 1970, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 61, Folder 3.

[220] Ibid.

Mapped Floor in which the Console is located."[221] Live television images would be routed to monitors in each space, so that the children could see each other. "The Production Area" would generate moving and still pictures for use in the "Responsive Television Units" and slide projectors. Cameras, video tape recorders and art supplies would be available; "[T]he material which children create will be exchanged between the Children's Communication Environments."[222]

When the event took place in December, it adhered closely to this design, although Whitman switched the painted grid for multi-colored broad-beam spotlights.[223] In a scene resembling a bizarre pedagogical capsule, children sat at terminals and wrote messages to each other, drawing pictures and asking questions. Spaced around the perimeter of each environment were ten telephones, two teleprinters, two facsimile machines, and two telewriters. The teleprinters (which were linked by Telex, the global teleprinter network) allowed for instantaneous two-way typewriter transmissions. The facsimile machines, one from Xerox and one from Magnavox, utilized ordinary telephone connections to provide faithful black-and-white reproductions of printed, drawn or photographed material in about five minutes of transmission time. The telewriters or "Electrowriters" provided for instantaneous two-way communication of graphics, hand-written messages and drawings.[224] Groups of approximately ten children, aged between

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[221] Ibid.

[222] Ibid.

[223] E.A.T., "Report, Children and Communication," May 1, 1971, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 61, Folder 3.

[224] "The electrowriter is about eleven by eighteen inches and four inches high. The sender places a stylus on a magnetic ball which fits into the end of the stylus and proceeds to write as with a regular pen in a 17 1/2 " square area. The continuous roll of paper is advanced by moving the stylus to the upper left corner of the writing area which activates the paper feed. When the pen is returned to the center of the area the paper

six and fourteen, were at each center. Financial support and equipment were lended by Automation House, Creative Playthings, Magnavox, the NEA, New York Telephone, Victor Comptrometer Corporation, Western Union, Xerox; some of the equipment was to stay in the Mount Morris community center as donated.[225] The exchange grew to include a number of schools; by April 8, 1971, about twenty-five groups of children from public and private schools had participated in the project.

Teleprinters were actually the first interactive computer terminals (and the models employed in "Children and Communication" must be distinguished from the teletype machines used by Hans Haacke, for example, in his *News* works, beginning in 1969, which only received and printed information but could not send or transmit).[226] With the additional capability of being able to send graphic visuals via the telewriters and fax machines, the children thus encountered extraordinarily sophisticated systems of immediate communication. The organizers maintained that there were to be no overt pedagogical objectives; they studied the attention span and interaction between different socioeconomic groups (apparently, when children of differing socioeconomic, racial, and cultural demographics were linked, there was far less interest in communication).[227]

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feed stops. To reply, the person receiving waits until the sender replaces the stylus and a red busy light goes off." Ibid.

[225] E.A.T., "Progress Report, Children and Communication," April 8, 1971**,** Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 61, Folder 3

[226] The teleprinter operated in the following manner: "A message is printed simultaneously at both locations on a continuous roll of paper. All four machines are able to send and receive. To carry on a conversation the person receiving the message waits until the message is completed and then replies. The result is two sides of an exchange printed alternately." E.A.T., "Report, Children and Communication," May 1, 1971**.**

[227] "The children came to the environment and they could isolate the experience that they had there from the normal school experience because it had not been overlaid with instructional objectives. …the children felt freer to do what they wanted and got a great deal of enjoyment. Their attention span ranged from 1 1/2 to 2 hours …at the end they get a little rowdy but throughout there was not that much restlessness… When

Emotion, too, was of interest: As the E.A.T. staff member Ritty Burchfield observed: "I noticed that even with complete strangers there was a tendency to express very strong emotions. I recall seeing one conversation go from 'I hate you' to 'I love you' in about four or five sentences. … The exchanges seemed to be very uninhibited in almost all cases."[228]

Moreover, Whitman, Klüver, Martin, and E.A.T. staff undertook research in developmental psychology, education theory, and communications, as collected research materials in the E.A.T. archive show.[229] The project garnered a critical amount of attention, and shortly thereafter the NYU Institute for Developmental Studies even attempted to model a "Curriculum of the Future" on "Children and Communication," proposing to replicate E.A.T.'s communication structures, down to the tent-like housing, colored layout, and equipment design.[230] The aim was to give children "the skills in actively and creatively absorbing, coping with and transmitting change both as individuals and in cooperative interpersonal interaction… To enable children to

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we had a group from Northside, a specialized school for children with learning and discipline problems at Automation House and a group, the same age, from a private school at the loft; the black children from Northside were interested in communicating with the other children but their inputs were largely unanswered. The richer children tended to feel they could not understand the black children and their language. There was no active communication. The white kids were receiving and the black kids were giving information about being black but the white kids couldn't communicate tot he black about their experiences. However, when we had compatible groups…an active exchange took place…" Barry Kaplan, cited in interview with Julie Martin, "Children and Communication" report, April 8, 1971, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 61, Folder 4.

[228] Ritty Burchfield, cited in E.A.T., "Report, Children and Communication," May 1, 1971.

[229] Materials included brochures for the Stanford University Communications program; the NYU Institute for Developmental Studies; research articles on education, socioeconomic factors, and developmental psychology. See Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 61, Folder 31.

[230] "Curriculum for the Future," proposal by NYU Institute for Developmental Studies, June 3, 1971, Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 61, Folder 12.

understand new communications technology operationally, conceptually and emotionally," and, most intriguingly, " Finding and Using Serendipity: To make people more sensitive to and proficient at constructively utilizing chance discoveries and events."[231] The stakes were high: communication skills would be "crucial to survival."[232] Yet whether "Children and Communication" could serve as a kind of Benjaminian sensory training, a preparation of young minds for the transitory perceptual conditions of high-speed communication, was unclear.[233] Indeed, if preadolescent emotions ran high in the children's communiqués, as Burchfield noted, the other prevalent aspect of the messages and drawings was their propensity for profanity, argument, and pornographic jokes, as extant drawings and transcripts show.[234] Any kind of disciplinary or adaptive mission hit a juvenile stumbling block.

What transpired in "Children and Communication" was an inquiry into individuation. This has been the cardinal dilemma of modern sociology, from Durkheim, Weber, Parsons, and Bourdieu to Habermas and Luhmann. Following the legacy of

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[231] Ibid.

[232] Ibid. The NYU report also cited collaboration on the project with the Institute for the Future, a RAND spin-off think tank founded in 1968 by Paul Baran, the early internet pioneer and co-developer of packet-switching (crucial for the formation of the internet). On Baran and the development of decentralized communications and architectural networks aimed at withstanding nuclear attack, see Peter Galison, "War Against the Center," *Architecture and the Sciences*, eds. Antoine Picon, Alessandra Ponte, and Ralph Lerner (Princeton: Princeton Architectural Press, 2003), 196-227.

[233] In his formative statement for media studies and the history of modernism and technology, Walter Benjamin famously pronounced, "Technology has subjected the human sensorium to a complex kind of training." Walter Benjamin, "On Some Motifs in Baudelaire" (1939), *Illuminations*, ed. Hannah Arendt (New York: Schocken Books, 1969), 175. In the historical moment of "Children and Communication," however, the sensory stimuli in question is not that of modernist shock but of flexible and evanescent currents of information; and the efficacy and extent of the technological rationalization of the body is thrown into doubt.

[234] "Children and Communication, Children's Responses," Experiments in Art and Technology Records, Getty Research Institute, Accession no. 940003, Box 61, Folders 13-31. I am indebted to Carrie Lambert-Beatty's observations regarding the profane turn of the Children and Communication drawings; the extant records are quite humorous.

classical and medieval divisions between accident and essence, specific and general, the "individual" became a question of how to understand *distinctions* between individual and system, subject and object, agency and structure, self and *lebenswelt*.[235] The experiment of "Children and Communication" laid bare the divisions propagating within these older sociological categories: the production of individuality was not only defined by distinction from a broader system or structure, but by an iterative process of *internal* splitting and differentiation. As the April 1971 project report stated, "Each time a machine is used with another child, that operation takes on its own personality and potential."[236] The project plotted both the colonization of the subject by information technologies—the domination of *structure* over *agency*—and, at the same time, the points at which those structuring technologies were *not* assimilable, not determinative, instead generating endlessly bifurcating operations and events. The "technology of separation" that stood behind previous sociological models of the modern subject, from Tönnies's analysis of society to Debord's analysis of spectacle—in other words, the partitioning and management of the subject, the "inner isolation of the individual" that

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[235] For Giddens, advancing what he has termed the "theory of structuration," rules are recursively produced in social reproduction. Individual agency is a reflexive process, in the way that the sociological project is itself a "double hermeneutic," shaping and composing a part of the world it aims to understand. This nonlinear reflexivity stands in contrast to both the model of linear agency outlined by Habermas and the functionalism of Talcott Parsons's systems theory, which goes so far as to conceive of society as wholly independent of the subject. Anthony Giddens and Christopher Pierson, *Conversations with Anthony Giddens: Making Sense of Modernity*, (Stanford: Stanford University Press, 1998), 3-4. See also Beck, "The Reinvention of Politics: Toward a Theory of Reflexive Modernization," *Reflexive Modernization: Politics, Tradition and Aesthetics in the Modern Social Order*, 19; Talcott Parsons, *The Social System* (1951), (London: Routledge, 1991). Habermas, building upon the work of George Herbert Mead, understood the problem of individuation via communicative intersubjectivity and action. See Jürgen Habermas, "Individuation Through Socialization: On George Herbert Mead's Theory of Subjectivity," *Postmetaphysical Thinking*, trans. William Mark Hohengarten (Cambridge: MIT Press, 1994), 149-204.

[236] E.A.T., "Progress Report, Children and Communication," April 8, 1971.

Weber deemed a foundation of capitalist modernity—was here troubled.[237] The participants were not rational actors but developing subjects, whose choices and behaviors were not easily structured but multiplicitous and constantly changing. This continuous, internal differentiation of individuality and agency has, in fact, been described by Beck: beginning roughly in the 1970s, individuals are characterized by "subdivision"; they are "no longer the 'role players' of classical industrial society, as assumed by [sociological] functionalism. Individuals are constructed through a complex discursive interplay which is much more open-ended than the functionalist role model would assume."[238]

By upending the very integrity of any "inside" and "outside" of the individual—and, moreover, the sites and systems of art—Projects Outside Art advanced a porous and non-functionalist model of the subject. It registered the atomization of the individual in the postwar era. There could be no lapidary individual stance toward an external system, no modernist subject battling disciplinary institutions or mass culture. This was, of course, a risky position to take. It was open to charges of either collusion with oppressive legitimation structures or naïve utopianism. But it was a position that demonstrated the impossibility of any clear affirmation, opposition, or escape from authoritarian control. And this fractured individuation was at the core of the risk society, its erosion of collectives, its nonlinear social systems. It is in this sense that, for Beck, the risk society

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[237] Ferdinand Tönnies, *Community and Society* (1887), trans. Charles P. Loomis (East Lansing: Michigan State University Press, 1957); Debord, *Society of the Spectacle*, 121, 137; Max Weber, *The Protestant Ethic and the Spirit of Capitalism* (1904), trans. Talcott Parsons (New York: Scribner, 1958), 108.

[238] Beck, "The Reinvention of Politics: Toward a Theory of Reflexive Modernization," *Reflexive Modernization: Politics, Tradition and Aesthetics in the Modern Social Order*, 16.

also means the individualization and atomization of political conflict.[239] Hence the wide range of Projects Outside Art, from sustainable rooftop gardens to communications experiments, were to spawn other initiatives in sustainability and educational television programming in India and a global Telex project (discussed in the conclusion), each endeavor dealing with the complex and circumscribed role of individuals in the face of ecological, economic, informatic, and political turbulence. E.A.T.'s move "outside art" was, then, also a move inward. It addressed the very internalization of risk, exploding the subject from within.[240]

VI. The Anomaly

It was also an undertaking that addressed the ways in which, as Giddens writes, "Manufactured risk isn't associated only with human intervention in nature, but also with social change in an information society based upon high reflexivity."[241] Such an articulation of the sweeping pervasiveness of risk echoes the earlier words of Klüver, in the aftermath of the Projects Outside Art. In 1972, Klüver delivered a lecture titled "The Future of Art and Technology," and it was an express response to the legendary study

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[239] For Beck, this represents a nondialectical "third way" beyond oppositional and affirmative positions. "The individualization of political conflicts and interests thus does not mean disengagement, not the 'opinion poll democracy' and not weariness of politics. But a contradictory multiple engagement arises, which mixes and combines the classical poles of politics so that, if we think things through to their logical conclusion, everyone thinks and acts as a right-winger and left-winger, radically and conservatively, democratically and undemocratically, ecologically and anti-ecologically, politically and unpolitically, all at the same time. Everyone is a pessimist, a passivist, an idealist and an activist in partial aspects…That only means, however, that the current clarities of politics—right and left, conservative and socialistic, retreat and participation—are no longer correct or effective." Beck, "The Reinvention of Politics: Toward a Theory of Reflexive Modernization," *Reflexive Modernization: Politics, Tradition and Aesthetics in the Modern Social Order*, 21.

[240] As Giddens writes, "Manufactured risk isn't associated only with human intervention in nature, but also with social change in an information society based upon high reflexivity." Giddens and Pearson, *Conversations with Anthony Giddens: Making Sense of Modernity*, 105.

[241] Giddens and Pierson, *Conversations with Anthony Giddens: Making Sense of Modernity*, 105.

The Limits to Growth.[242] Published that same year by the esoteric think tank The Club of Rome (founded in 1968), the report famously concluded that "the human environment as we know it now cannot be sustained; it will collapse under its own growth rate," outlining an extensive study that went beyond [Paul] Ehrlich's dire prediction just several years before.[243] The only possible solution, according to the report, was to attempt to move toward an equilibrium economy, in which no resources would be wasted. The group thus set up a research division to explore "scenarios for the future within an equilibrium society." Kluver was interviewed by a member of the research division and was privy to the resulting report, a copy of which he temporarily obtained and took notes from, as recounted in his lecture transcript. Interrelating art and technology was deemed a promising component to an equilibrium economy, as "an alternative use of industrial materials and waste."[244] The Club of Rome then attempted to simulate the outcome of an extensive art and technology program taking place in research laboratories and universities worldwide. "But when the researchers of the Club of Rome fed these five factors: access, research, production, international exchange and education into their world model," Klüver wrote,

> "along with profiles of 10,000 American artists, 5,000 Japanese artists, 2,000 French artists, and a proportional representation around the world, the computer printout showed that because of the motivational drive and productivity of artists, Art and Technology would grow exponentially and would no longer be considered a nonconsuming and nonpolluting activity. Thus the report was shredded."[245]

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[242] Billy Klüver, "The Future of Art and Technology," *E.A.T. Proceedings*, no. 12 (April 15, 1972): 1-4.

[243] Donella H. Meadows et al, *The Limits to Growth* (New York: Universe Books, 1972).

[244] Klüver, "The Future of Art and Technology," 1.

[245] Ibid., 4.

Klüver thus described a response to impending catastrophe that itself exploded into contingency, absurdly exceeding any attempt at equilibrium. The world outlined was that of a maelstrom of crises that eluded navigation.

This perspective may seem to resonate with the theorizations of second-order systems theory arising in the late 1960s. Systems theory is traditionally seen as the manifestation of capitalist techno-science, its interest in homeostasis, management, and control. Parsons's systems theory exemplified such a stance, in which social systems seek equilibrium (just as physical systems attain dynamic equilibrium) and control is attained through self-correction. But "if first-wave systems theory focuses primarily upon the capacity of circular causality to generate stability and systemic equilibrium," second-wave systems theory (as embodied in the work of Luhmann, Bateson, and others) "emphasizes instead how recursivity can lead to quite unexpected systemic effects and to the unpredictable evolution of complex systems," as William Rasch and Cary Wolfe argue.[246] (Hence Luhmann's rejection of the reduction of complexity via consensus in Habermas's model of communicative action.)

Yet, in still another twist, the model of *risk* differs crucially from second-order systems theory. Indeed, Beck transfers the emphasis *completely* from systemic structure to side effect: "…while simple modernization ultimately locates the motor of social transformation in categories of instrumental rationality (reflection), 'reflexive' modernization conceives of the motive force of social change in the categories of the side effect (reflexivity). What is not seen, not reflected upon, but externalized instead adds to

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[246] William Rasch and Cary Wolfe, eds., *Observing Complexity: Systems Theory and Postmodernity* (Minneapolis: University of Minnesota Press, 2000), 12. Alongside Luhmann, other theorists of second-order systems theory (also termed "second-order cybernetics") include Humberto Maturana and Francisco Varela, Heinz von Foerster, and Ilya Prigogine and Manfred Eigen.

the structural rupture which separates industrial society from risk society." [247] Nonlinear, complex systems are in constant dis-equilibrium—change and anomaly are always internal to the system itself, not just produced by an external system, as Luhmann would have it.[248]

Let us revisit, then, an early essay by Klüver, appropriately titled "Fragment on Man and the System" and published in 1960 in Alfred Leslie's "one-shot review," *The Hasty Papers*.[249] It is perhaps all too fitting that, at this point, Klüver already indicated an idiosyncratic view of individual and system that E.A.T. would come to enact. The text begins by discussing the need for individual agency within the (social and technological) system, which was rapidly becoming divorced from the needs of its constituents: "The present gap between the individual and the system builder should be closed so that the individual becomes an active rather than a passive element of the general systems." [250] But far from any direct route to equilibrium, to homeostasis, Klüver takes a surprising turn. As agency and structure converge, "The system builder and the technology have the

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[247] Beck, "Self-Dissolution and Self-Endangerment of Industrial Society: What Does This Mean?", *Reflexive Modernization: Politics, Tradition and Aesthetics in the Modern Social Order*, 183.

[248] Beck, The Reinvention of Politics: Toward a Theory of Reflexive Modernization," *Reflexive Modernization: Politics, Tradition and Aesthetics in the Modern Social Order*, 5. In this sense, Beck and Giddens have been seen to go beyond the Luhmann/Habermas debate that arose in the early 1970s, stemming from the Luhmannian side of this rift but departing fundamentally from Luhmann's notion of systemic structure, as noted above. As Scott Lash writes, "After two decades of dominance of the German social-theoretical landscape by the interminable struggle between Habermas's communicative action and Niklas Luhmann's autopoetic systems theory, the impact of Beck's *Risikogesellschaft* was quintessentially that of social theory finally coming back down to earth. This was true in terms of the accessibility of both the ideas and the presentation—*Risk Society* and *Das ganz normale Chaos der Liebe* are two of the best selling social science books in continental European history—and are read widely by the educated lay public…The publication of *Consequences of Modernity*…represented also a *zeitdiagnostisch* turn in Anthony Giddens's intellectual history." Scott Lash, "Reflexive Modernization: The Aesthetic Dimension," *Reflexive Modernization: Politics, Tradition and Aesthetics in the Modern Social Order*, 118.

[249] Billy Klüver, "Fragment on Man and the System," *The Hasty Papers* 1, no. 1 (1960): 45.

[250] Ibid.

capacity of providing the individual with any type of system, involving any degree of uncertainty or change: a system could even be designed to disintegrate itself."[251] Where both first- and second-order systems theory would have assigned the individual to being a regulated element of systems, in which a reduction of complexity and increased efficiency were the goal, Klüver implies constant instability and even destruction in the system itself.[252] What begins as intention ends in obliteration.

Klüver intimated a pathway along which E.A.T. and Automation House would eventually find themselves swept—the path of the aberration, the rupture, the implosion. And this model can be seen to supersede the theories of control implied by post-Fordism. The latter, as I've outlined, have been brilliantly acute. Deleuze's "control society" figures the corporation as a "a spirit, a gas" spawning "ceaseless control in open sites."[253] For Deleuze, the historical transition between forms of power—from sovereign to disciplinary and finally to control societies—marks a succession of epistemes that culminate in the atomization and permeation of power not around but within bodies, sites, structures. Power moves from consolidation to dispersal. In contrast to the enclosures of disciplinary administration,

> "[C]ontrols are a *modulation*, like a self-deforming cast that will continuously change from one moment to the other, or like a sieve whose mesh will transmute from point to point. … Control is short-term and of rapid rates of turnover, but

[251] Ibid.

[252] Parsons' project was continued in the early work of Luhmann (who, in his mature work of the 1980s onward, would come to fundamentally *oppose* key tenets of Parsons' social systems theory). See Niklas Luhmann, *Legitimation durch Verfahren* (Neuweid: Luchterhand, 1969). On the technocratic and rationalist aspects of Parsons' systems theory (and a somewhat shortsighted critique of Luhmann based on his early ties to Parsons), see Jean-François Lyotard, *The Postmodern Condition: A Report on Knowledge*, trans. Geoff Bennington and Brian Massumi (Minneapolis: University of Minnesota Press, 1984), 11-12.

[253] Deleuze, "Postscript on the Societies of Control," 445. See also Gilles Deleuze in conversation with Antonio Negri, "Control and Becoming," Deleuze, *Negotiations*, 169-76.

> also continuous and without limit, while discipline was of long duration, infinite and discontinuous."[254]

In the history of postwar art, Branden W. Joseph has mounted perhaps the most ambitious extrapolation from Deleuze's conception of control; Joseph sees a precursor to the ever newer forms and infrastructures of "control" (versus the disciplinary institutions of the past) in the work of Tony Conrad and others, spanning the biopolitical and neurological to the cybernetic, and positions Conrad's project as a kind of early warning system for these encroaching and eventually all-encompassing forms of flexible and microphysical domination.[255] This is the totalizing world in which, as Adorno and Horkheimer warned, "chance itself is planned."[256]

Quite apart from these formulations, however, E.A.T. and Automation House intervened in systems of "planned chance"—regulation, automation, and risk management—only to foretell the possibility of their dissolution. The result was not the prediction, opposition, or evasion of control—of tentacular, ever-flexible, and insidious post-Fordist systems. Indeed, those very systems—"the society of control"—may not be as omnipotent and seamless and totalizing as we think. For the flexibility and adaptability of post-Fordism depend precisely on clarity, on the transparency of communication and the ceaseless flow of information—a predicate that is by no means

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[254] Ibid., 445-446.

[255] Joseph, *Beyond the Dream Syndicate*, 58, 351. See also Michelle Kuo, review of *Beyond the Dream Syndicate: Tony Conrad and the Arts After Cage* by Branden W. Joseph, *The Art Bulletin* XCI, no. 4 (December 2009): 518-522. Joseph shows that *The Flicker* "acted as both harbinger and disruptor of this new 'infrastructure' of control" (Joseph, 351). I argue that, in this way, "The work was simultaneously warning, model, and agitator. As Friedrich Kittler has written, 'Media cross one another in time, which is no longer history.'" See Friedrich Kittler, *Gramophone, Film, Typewriter*, trans. Geoffrey Winthrop-Young and Michael Wutz (Stanford: Stanford University Press, 1999), 115.

[256] Max Horkheimer and Theodor W. Adorno, *Dialectic of Enlightenment*, trans. John Cumming (New York: Herder and Herder, 1972), 146.

certain. To presume such spectacular power is, in fact, to lapse into technological determinism, to grant technology a totalizing domination over all aspects of life. But it is also, paradoxically, to evince a curiously humanistic faith in manmade systems of control.[257] In contrast, E.A.T. modeled alternate outcomes: the unseen and unforeseeable side effects that may trump all. It was a venture at once pioneering and terrifying. Not a control society, but a risk society.

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[257] Here I draw on the analyses of Leo Marx, who has articulated the "aggrandizement" of technological domination by theories of postmodernism: "A common feature of … the umbrella concept of postmodernism, is the decisive role accorded to the new electronic communications technologies. The information or knowledge these technologies are able to generate and to disseminate is said to constitute a distinctively postmodern, increasingly dominant, form of capital, a "force of production," and in effect a new, dematerialized kind of power. This allegedly is the age of knowledge-based economies… power, as defined by these theories, is dynamic, fluid, always being moved, exchanged, transferred; it flows endlessly through the society and culture the way blood flows through a circulatory system, or information through a communications network … This kind of power is everywhere but concentrated nowhere." Marx concludes, "In many respects postmodernism seems to be a perpetuation of—and an acquiescence in—the continuous aggrandizement of 'technology' in its modern, institutionalized, systemic guises." Although Marx identifies such a problematic stance with a "shrunken sense of human agency—of irresistible technological determinism"—I would argue that here the two viewpoints converge. In other words, a strange and untenable coupling of humanism with technological determinism occurs when technological structures are deemed to be so fatalistically and omnisciently dominant. Both such humanism and technological determinism may be seen as ways of repressing contingency, of attempting to find certainty in an age of risk. As Marx himself writes of postmodernism's fatalistic pessimism regarding technology, "it might be well to acknowledge how consoling it is to attribute our pessimism to the workings of so elusive an agent of change." See Leo Marx, "The Idea of 'Technology' and Postmodern Pessimism," Merrill Roe Smith and Leo Marx, eds., *Does Technology Drive History?: The Dilemma of Technological Determinism* (Cambridge: MIT Press, 1994), 256-257.

CONCLUSION

From invention to collaboration to proliferation, E.A.T. created a network with a vast reach. Nothing in the history of art approaches E.A.T.'s size, span, and sprawl (let alone the relatively circumscribed historical avant-gardes, such as Dada, that have been retroactively labeled as "networks"). E.A.T. showed that aesthetic experimentation and collaborative exchange could operate at an unprecedented scale. It took on the most ambitious expansion of research and invention of our time: the colossal global networks of telecommunications, capital, and knowledge—the military-industrial complexes—taking shape in the postwar period. But E.A.T. also showed that such networks did not need to conform to existing models.

Indeed, E.A.T. transformed a *collective* into a *network*. In this sense, the organization represents the waning of modernist models of mass culture, which are predicated on older structures of collectivity and communication (as top-down mass communication rather than network technologies), and the presupposition of (unified and autonomous) subjects, individuals, and identities.

What we see in the movement from E.A.T.'s discrete collaborations to the Local Groups, Pepsi Pavilion, Artists and Television, Automation House, and Projects Outside Art is the movement from physical collectivities to informatic networks: to an increasingly ephemeral sphere of telecommunications; to remote control; to the wireless world so haltingly foreshadowed in *9 Evenings*; to a form of individuation defined by connections rather than autonomy; to big science. The matching forms of the Technical Services Program—a nascent database that also produced a new set of data-driven relationships and subjects—complemented the group's ever-expanding circulation of publications, broadcasts, and transmissions. One of the last such projects E.A.T. pursued was *Telex Q&A*, 1971, which connected telex machines—early fax machines, versions of which were used for regular communication within the organization, and would also be deployed in *Children and Communication,* 1974—in four different cities as part of the Moderna Museet's exhibition "Utopia and Visions, 1871-1971," curated by Pontus Hultén in 1971. Telex terminals were set up in public locations in New York, Stockholm, Tokyo, and Bombay for one month from July 30 to August 30, 1971. Anyone could type a question, send it to participants—including designated experts—in other cities, and receive an answer.[1] *Telex Q&A* (alternately referred to as *Utopia Q&A*) spawned questions such as: "In what areas will computer programs be written in 1981?"; "Will people seek greater or less contact?"; "Will accidents be a public ritual in 1981?"; "Will oxygen be rationed in 1981?"[2] Dubbed "a hot-line with citizens on a global scale," a "global communication sculpture,"[3] the project realized yet another worldwide network aimed at a utopian democratization of knowledge, prediction, and exchange.

And yet, as I have argued, the network of E.A.T. is riddled with holes and ruptures, with discontinuity and disorder, with unstable subjects and entropic communication. When the Technical Services Program—the matching network—ended, due to disorganization and lack of funding, in 1973, the core activity of the organization,

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[1] See "Telex Q&A: Questions from New York," "Questions from Tokyo," "Questions from Stockholm," "Questions from Bombay," 1971. E.A.T./GRI Box 68, Folders 3-6. See also Fujiko Nakaya, letter to Pontus Hultén, June 10, 1971. E.A.T./GRI Box 68, Folder 11.

[2] Ibid.

[3] "Utopia Q&A 1981," 1971, E.A.T. Tokyo press release. E.A.T./GRI Box 68, Folder 24.

and the organization itself, may be seen as beginning to wane.[4] Or, viewed from a different angle, the instabilities and impossibilities of the network may have finally come to pass, in the same way that the organization posed the self-dissolution of other systems. In this way, E.A.T. represents the ceding of the control society—with its seamless, totalizing networks—to the risk society. This is a world in which control is continually upended, where control systems in fact produce their own uncertainty: side effects that everywhere become the main event.

It is not by coincidence that the dissolution of the stable subject and the coming of the risk society have been described in another way, by Giorgio Agamben. Just over a decade ago, the philosopher asked, "What Is an Apparatus?"[5] His query, well known by now, takes up Foucault's concept of the *dispositif*, or apparatus. This is a "network" (*le réseau*), as Foucault defined it in 1977, established between institutions, laws, philosophy, buildings—all those elements that enforce power relations and relations of knowledge; a "system of relations" with a "dominant strategic function"[6]; a "set of strategies."[7] Agamben seeks to expand this definition radically: to encompass "literally anything that has in some way the capacity to capture, orient, determine, intercept, model, control, or secure the gestures, behaviors, opinions, or discourses of living beings."[8] Not

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[4] "Experiments in Art and Technology: a description of selected activities, September 1966-September 1974," October 1, 1974. Daniel Langlois Foundation for Art, Science, and Technology, Montreal, Accession no. EAT C16-10/8; 321.

[5] Giorgio Agamben, "What Is an Apparatus?" (2006), in *What Is an Apparatus? and Other Essays*, trans. David Kishik and Stefan Predatella (Stanford, CA: Stanford University Press, 2009), 1-24.

[6] Michel Foucault, "The Confession of the Flesh," in *Power/Knowledge: Selected Interviews and Other Writings*, ed. Colin Gordon (New York: Pantheon, 1980), 194-228; 194-195.

[7] Agamben, *What Is an Apparatus?*, 2-3.

[8] Agamben, 14.

only schools and jails, then, but "the pen," "cigarettes," "cellular telephones," and so forth.

What is new here, after the turn of the millennium, is Agamben's focus on expansion and *size*. It is not simply the existence of apparatuses that defines the experience and constraint of the subject in our historical moment. It is, rather, the *proliferation* of apparatuses in both number and kind: "The boundless growth of apparatuses in our time corresponds to the equally extreme proliferation in processes of subjectification."[9] And yet apparatuses today do not only produce subjects, they also induce the process of what Agamben calls desubjectification—a splitting or negation of the subject. This rampant making and unmaking of the subject does not "give rise to the recomposition of a new subject, except in larval or, as it were, spectral form."[10] This is why technology—the apparatus par excellence—cannot simply boil down to a question of using tools "the right way."[11] "Contemporary societies therefore present themselves as inert bodies going through massive processes of desubjectification without acknowledging any real subjectification."[12] This "governmental machine" is incessant, a technology in perpetual motion; one might say that its fullest expression today is found in the expansionist efforts of AT&T and other megalithic communications corporations, which seek to eliminate net neutrality and further privatize access to the Internet. And, as

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[9] Agamben, 15.

[10] Agamben, 21.

[11] Ibid.

[12] Agamben, 22.

Agamben writes, "this machine (true to the original eschatological vocation of Providence) is leading us to catastrophe."[13]

But this seemingly infinite expansion of control, of governance, is not without its frailties: "The more apparatuses pervade and disseminate their power in every field of life, the more government will find itself faced with an elusive element, which seems to escape its grasp the more it docilely submits to it."[14] With proliferation, there is also elusiveness. With the asymptotic expansion of technological apparatuses, of tools, of the network, there is also the chance for counter-use, for profanation. I cannot think of a better description of Experiments in Art and Technology: a glimmer, at the dawning of the latest stage of capitalism and big science and big data, of a counter-apparatus, a network other than the one under which we live now.

[13] Agamben, 24.

[14] Agamben, 23.

Figure 1.1.
Jasper Johns, *Zone*, 1962.
Oil and encaustic on canvas with objects, 60 ¼ x 36 inches.
Kunstmuseum Basel.

Figure 1.2.
Jasper Johns, *Field Painting*, 1963-64.
Oil on canvas with objects, 72 x 36 ¾ inches.
The National Gallery of Art, Washington, DC.

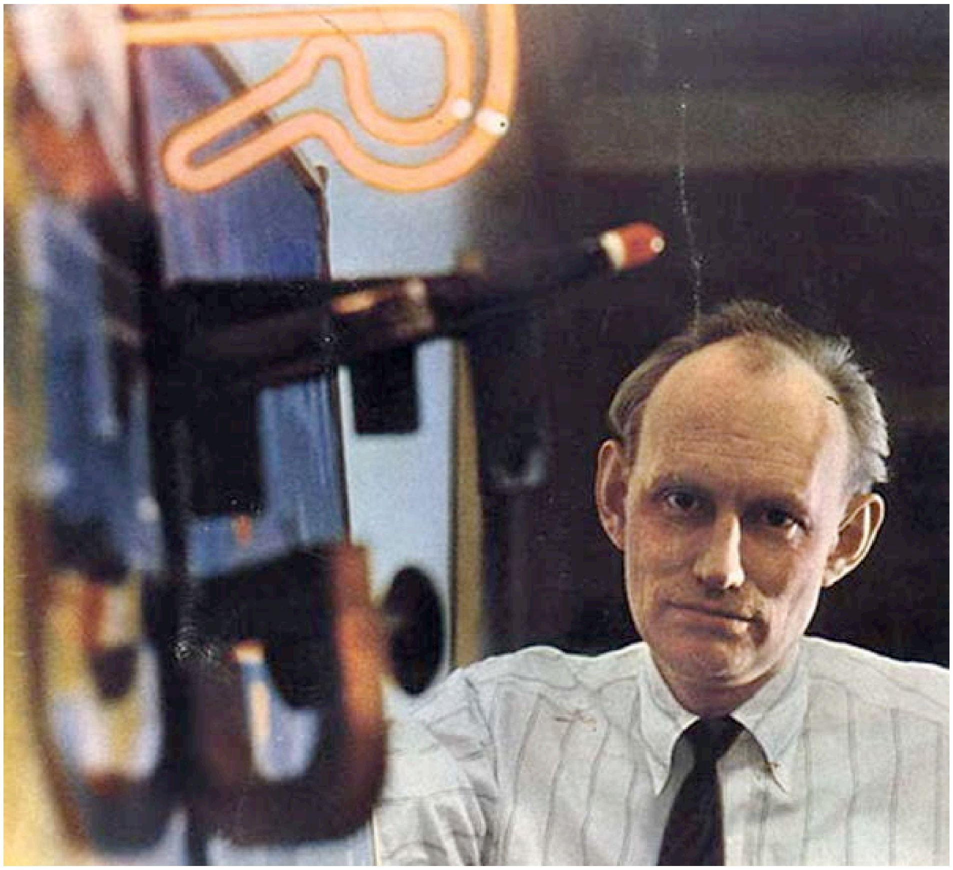
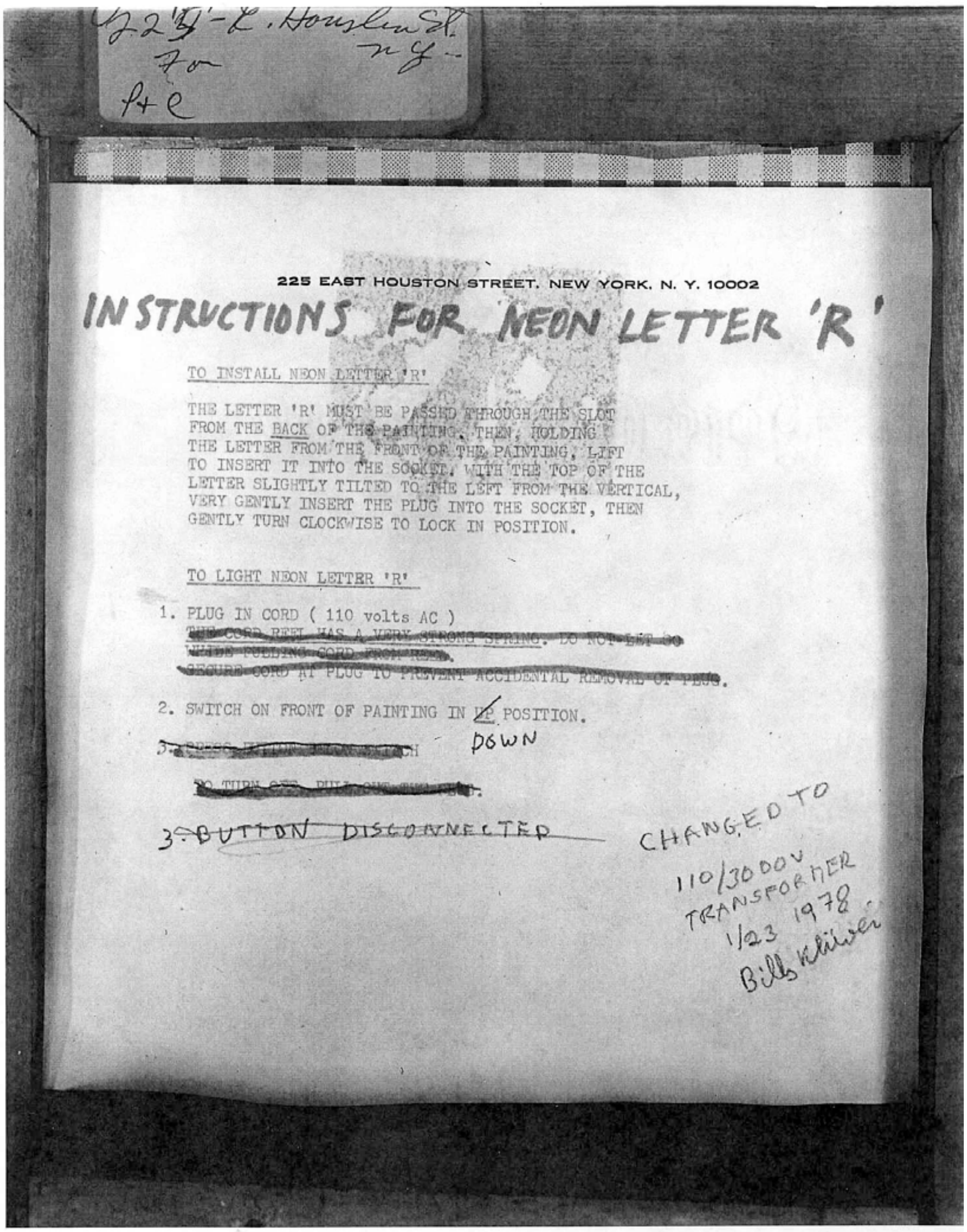


Figure 1.3.
Billy Klüver with Jasper Johns, *Field Painting*, 1964.
Photo: Bell Laboratories.

Figure 1.4.
Jasper Johns, *Field Painting*, detail.

Figure 1.5.
Jasper Johns, *Slow Field*, 1962.
Oil on canvas with objects, 71 ¼ x 35 7/16 inches.
Moderna Museet, Stockholm.

Figure 1.6.
Back of Jasper Johns, *Field Painting*, before a 1995 restoration at the National Gallery of Art, Washington, D.C. Photo: Conservation Department, National Gallery of Art.


225 EAST HOUSTON STREET. NEW YORK, N. Y. 10002

INSTRUCTIONS FOR NEON LETTER 'R'

TO INSTALL NEON LETTER 'R'

THE LETTER 'R' MUST BE PASSED THROUGH THE SLOT FROM THE BACK OF THE PAINTING. THEN, HOLDING THE LETTER FROM THE FRONT OF THE PAINTING, LIFT TO INSERT IT INTO THE SOCKET. WITH THE TOP OF THE LETTER SLIGHTLY TILTED TO THE LEFT FROM THE VERTICAL, VERY GENTLY INSERT THE PLUG INTO THE SOCKET, THEN GENTLY TURN CLOCKWISE TO LOCK IN POSITION.

TO LIGHT NEON LETTER 'R'

1. PLUG IN CORD (110 volts AC)
[redacted]

2. SWITCH ON FRONT OF PAINTING IN ~~UP~~ DOWN POSITION.

[redacted]

3. ~~BUTTON DISCONNECTED~~

CHANGED TO 110/3000V TRANSFORMER 1/23 1978 Billy Klüver

Figure 1.7.
Original document of instructions posted on the back of *Field Painting* and modified by Klüver in 1978. Photo: Conservation Department, National Gallery of Art.

Figure 1.8.
Andy Warhol, *Silver Clouds*, 1966.
Scotchpak, helium, oxygen, dimensions variable.
The Andy Warhol Museum, Pittsburgh.
Photo: Leo Castelli Gallery, 1966. Reprinted from *The Andy Warhol Catalogue Raisonne*, vol. 2, eds. George Frei and Neil Printz, 2004.

Figure 1.9.
Andy Warhol, *Silver Clouds*, 1966.
Scotchpak, helium, oxygen, dimensions variable.
The Andy Warhol Museum, Pittsburgh.
Photo: Leo Castelli Gallery, 1966. Reprinted from *The Andy Warhol Catalogue Raisonne*, vol. 2, eds. George Frei and Neil Printz, 2004.

Figure 1.10.
Andy Warhol, *Silver Clouds*, 1966.
Photo: Nat Finkelstein.
Reprinted from *The Andy Warhol Catalogue Raisonne*, vol. 2,
eds. George Frei and Neil Printz, 2004.

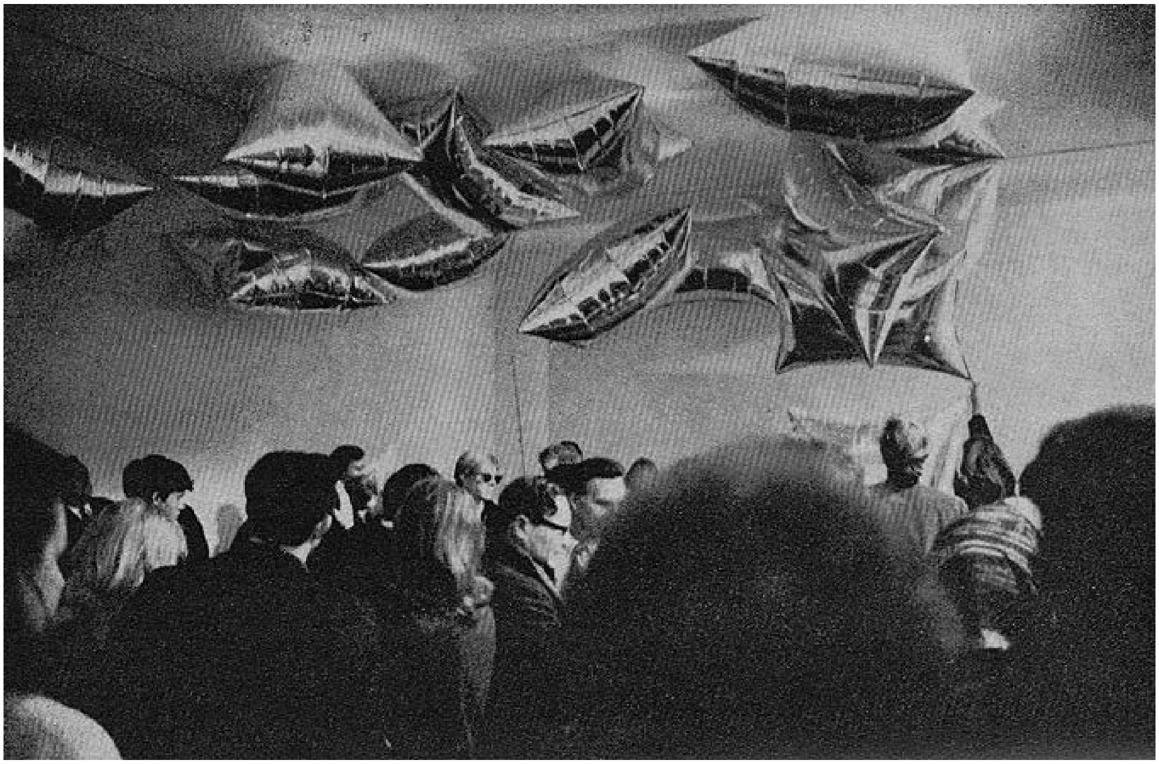


Figure 1.11.
Andy Warhol, *Silver Clouds*, 1966.
Photo: Stephen Shore.
Reprinted from Stephen Shore, *The Velvet Years: Warhol's Factory, 1965-67*, 1995.

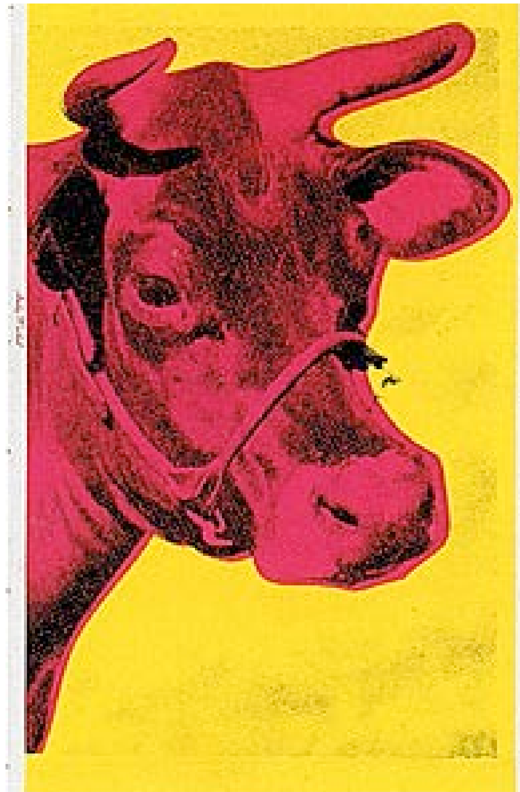


Figure 1.12.
Andy Warhol, *Cow*, 1966.
Screenprint on wallpaper, 45 x 29 inches. Detail.
Reprinted from *The Andy Warhol Catalogue Raisonne*, vol. 2,
eds. George Frei and Neil Printz, 2004.

Figure 1.13.
Andy Warhol, *Cow Wallpaper*, 1966.
Installation view, Leo Castelli Gallery.
Reprinted from *The Andy Warhol Catalogue Raisonne*, vol. 2,
eds. George Frei and Neil Printz, 2004.

Figure 1.14.
Andy Warhol at the Factory, 1965.
Photo: Stephen Shore.
Reprinted from Stephen Shore, *The Velvet Years: Warhol's Factory, 1965-67*, 1995.

Figure 1.15.
Echo I, 1960.
Photo: NASA.

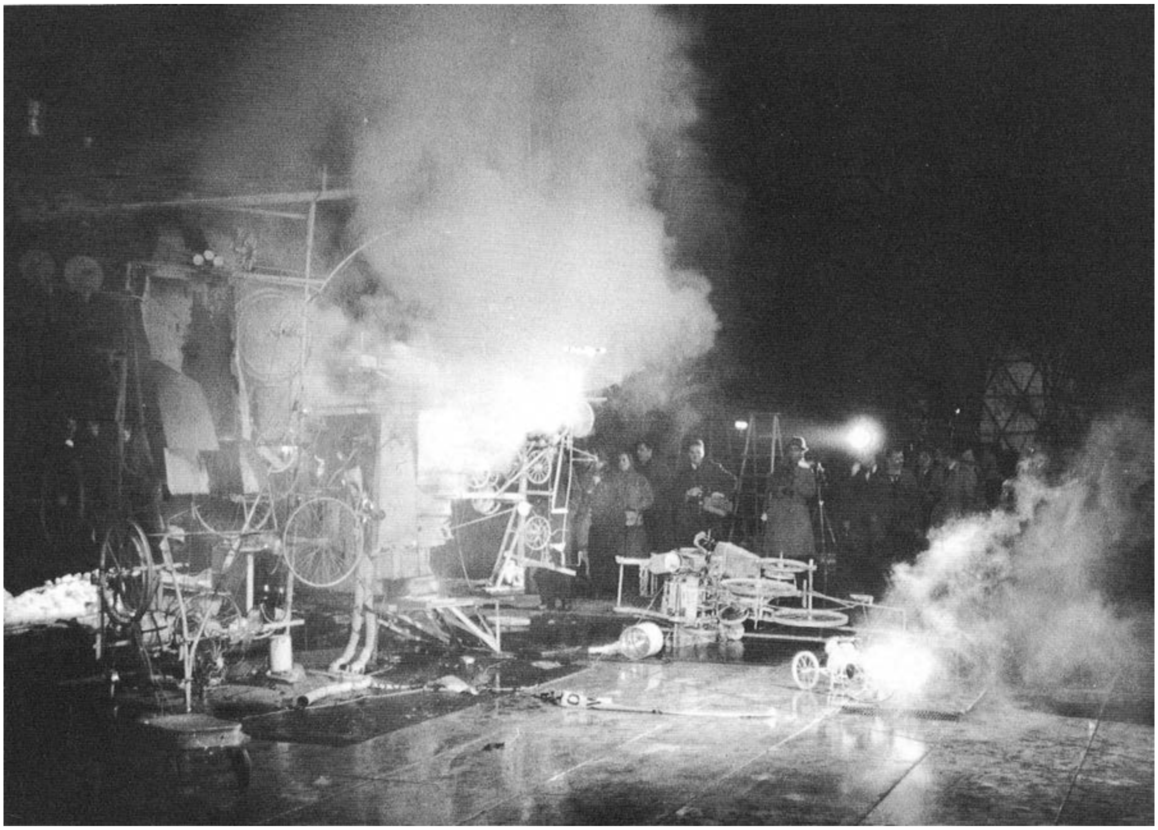


Figure 1.16.
Jean Tinguely, *Homage to New York,* March 1960, performance view.
Photo: David Garr.

Figure 1.17.
Warhol and Klüver (middle and right) on the roof of Warhol's Factory, October 4, 1965.
Photo: Billy Name.

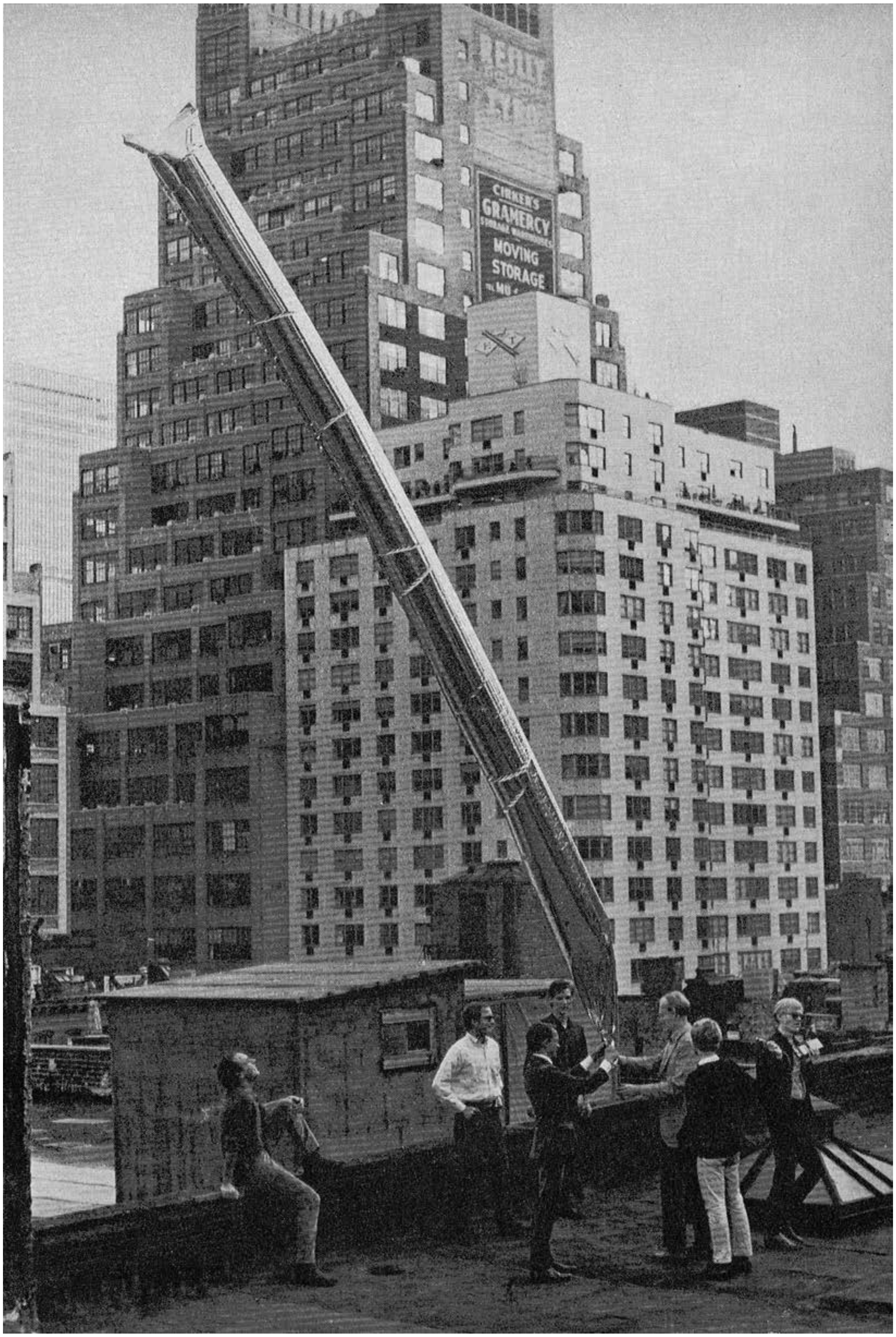


Figure 1.18.
Roof of Warhol's Factory, October 4, 1965.
Photo: Billy Name.

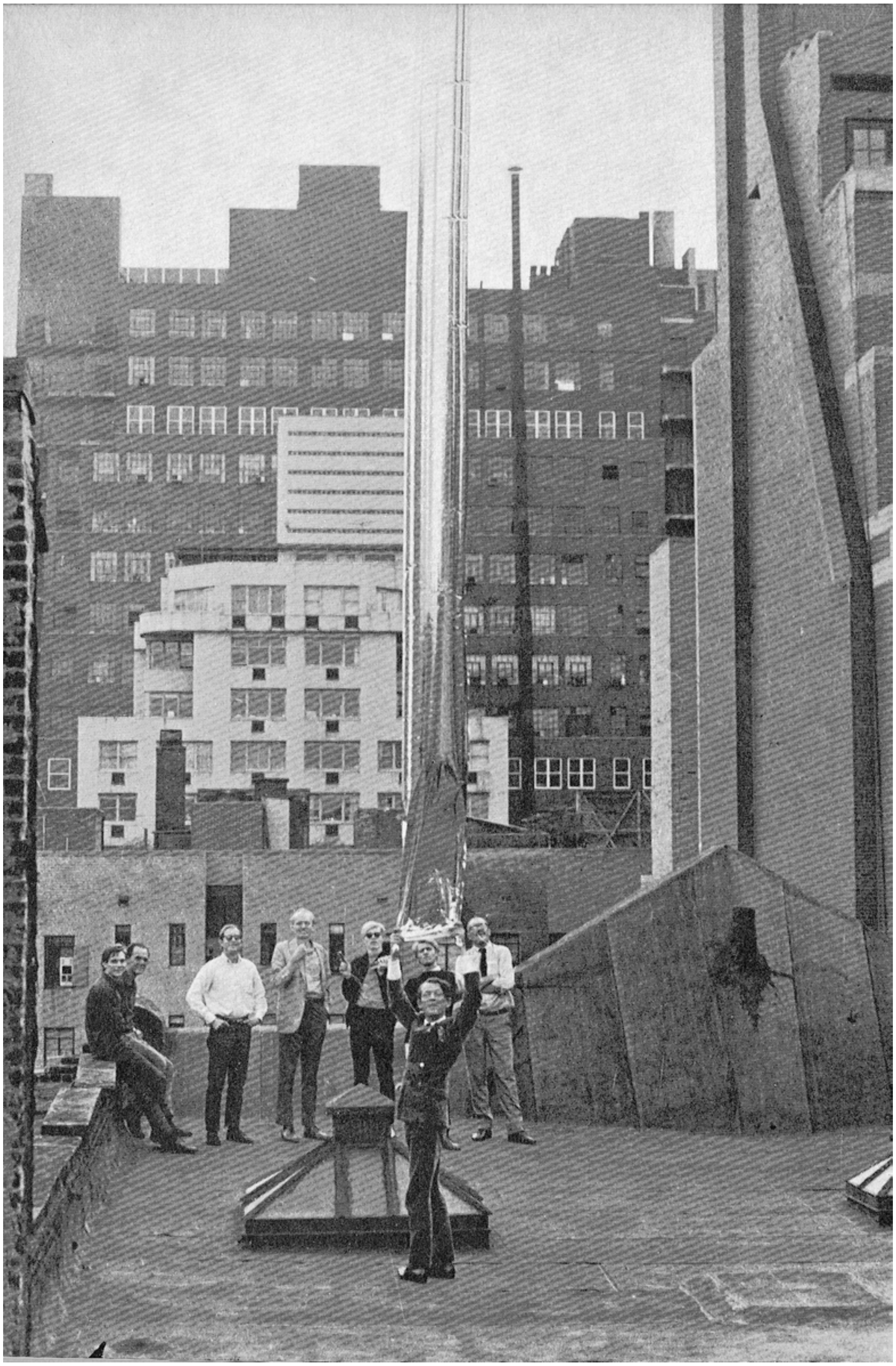


Figure 1.19.
Roof of Warhol's Factory, October 4, 1965.
Photo: Billy Name.

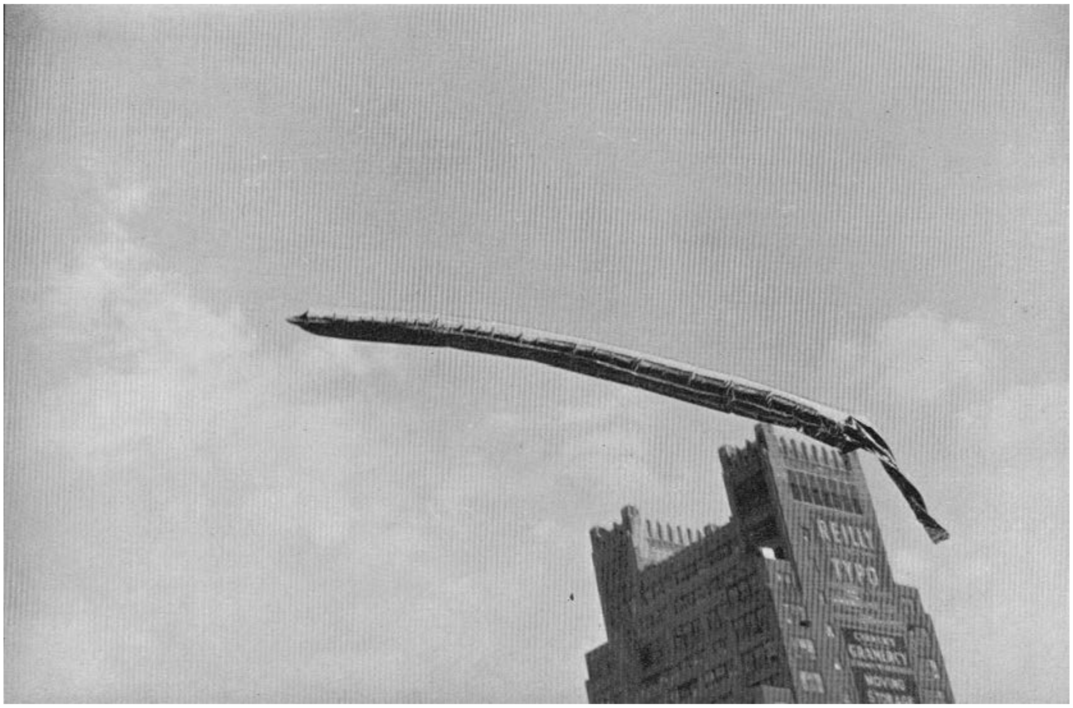


Figure 1.20.
View from of Warhol’s Factory, October 4, 1965.
Photo: Billy Name.

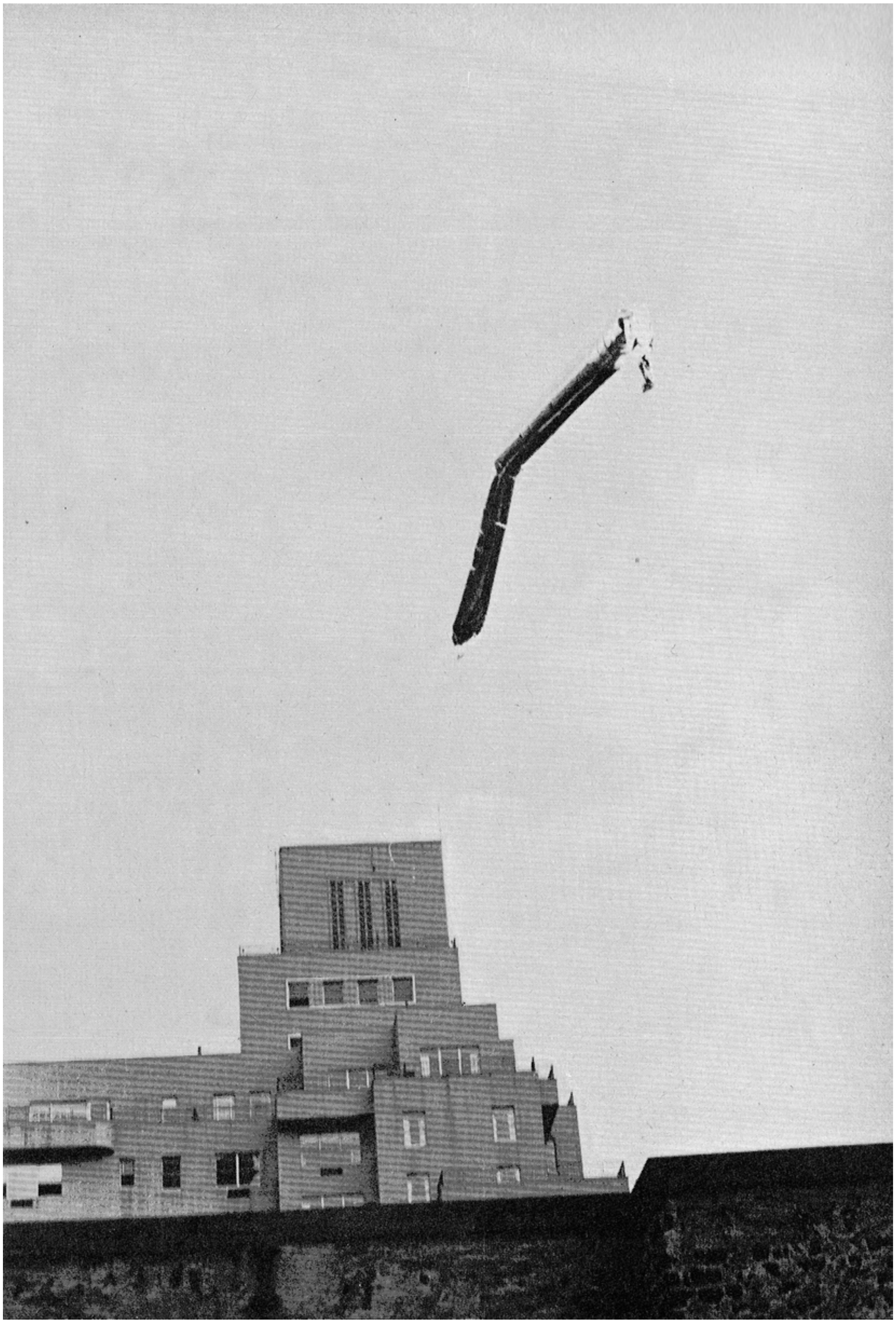


Figure 1.21.
Roof of Warhol's Factory, October 4, 1965.
Photo: Billy Name.

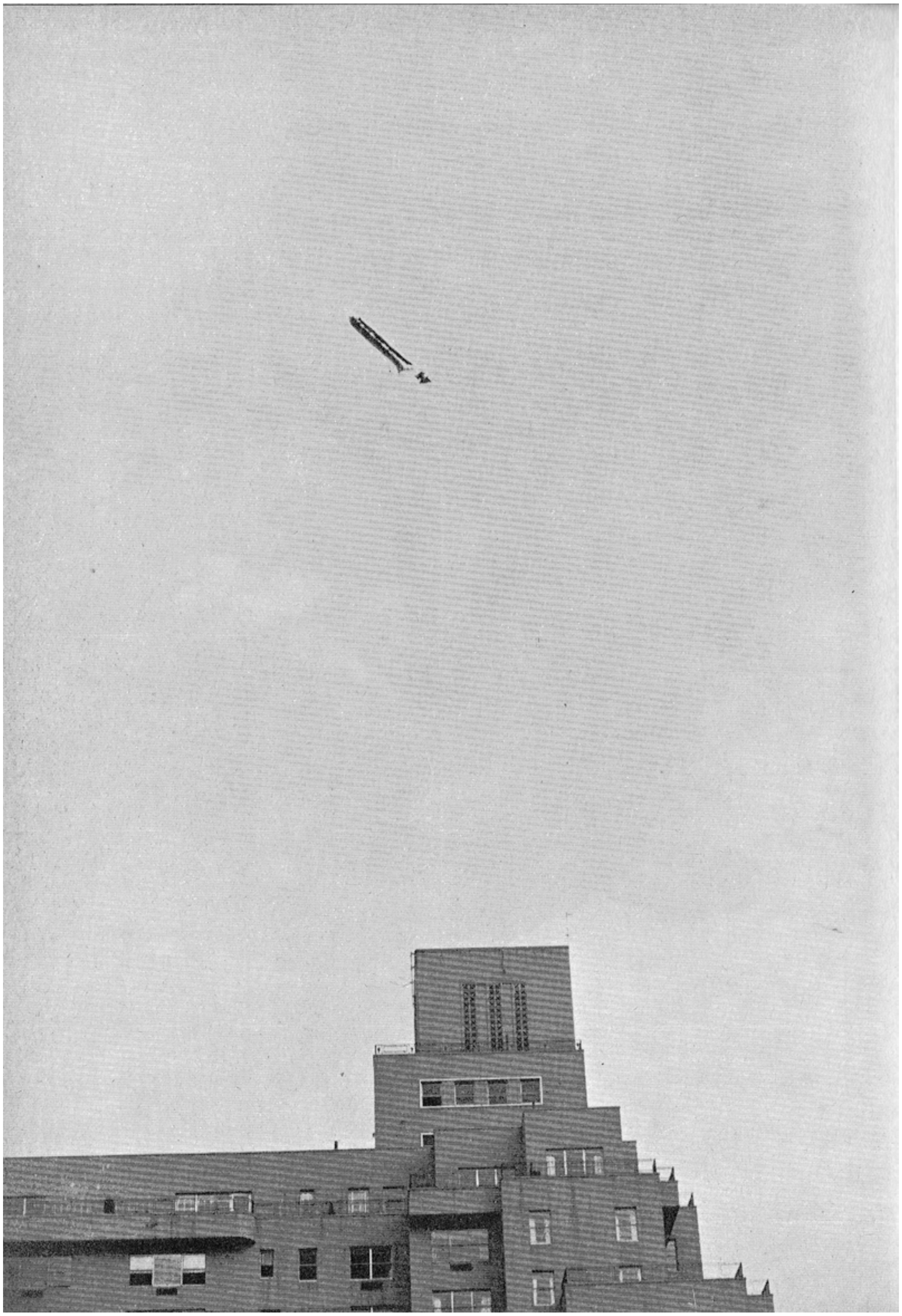


Figure 1.22.
Roof of Warhol's Factory, October 4, 1965.
Photo: Billy Name.

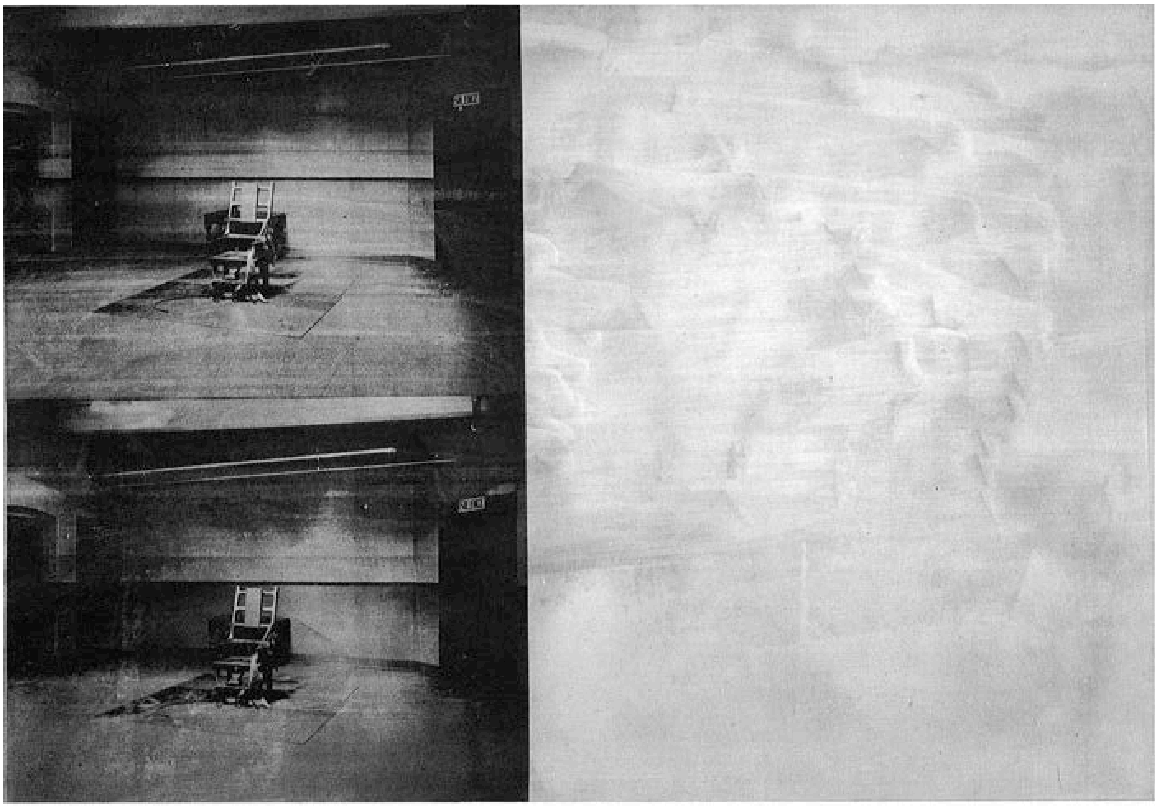


Figure 1.23.
Andy Warhol, *Silver Disaster*, 1963.
Silkscreen ink on synthetic polymer paint on canvas, 42 x 60 in.
The Sonnabend Collection.

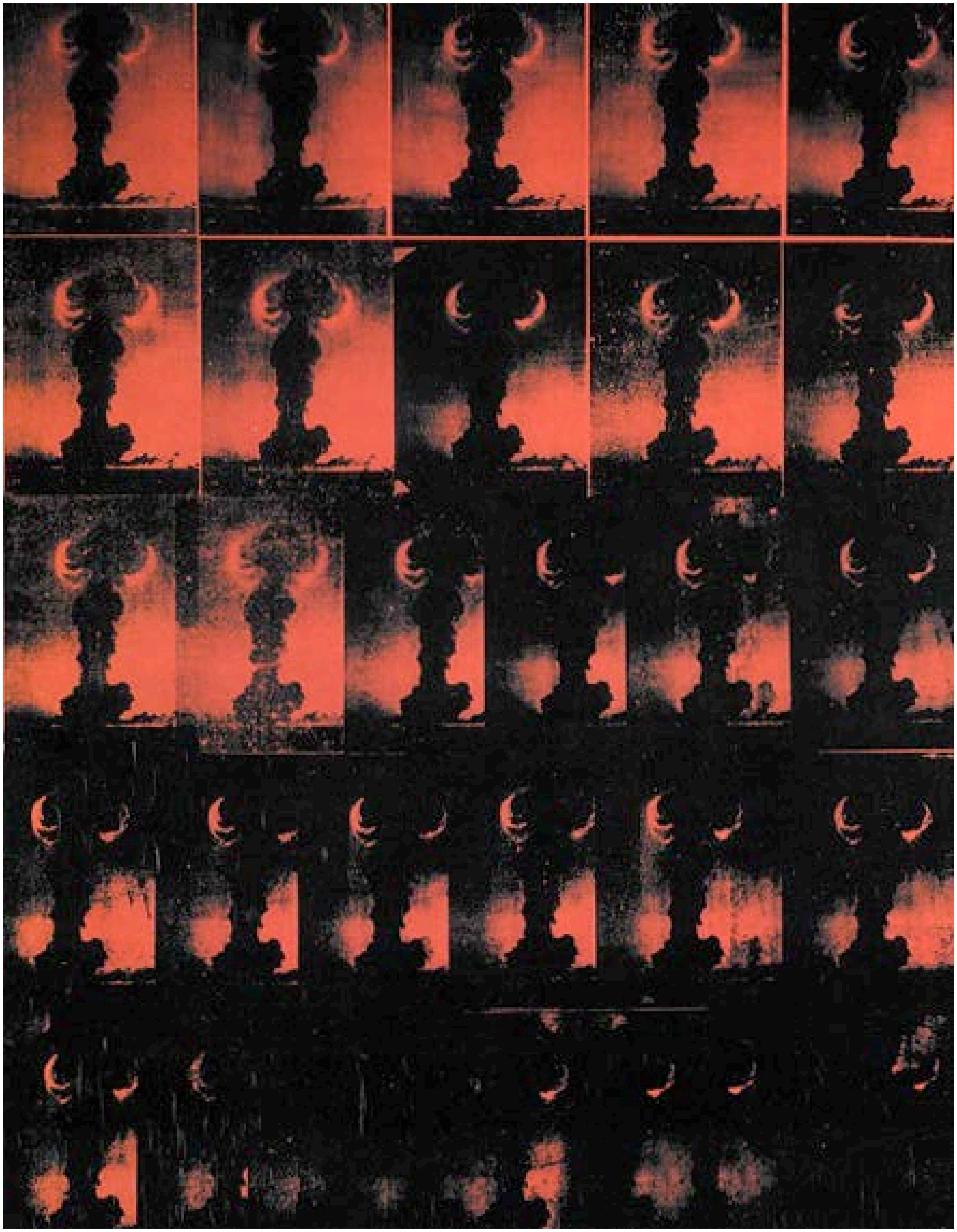


Figure 1.24.
Andy Warhol, *Red Disaster*, 1965. Silkscreen on canvas.
Reprinted from *Andy Warhol, A Retrospective*, exh. cat.
(Museum of Modern Art, New York: 1991).

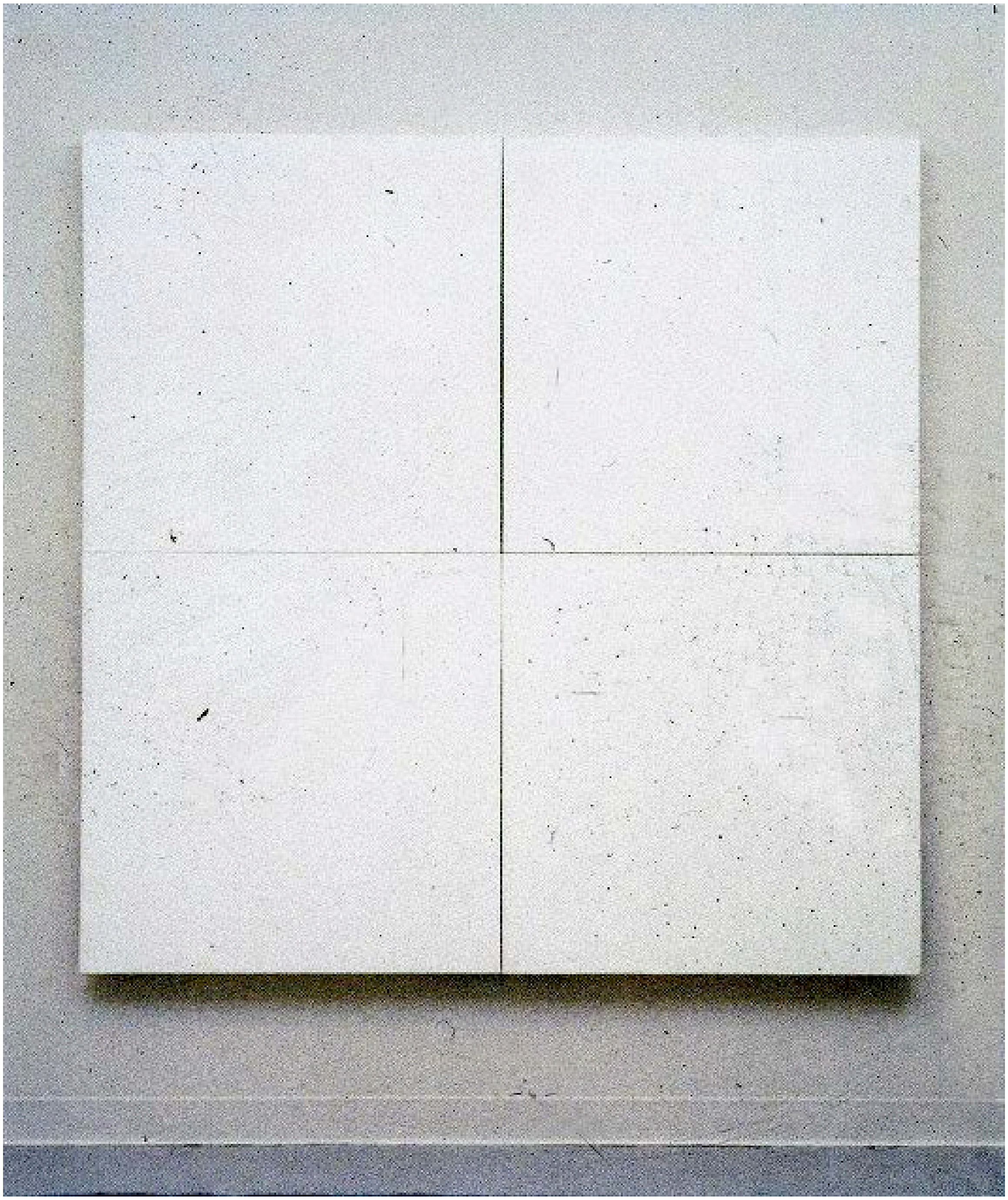


Figure 1.25.
Robert Rauschenberg, *White Paintings* (1951-53).
House paint on canvas, four panels, each 72 x 72 inches.
Collection, Estate of the Artist.

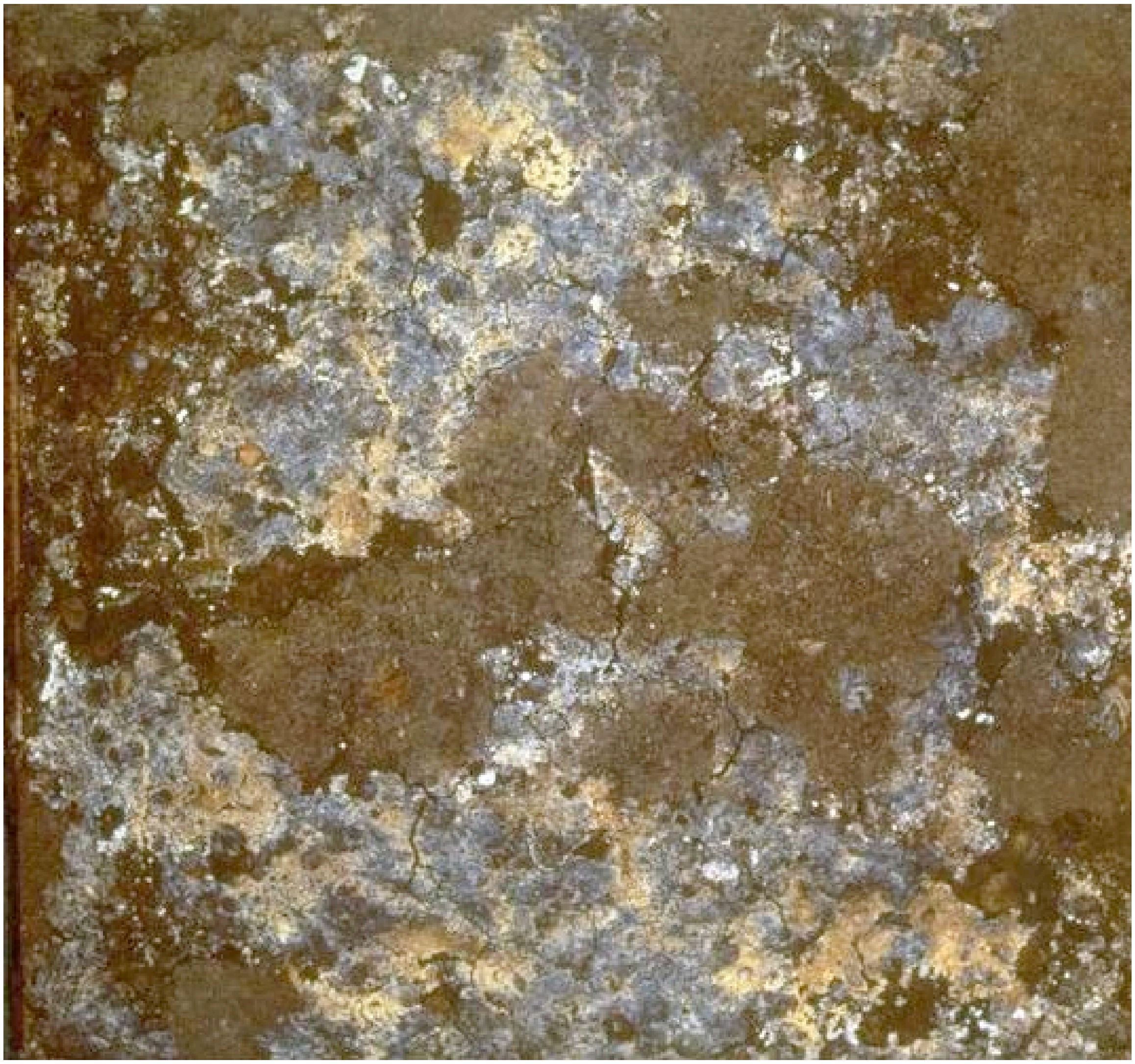


Figure 1.26.
Robert Rauschenberg, *Dirt Painting (for John Cage)*, c. 1953. Dirt and mold in wooden box, 15 ½ x 16 x 2 ½ inches. Collection, Estate of the Artist.

Figure 1.27.
The Factory, interior, 1966. Photo: Billy Name.
Reprinted from *The Andy Warhol Catalogue Raisonne*, vol. 2,
eds. George Frei and Neil Printz, 2004.

Figure 1.28.
Andy Warhol and the Velvet Underground, *Exploding Plastic Inevitable*, 1966.
Performance view. Photo: David Bourdon.

Figure 1.29.
Ferus Gallery, Los Angeles, May 1966.
Reprinted from *The Andy Warhol Catalogue Raisonne*, vol. 2,
eds. George Frei and Neil Printz, 2004.

Figure 1.30.
Press conference for the founding of Experiments in Art and Technology, Robert Rauschenberg’s studio, October 1967, New York.
Photo: Neal Boenzi/The New York Times.
Collection the Getty Research Institute, Los Angeles.

Figure 1.31.
Merce Cunningham Dance Company, *RainForest*, 1968.
Performance view. Photo: Martha Keller.

Figure 1.32.
Andy Warhol, *Silver Clouds*, 1966.
Photo: The Andy Warhol Museum, 2000.

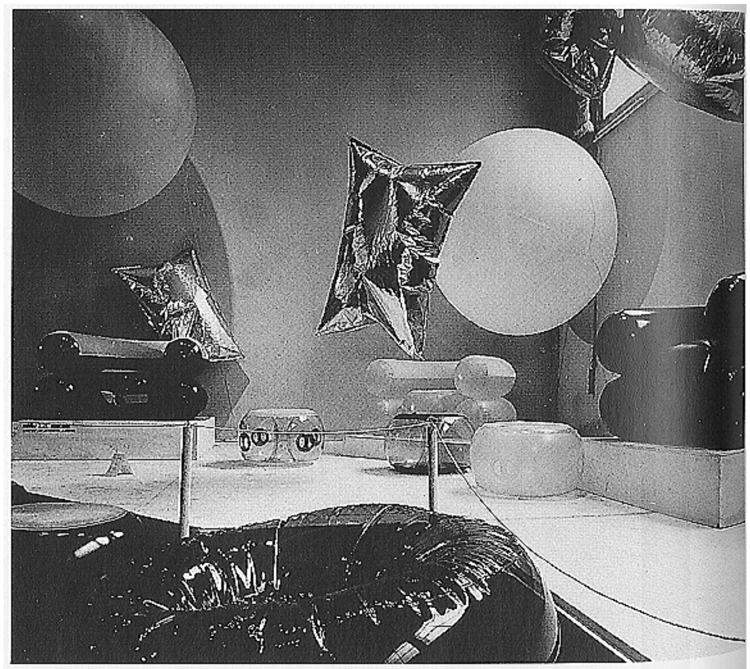


Figure 1.33.
Group Utopie, "*Structures Gonflables*" exhibition, 1968,
Musée d'Art Moderne de la Ville de Paris.
Reprinted from Marc Dessauce, *The Inflatable Moment*
(Princeton, NJ: Princeton Architectural Press, 1999).

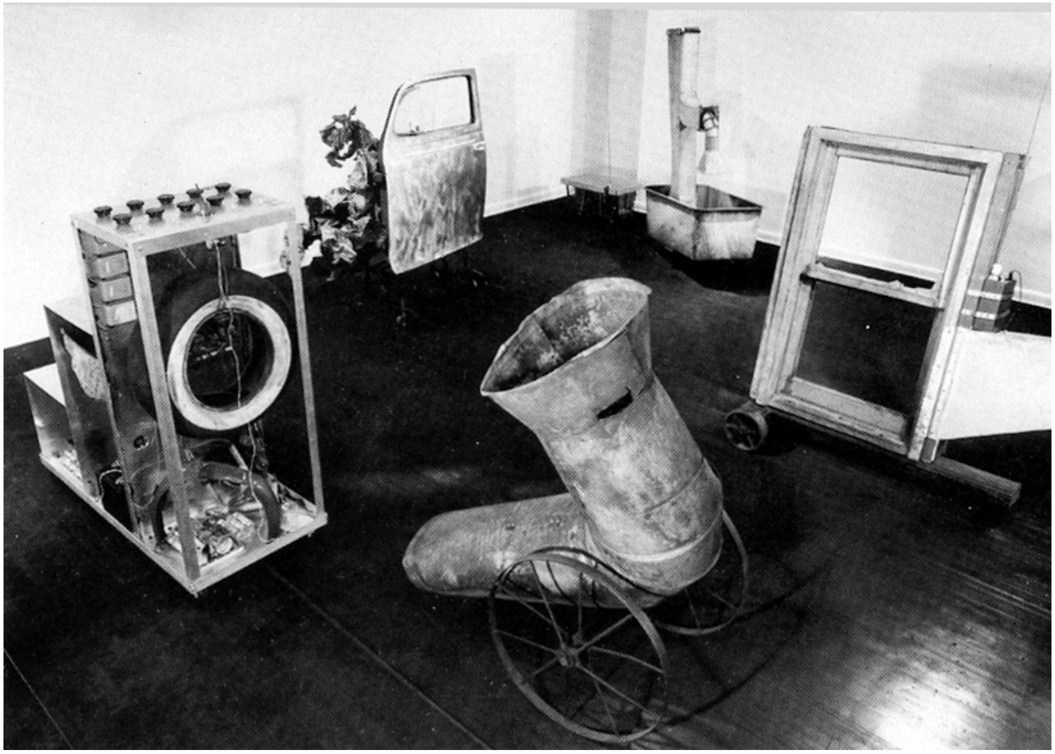


Figure 2.1.
Robert Rauschenberg, *Oracle*, 1962-65.
Mixed media, dimensions variable.
Installation view: Leo Castelli Gallery, New York.
Collection Centre Georges Pompidou, Paris.
Photo: Rudy Burckhardt.

Figure 2.2.
Robert Rauschenberg, *Broadcast,* 1959.
Oil, pencil, paper, fabric, newspaper, printed paper, printed reproductions, and plastic comb on canvas, with three concealed radios, 154.9 x 190.5 x 12.7 cm.
Collection John and Kimiko Powers, Carbondale, Illinois.

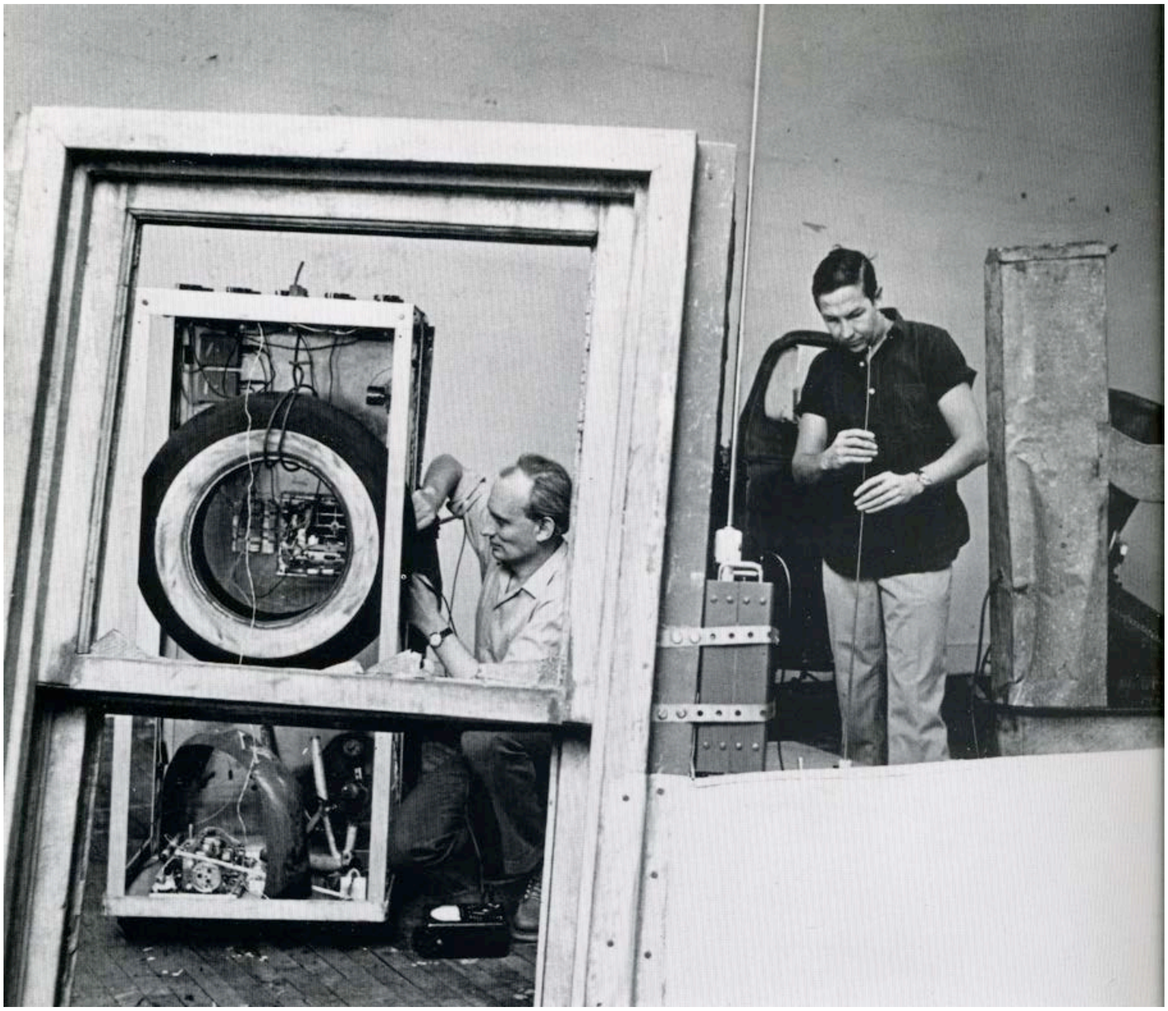


Figure 2.3.
Billy Klüver and Robert Rauschenberg working on *Oracle* at
Rauschenberg's Broadway Street studio, 1965.
Photo: Larry Morris, *The New York Times*.

Figure 2.4.
Robert Rauschenberg working on *Oracle*, 1965.
Photo: Larry Morris, *The New York Times*.

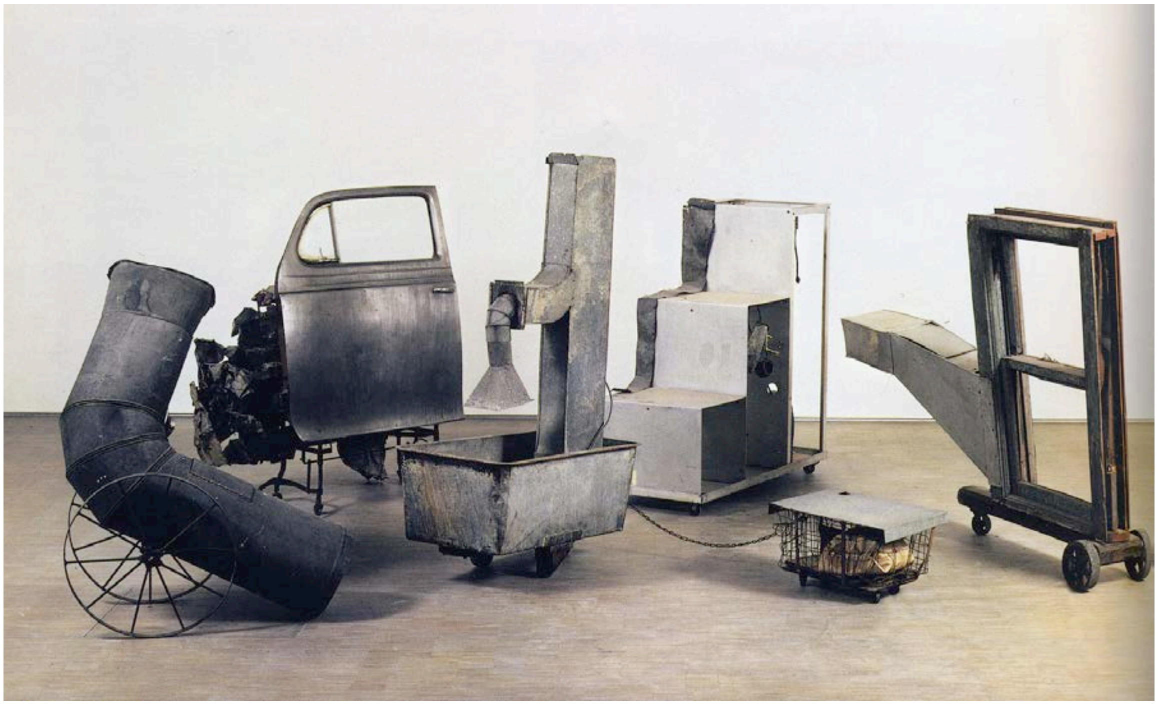


Figure 2.5.
Robert Rauschenberg, *Oracle*, 1962-65,
at Centre Georges Pompidou, Paris, 2004.
Photo: Réunion des Musées Nationaux.

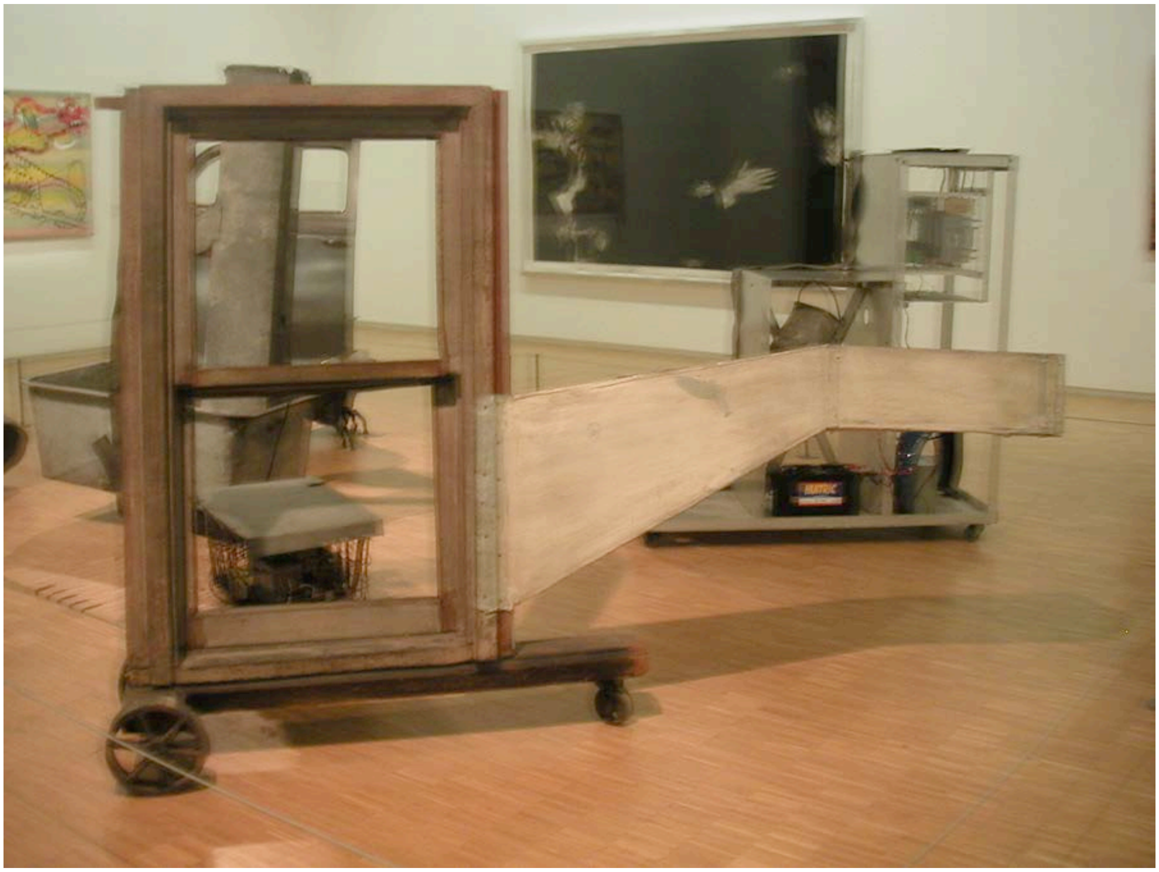


Figure 2.6.
Robert Rauschenberg, *Oracle*, 1962-65,
as installed at the Centre Georges Pompidou, Paris, 2007.
Photo: The author.

Figure 2.7.
Robert Rauschenberg, *Oracle*, 1962-65, detail of receiver and speaker inside duct attached to window frame, as installed at the Centre Georges Pompidou, Paris, 2007.
Photo: The author.

Figure 2.8.
Robert Rauschenberg, *Ace*, 1962.
Oil, cardboard, wood, and metal on canvas, 108 x 240".
Collection Albright-Knox Art Gallery.

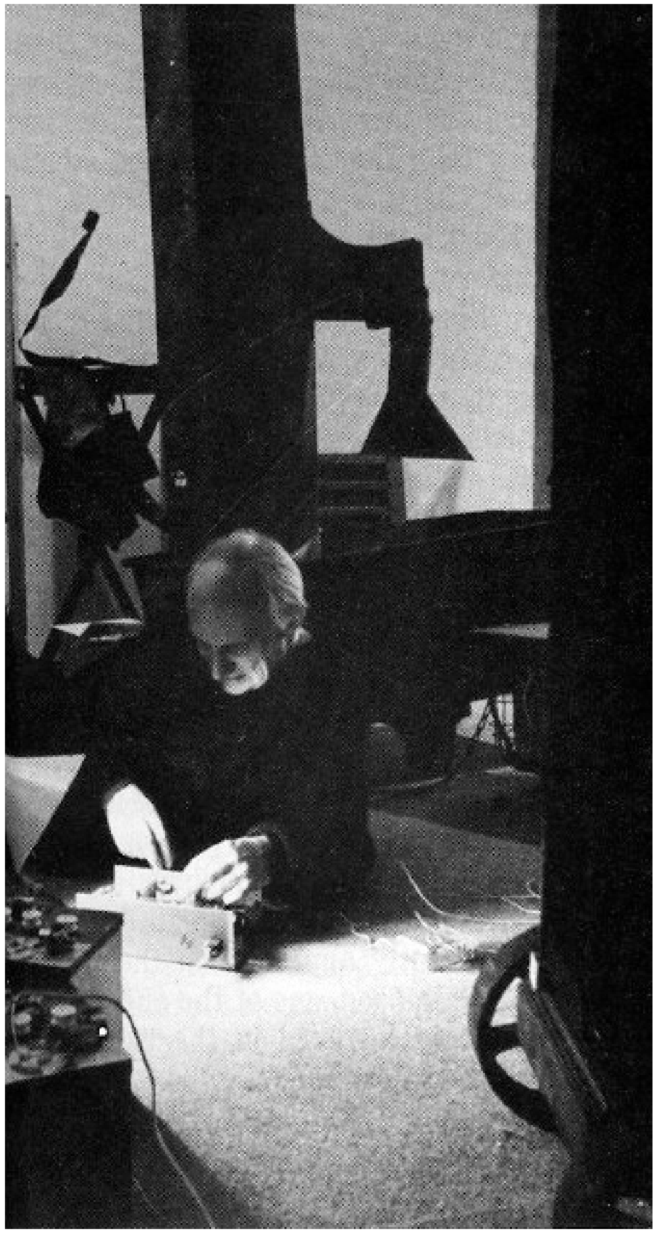


Figure 2.9.
Billy Klüver working on *Oracle*, Centre Georges Pompidou, Paris, 1977.
Photo: *Art in America*.

9 evenings: theatre & engineering

PROGRAM

13

OCT. '66, THUR. 8:30 P.M.

PHYSICAL THINGS
by: Steve Paxton
performance engineer: Dick Wolff
cast: Karen Bacon, Sue Hartnett, Margaret Hecht, Michael Kirby, Ted Kirby, Clark Poling, Elaine Sturtevant, David White, and others. technicians and help: Karen Bacon, Margaret Hecht, Tony Holder, Walter Gelb, Larry Leitch. sound: disparate sources.

GRASS FIELD
by: Alex Hay
performance engineer: Herb Schneider
sound distribution: David Tudor. cast: Steve Paxton, Robert Rauschenberg. credits: Schweber Electronics for integrated circuits, Mt. Sinai Laboratory for technical information.

SOLO
by: Deborah Hay
performance engineer: Larry Heilos
performers: Franny Breer, Lucinda Childs, William Davis, Jim Jardy, Alex Hay, Deborah Hay, Margaret Hecht, Ed Iverson, Kathy Iverson, Julie Judd, Olga Klüver, Vernon Lobb, Fujiko Nakaya, Steve Paxton, Bob Rauschenberg, Joe Schlichter, Bob Schuler, Marjorie Strider, Carol Summers, James Tenny. music: "Funakakushi" by Toshi Ichiyanagi. performed by: David Tudor. men's costumes by: Letty Lou Eisenhauer.

14

OCT. '66, FRI. 8:30 P.M.

OPEN SCORE
by: Robert Rauschenberg
performance engineer: Jim McGee
cast: Frank Stella and Mimi Kanarek and a group of 500 people.

BANDONEON ! (a combine)
by: David Tudor
performance engineer: Fred Waldhauer
tv images by: Lowell Cross. carts: David Behrman, Anthony Gnazzo.

15

OCT. '66, SAT. 8:30 P.M.

CARRIAGE DISCRETENESS
by: Yvonne Ranier
performance engineer: Per Biorn
performed by: Carl Andre, Becky Arnold, Rose Marie Castoro, William Davis, Letty Lou Eisenhauer, June Ekman, Ed Iverson, Kathy Iverson, Julie Judd, Michael Kirby, Alfred Kurchin, Benjamin Lloyd, Lewis Lloyd, Meredith Monk, Steve Paxton, Carol Summers. Stage manager: Rudy Perez.

VARIATIONS VII
by: John Cage
performance engineer: Cecil Coker
performers: David Tudor, David Behrman, Anthony Gnazzo, Lowell Cross. grateful acknowledgement is made for the cooperation of: Merce Cunningham Dance Foundation, Luchow's Restaurant, A.S.P.C.A., N. Y. Times, the City of New York, Terry Riley, Robert Wood, Richard Hennessy, Rubin Gorowitz.

16

OCT. '66, SUN. 8:30 P.M.

VEHICLE
by: Lucinda Childs
performance engineer: Peter Hirsch
cast: William Davis, Alex Hay. slides by: Les Levine.

VARIATIONS VII
by: John Cage
(See Oct. 15)

18

OCT. '66, TUES. 8:30 P.M.

TWO HOLES OF WATER—3
by: R. Whitman
performance engineer: Robby Robinson
film: Pan American. fiber optics: Flexi-Optics. tv help: Bill Hartig. performers: Max Baker, Gil Miller, Terry Riley, Les Levine, Toby Mussman, Bob Breer, Jane Kramer, Elaine Sturtevant, John Giorno, Susanne de Maria, Mimi Miller, Trisha Schlichter, Julie Martin.

BANDONEON ! (a combine)
by: David Tudor
(See Oct. 14)

19

OCT. '66, WED. 8:30 P.M.

PHYSICAL THINGS
by: Steve Paxton
(See Oct. 13)

TWO HOLES OF WATER—3
by: R. Whitman
(See Oct. 18)

21

OCT. '66, FRI. 8:30 P.M.

CARRIAGE DISCRETENESS
by: Yvonne Ranier
(See Oct. 15)

KISSES SWEETER THAN WINE
by: Oyvind Fahlstrom
performance engineer: Harold Hodges
direction Soren Brunes and Oyvind Fahlstrom. production assistants: Letty Lou Eisenhauer, Ulla Lyttkens. props: Alfonse Schilling. performers: Bob and Frances Breer, Letty Lou Eisenhauer, John Glover, Bruce Glushakow, Tom Gormley, Jim Hardy, Ed Iverson, Kosugi, Larry Leitch, Les Levine, Marjorie Strider, Bob Schuler, Ulla Wiggen, tapes: Sveriges Radio, Stockholm: WBAI-NYC. films: "Creation of Humanoids," courtesy of W. Barry, Genie Productions Inc. and Medallion Pictures. "Acqua Sangemini" courtesy Ditta Agrippa, Rome: and educational films courtesy AT&T. chemicals: Nuclear Research Associates.

22

OCT. '66, SAT. 8:30 P.M.

GRASS FIELD
by: Alex Hay
(See Oct. 13)

KISSES SWEETER THAN WINE
by: Oyvind Fahlstrom
(See Oct. 21)

23

OCT. '66, SUN. 8:30 P.M.

OPEN SCORE
by: Robert Rauschenberg
(See Oct. 14)

SOLO
by: Deborah Hay
(See Oct. 13)

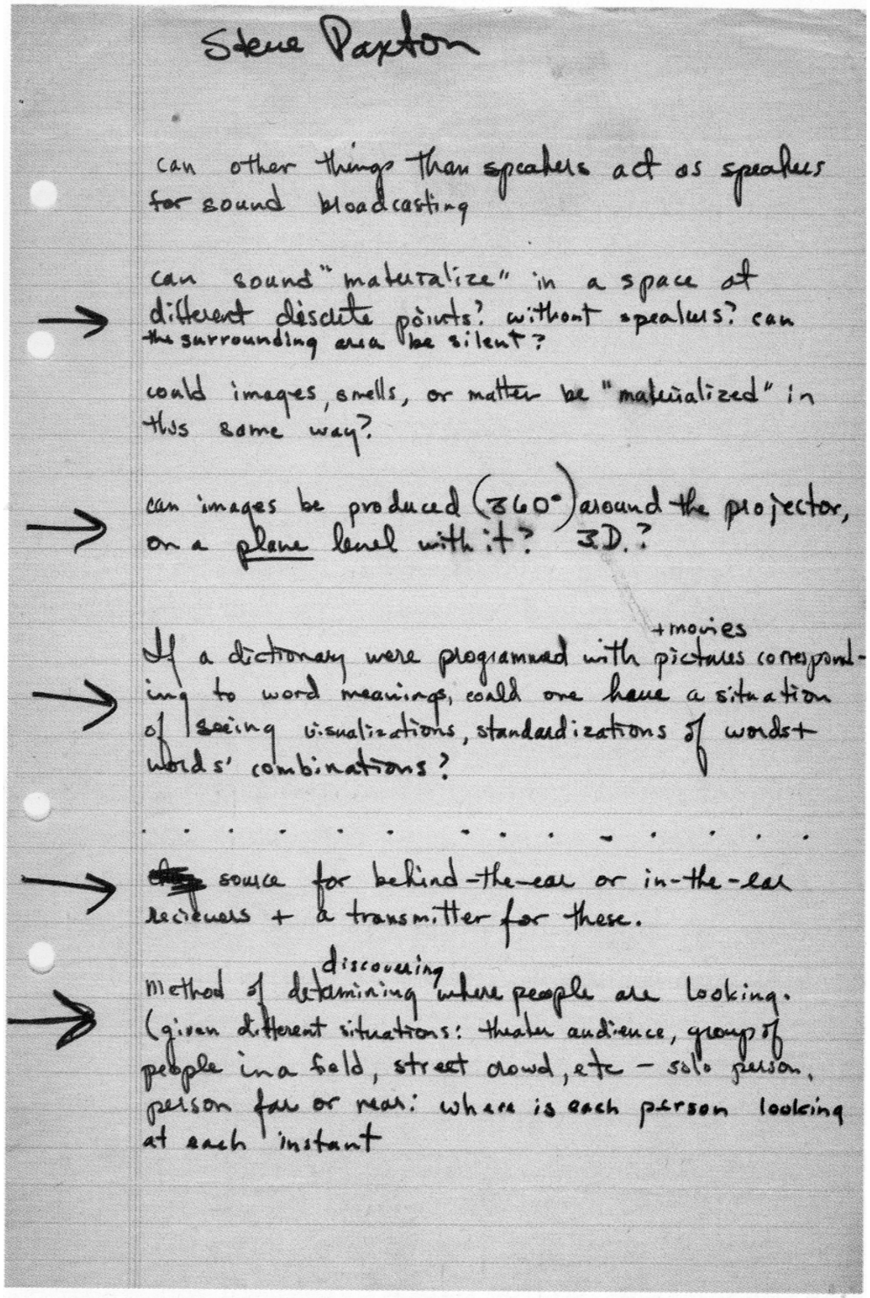
VEHICLE
by: Lucinda Childs
(See Oct. 16)

Poster for 9 Evenings available at DWAN Gallery, Galleria BONNINO and CASTELLI Gallery. Completely documented poster with 40 signatures, $200. with the designer's (Robert Rauschenberg's) signature $25.

Figure 2.10.
Program, *9 Evenings*, 1966.
Collection of Getty Research Institute, Los Angeles.

Figure 2.11.
Participants in *9 Evenings* in front of the Armory, New York, 1966.
Photo: Peter Moore.

Figure 2.12.
Robert Rauschenberg, Lucinda Childs, et al, *Spring Training*, 1965.
Performance view, First New York Theater Rally.



Steve Paxton

can other things than speakers act as speakers for sound broadcasting

can sound "materialize" in a space at different discrete points? without speakers? can the surrounding area be silent?

could images, smells, or matter be "materialized" in this same way?

can images be produced (360°) around the projector, on a plane level with it? 3D.?

If a dictionary were programmed with pictures +movies correspond-ing to word meanings, could one have a situation of seeing visualizations, standardizations of words + words' combinations?

. . . .

source for behind-the-ear or in-the-ear recievers + a transmitter for these.

method of determining discovering where people are looking. (given different situations: theater audience, group of people in a field, street crowd, etc – solo person, person far or near: where is each person looking at each instant

Figure 2.13.
Steve Paxton, notes for *9 Evenings*, 1966.
Collection the Getty Research Institute, Los Angeles.

Figure 2.14.
Ralph Flynn with TEEM equipment during *9 Evenings*, Armory, New York, 1966.
Photo: Peter Moore.

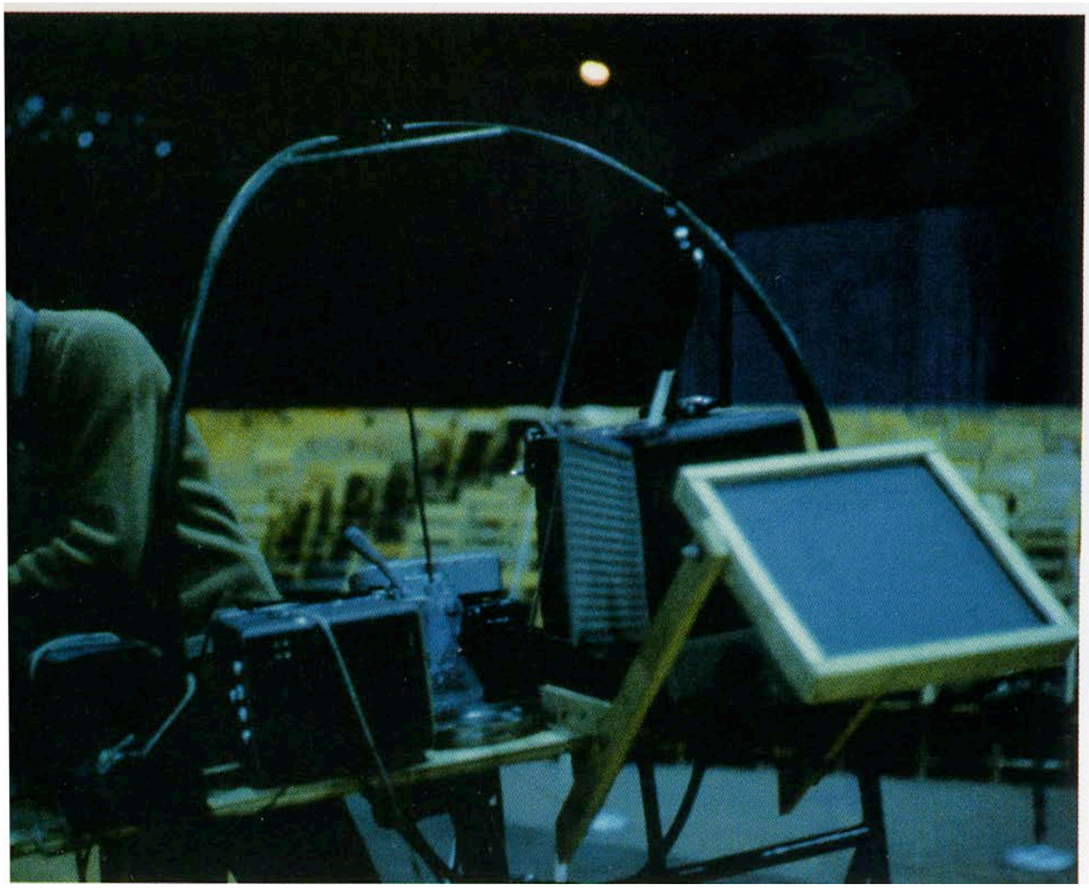


Figure 2.15.
View of preparations in control center for *9 Evenings*,
Armory, New York, 1966.
Photo: Herbert Migdoll.

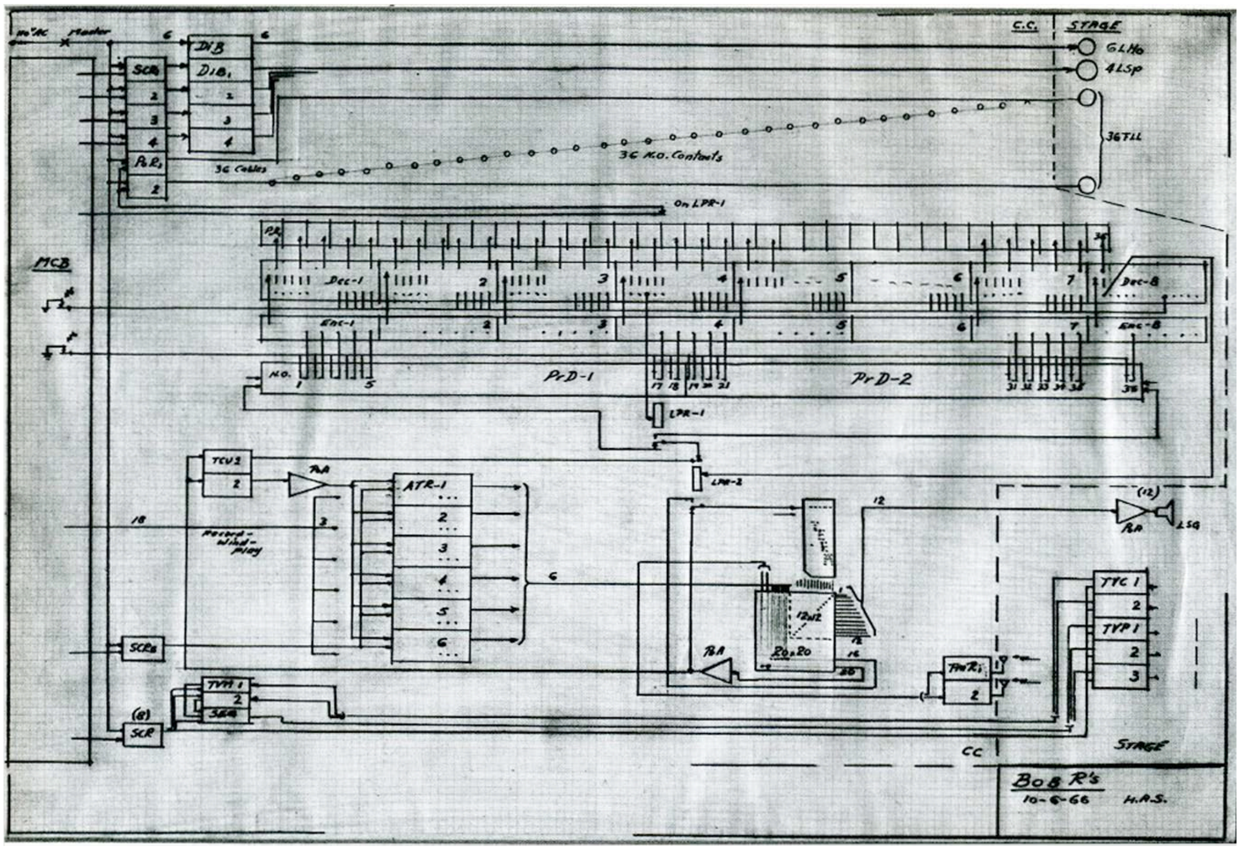


Figure 2.16.
Herbert Schneider, diagram for Robert Rauschenberg,
Jim McGee et al, *Open Score*, 1966.
Collection of Getty Research Institute, Los Angeles.

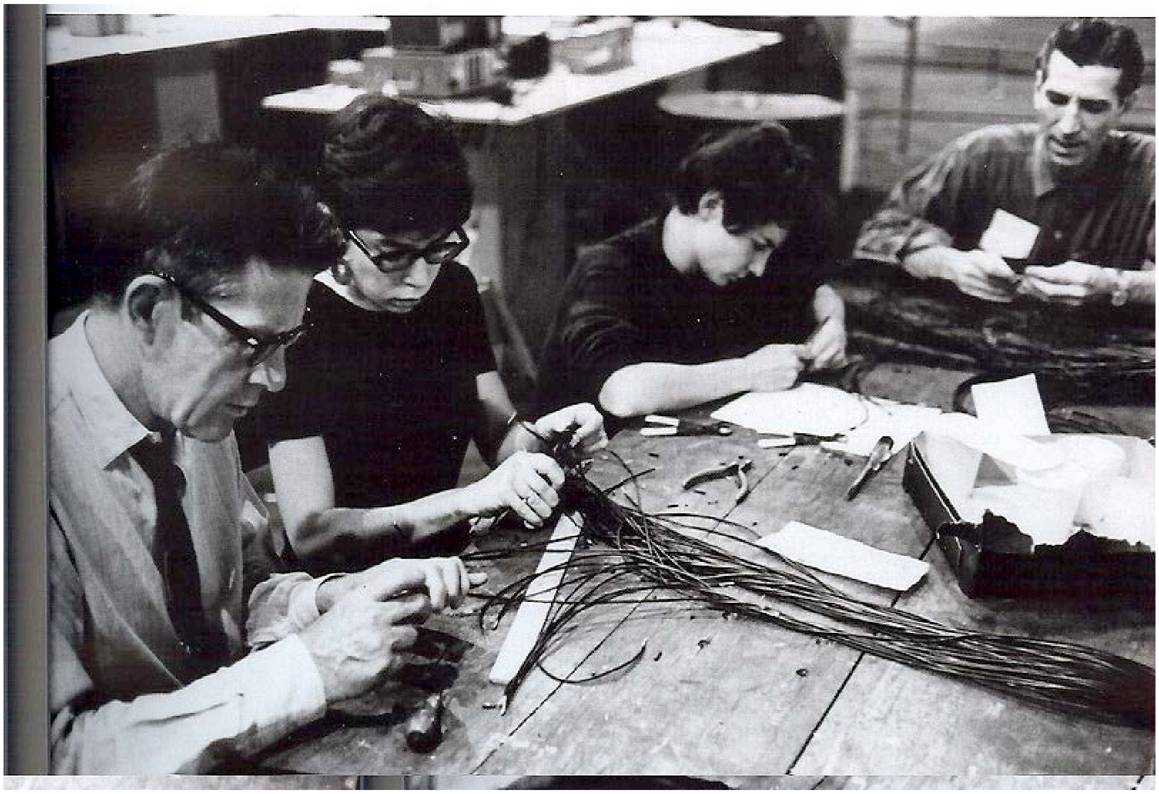


Figure 2.17.
From left: John Cage, Deborah Hay, Simone Forti (Whitman),
and Jim McGee stripping wires during preparation for *9 Evenings*, 1966.
Photo: Peter Moore.

Figure 2.18.
John Cage, Cecil Coker et al, *Variations VII*, 1966.
Performance view. Photo: Peter Moore.

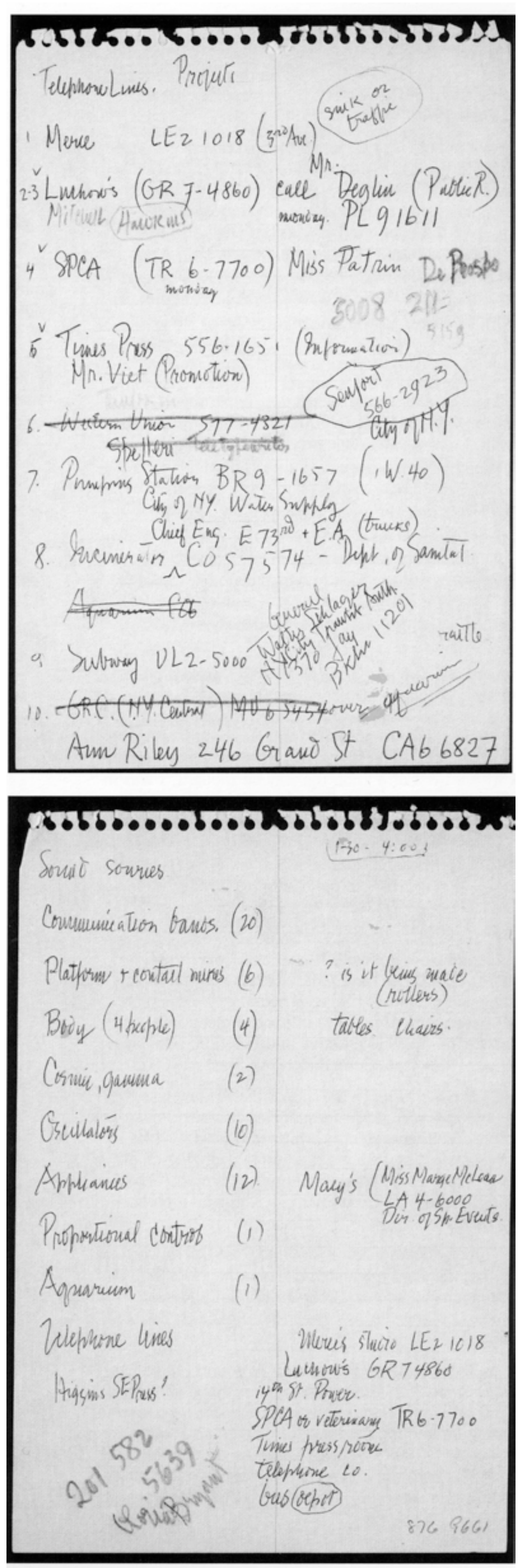


Figure 2.19.
John Cage, notes for *Variation VII*, 1966.
Collection of the Getty Research Institute, Los Angeles.

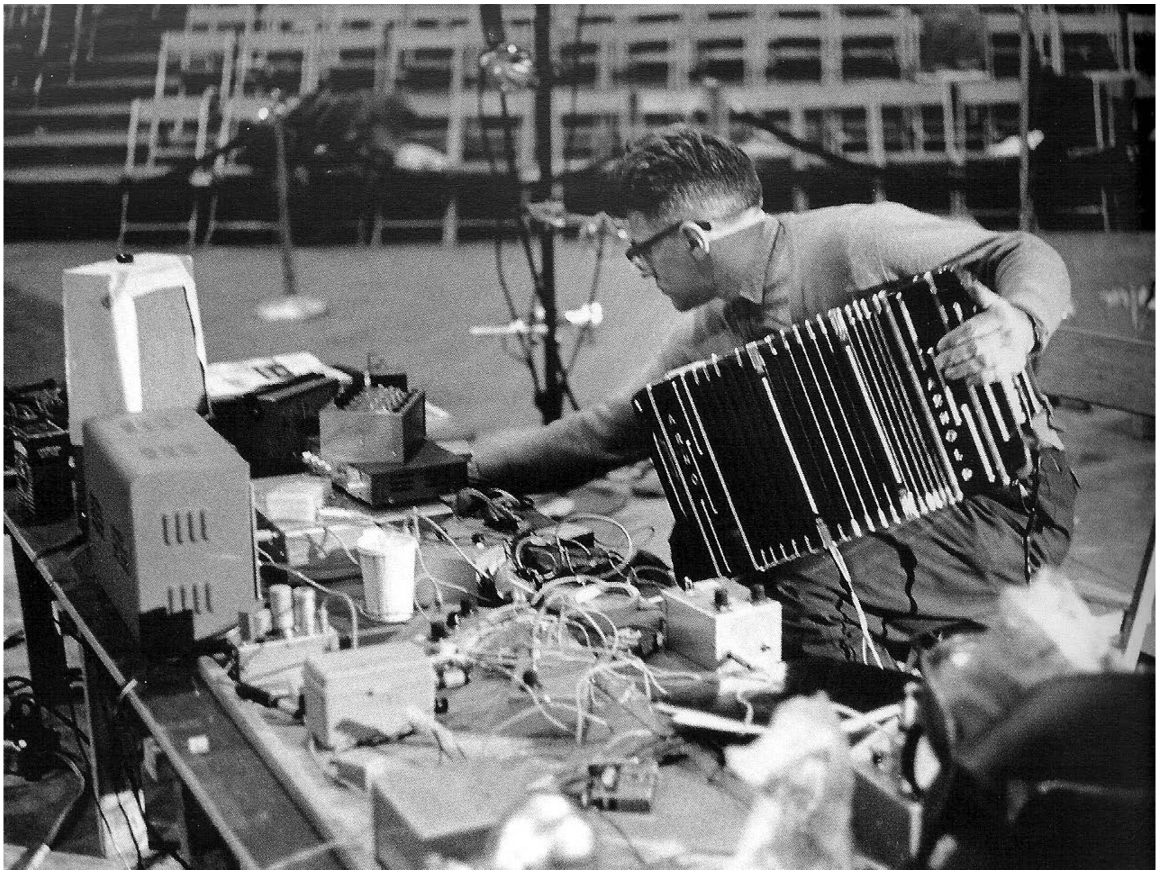


Figure 2.20.
David Tudor, Fred Waldhauer et al, *Bandoneon !*, 1966.
Performance view (David Tudor). Photo: Peter Moore.

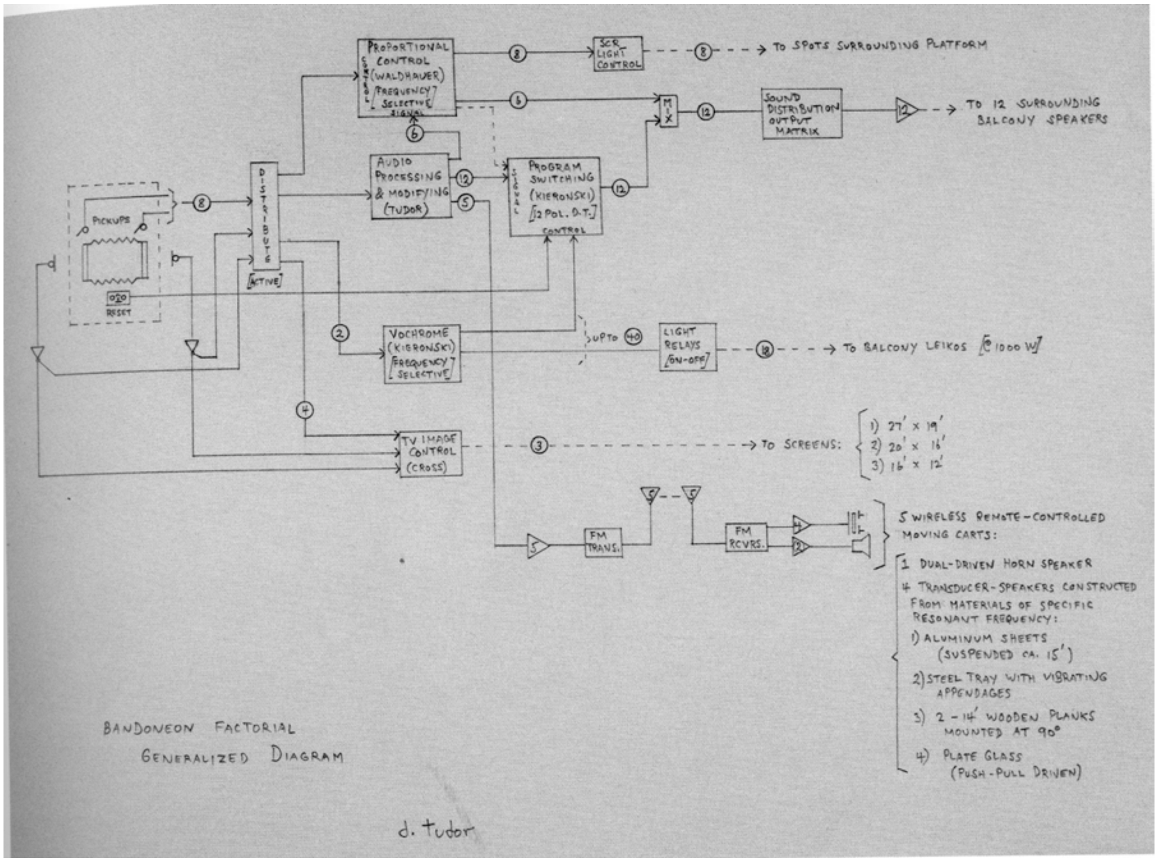


Figure 2.21.
David Tudor, block diagram for *Bandoneon!*, 1966.
Collection of the Getty Research Institute, Los Angeles.

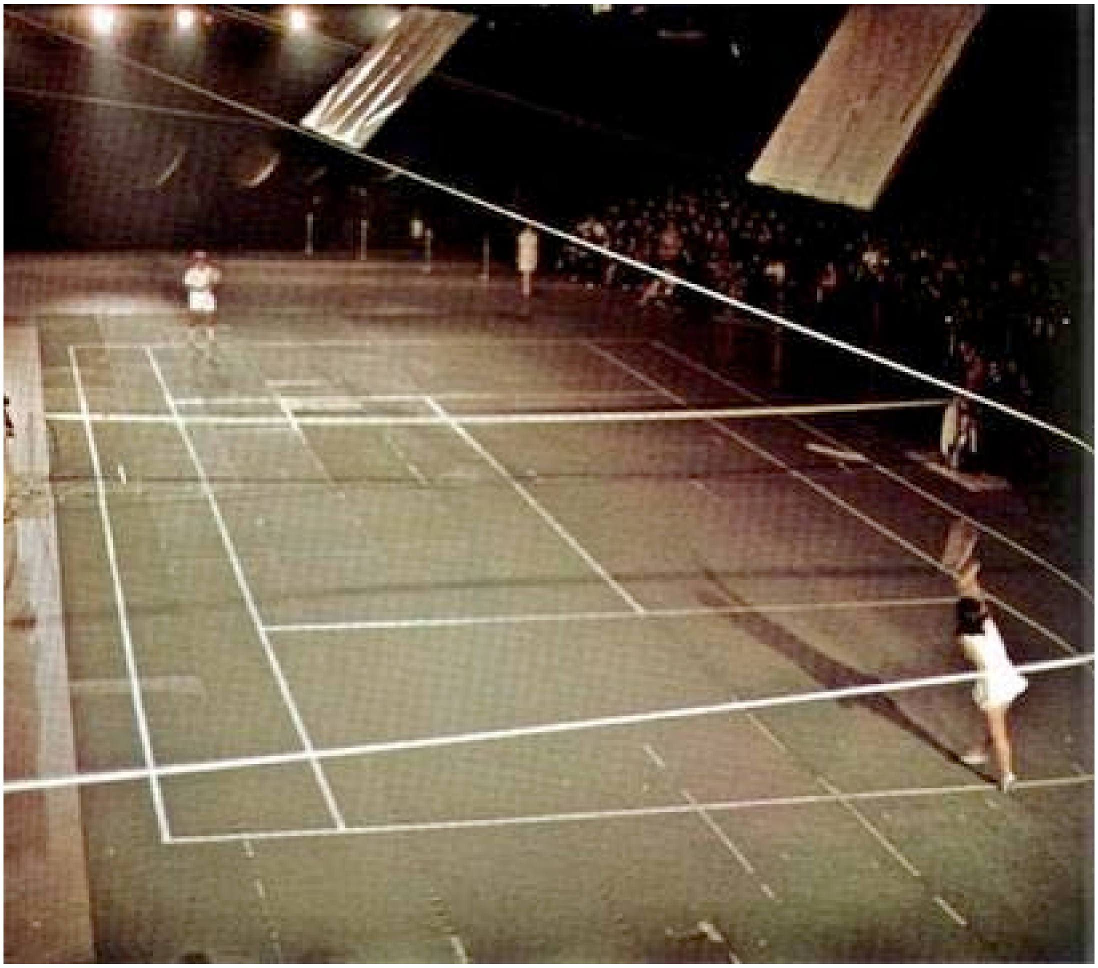


Figure 2.22.
Robert Rauschenberg, Jim McGee et al, *Open Score*, 1966.
Performance view (Frank Stella and Mimi Kanarek).
Still from 16mm film, Alphonse Schilling.
Collection of Fondation Langlois, Montreal.

Figure 2.23.
Wired racket from *Open Score*, 1966.
Collection of Fondation Langlois, Montreal.

Figure 2.24.
Robert Rauschenberg, Jim McGee et al, *Open Score*, 1966.
Performance view. Photo: Peter Moore.

Figure 2.25.
Robert Rauschenberg, Jim McGee et al, *Open Score*, 1966.
Performance view. Photo: Peter Moore.

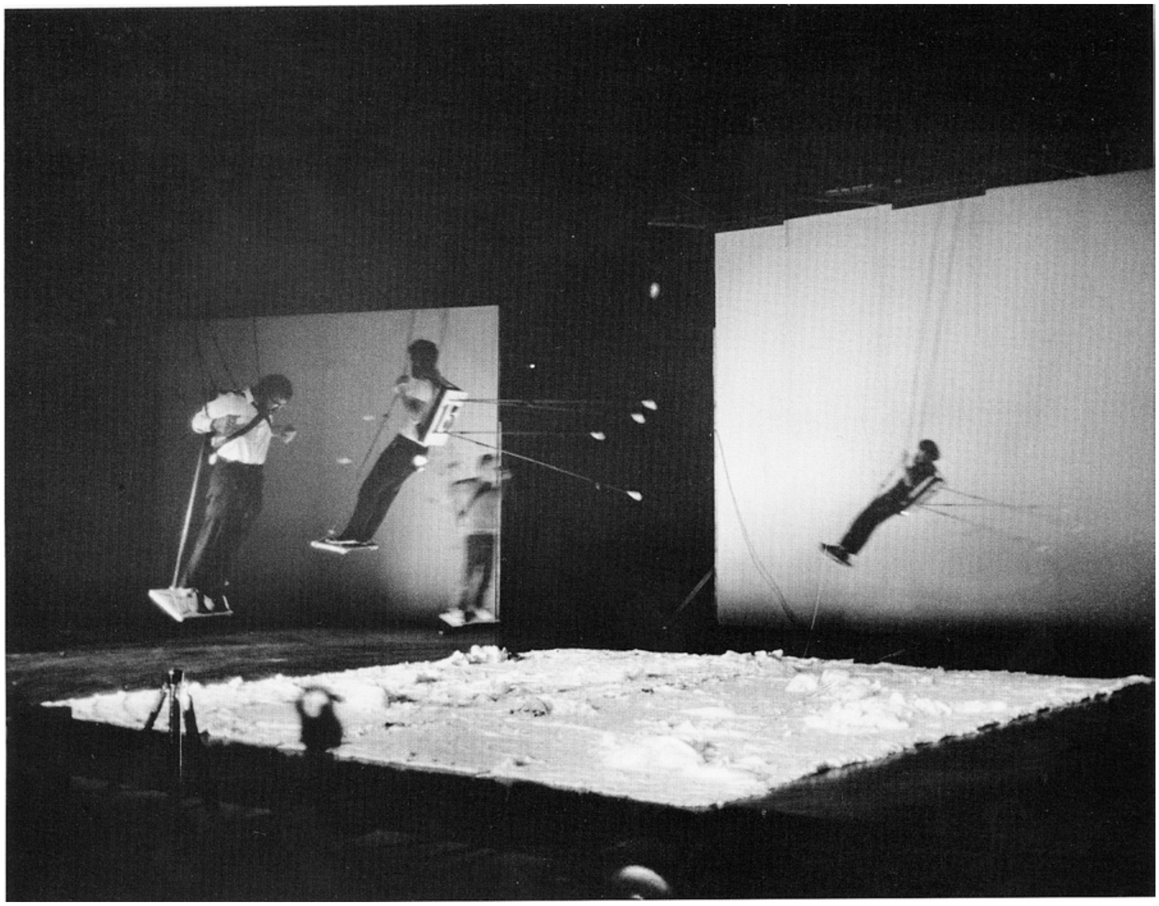


Figure 2.26.
Öyvind Fahlström, Harold Hodges et al, *Kisses Sweeter than Wine*, 1966.
Performance view. Photo: Peter Moore.

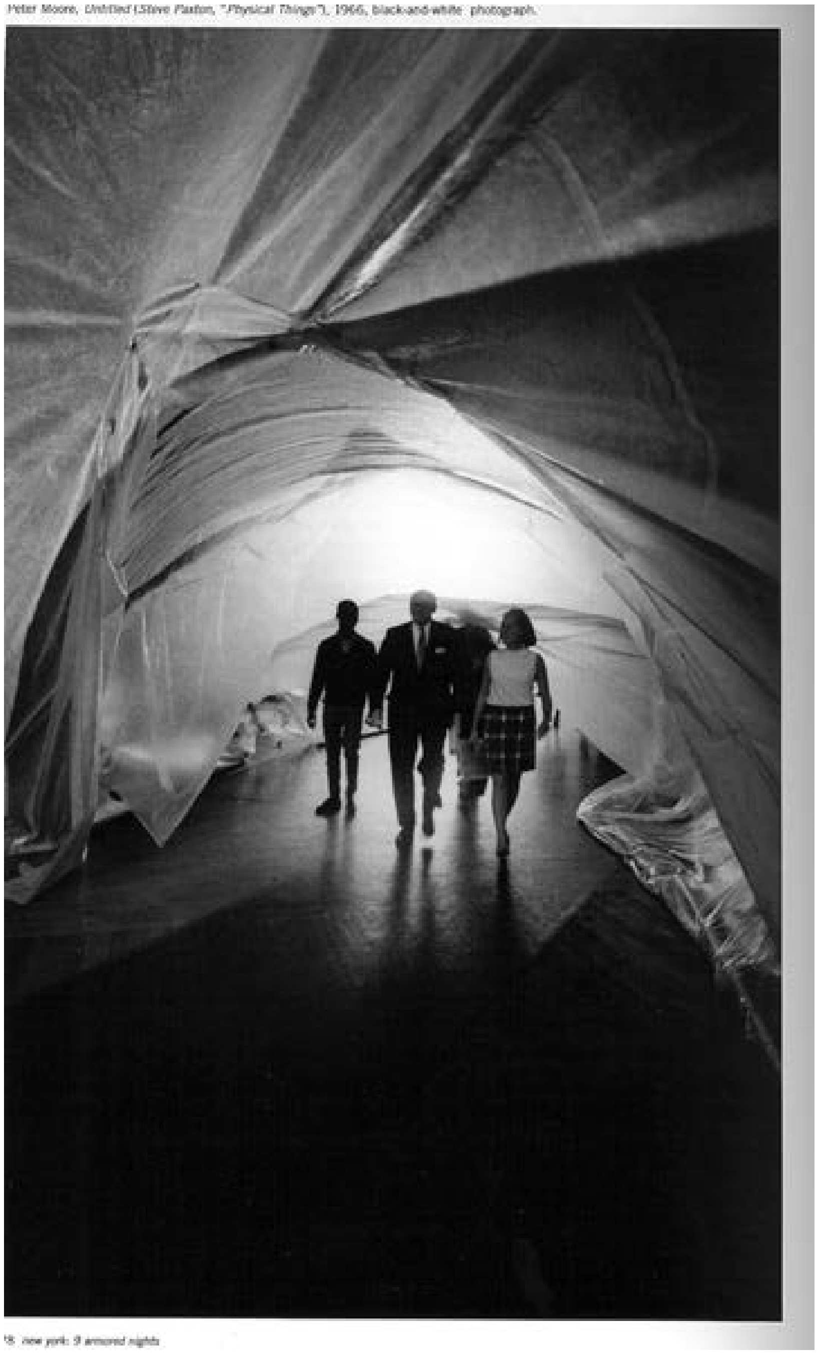


Figure 2.27.
Steve Paxton, Dick Wolff et al, *Physical Things*, 1966.
Performance view. Photo: Peter Moore.

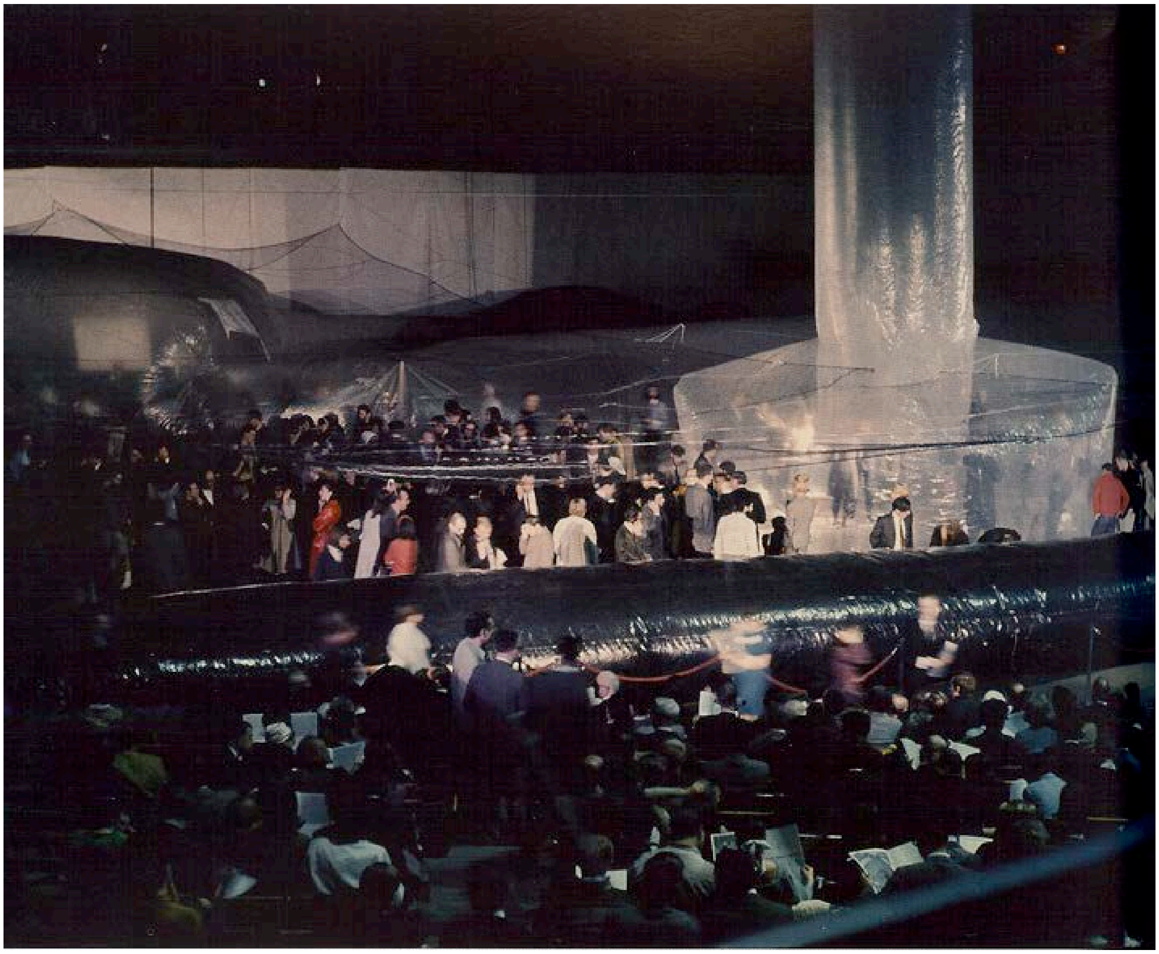


Figure 2.28.
Steve Paxton, Dick Wolff et al, *Physical Things*, 1966.
Performance view. Photo: Herbert Migdoll.

Figure 2.29.
Robert Whitman, Robby Robinson et al, *Two Holes of Water—3*, 1966.
Performance view. Photo: Peter Moore.

Figure 2.30.
Robert Whitman, Robby Robinson et al, *Two Holes of Water*, 1966.
Performance view. Photo: Peter Moore

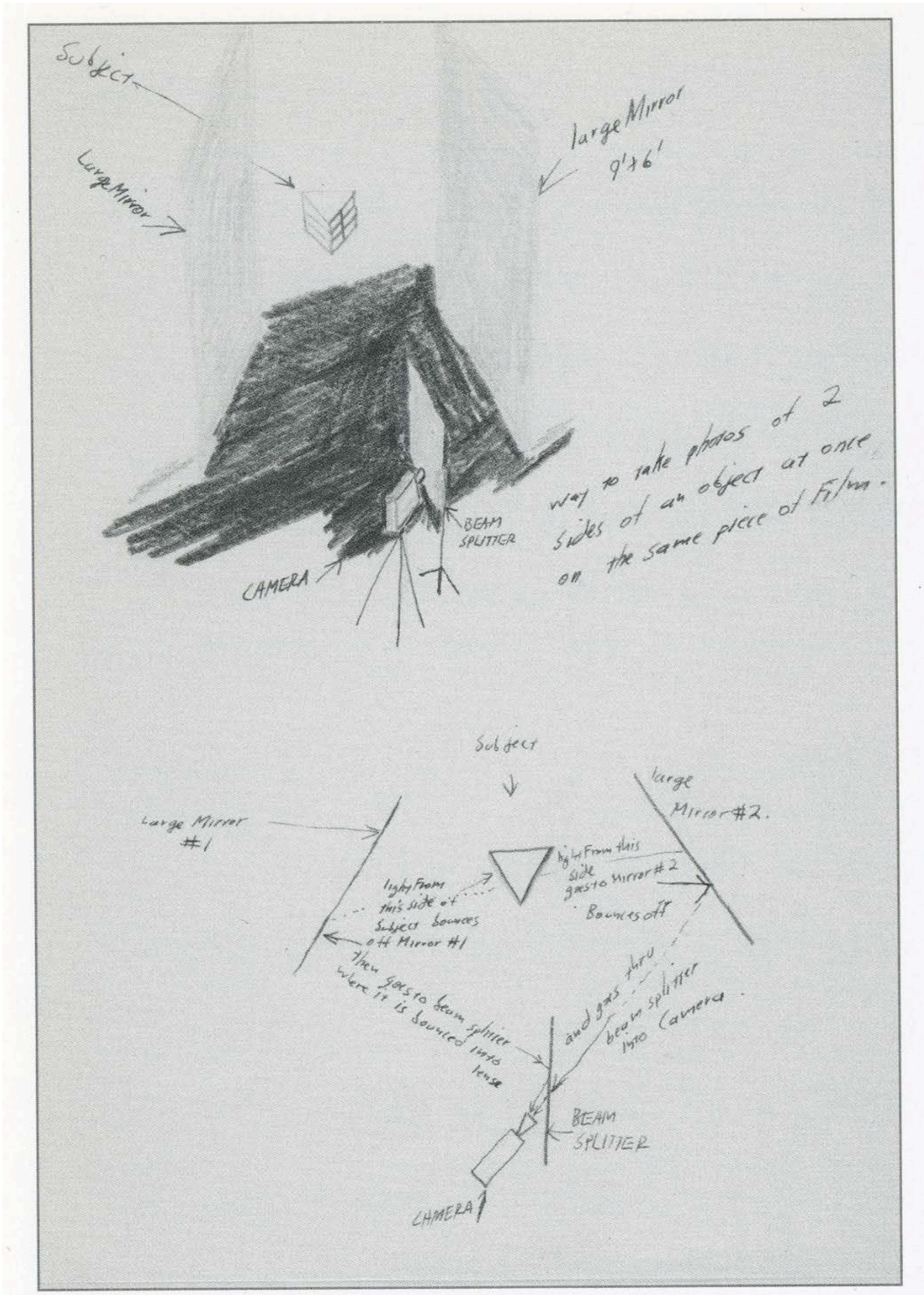
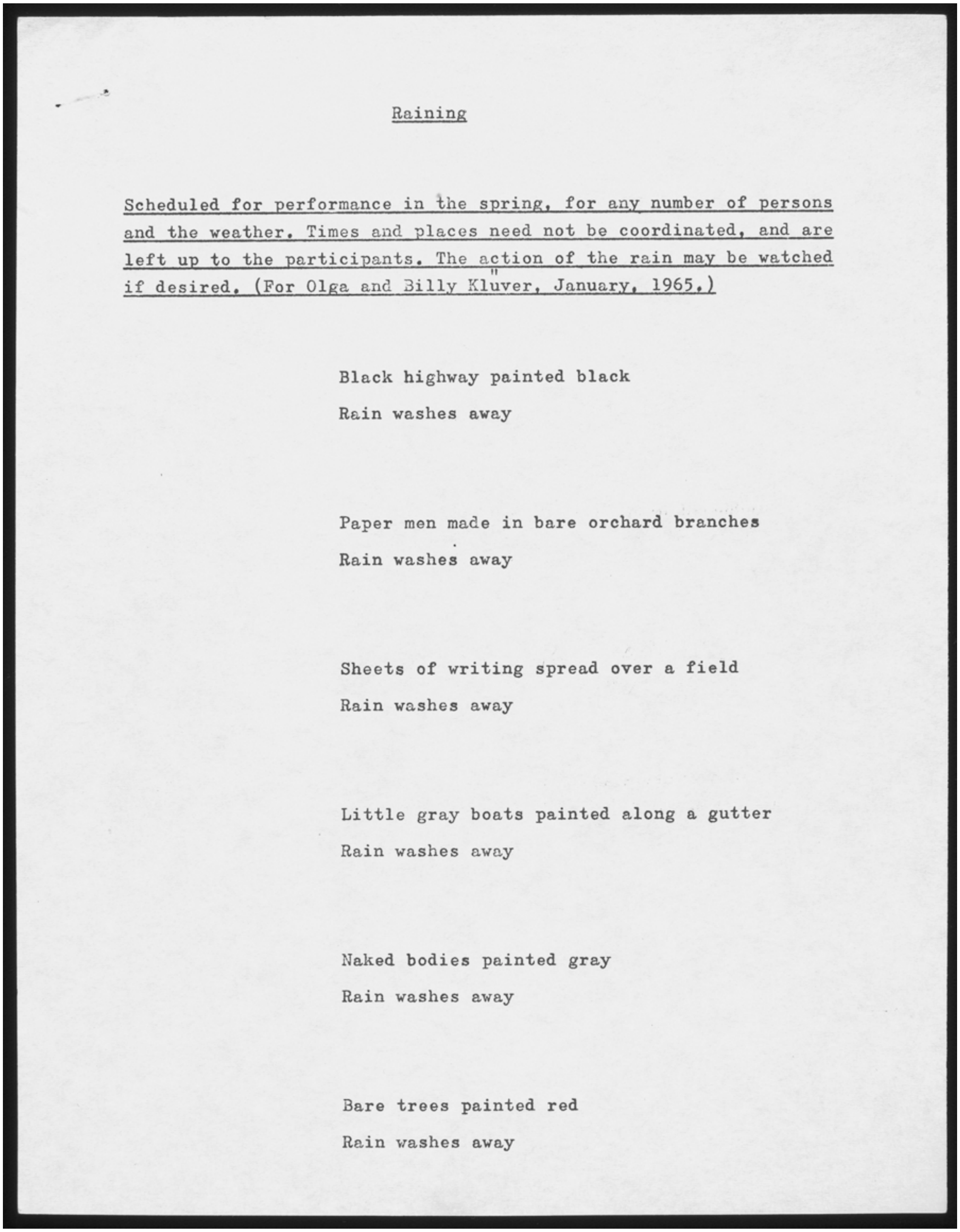


Figure 2.31.
Robert Whitman, diagram, 1966. Graphite on paper.
Collection of the Getty Research Institute, Los Angeles.



Raining

Scheduled for performance in the spring, for any number of persons and the weather. Times and places need not be coordinated, and are left up to the participants. The action of the rain may be watched if desired. (For Olga and Billy Klüver, January, 1965.)

Black highway painted black
Rain washes away

Paper men made in bare orchard branches
Rain washes away

Sheets of writing spread over a field
Rain washes away

Little gray boats painted along a gutter
Rain washes away

Naked bodies painted gray
Rain washes away

Bare trees painted red
Rain washes away

Figure 2.32.
Allan Kaprow, *Raining (for Olga and Billy Klüver)*, 1965.
Typewritten document.
Collection of Getty Research Institute, Los Angeles.

Figure 2.33.
Deborah Hay, Larry Heilos et al, *Solo*, 1966. Performance view.
Photo: Peter Moore.

Figure 2.34.
Yvonne Rainer, Per Biorn et al, *Carriage Discreteness*, 1966.
Performance view. Photo: Herbert Migdoll.

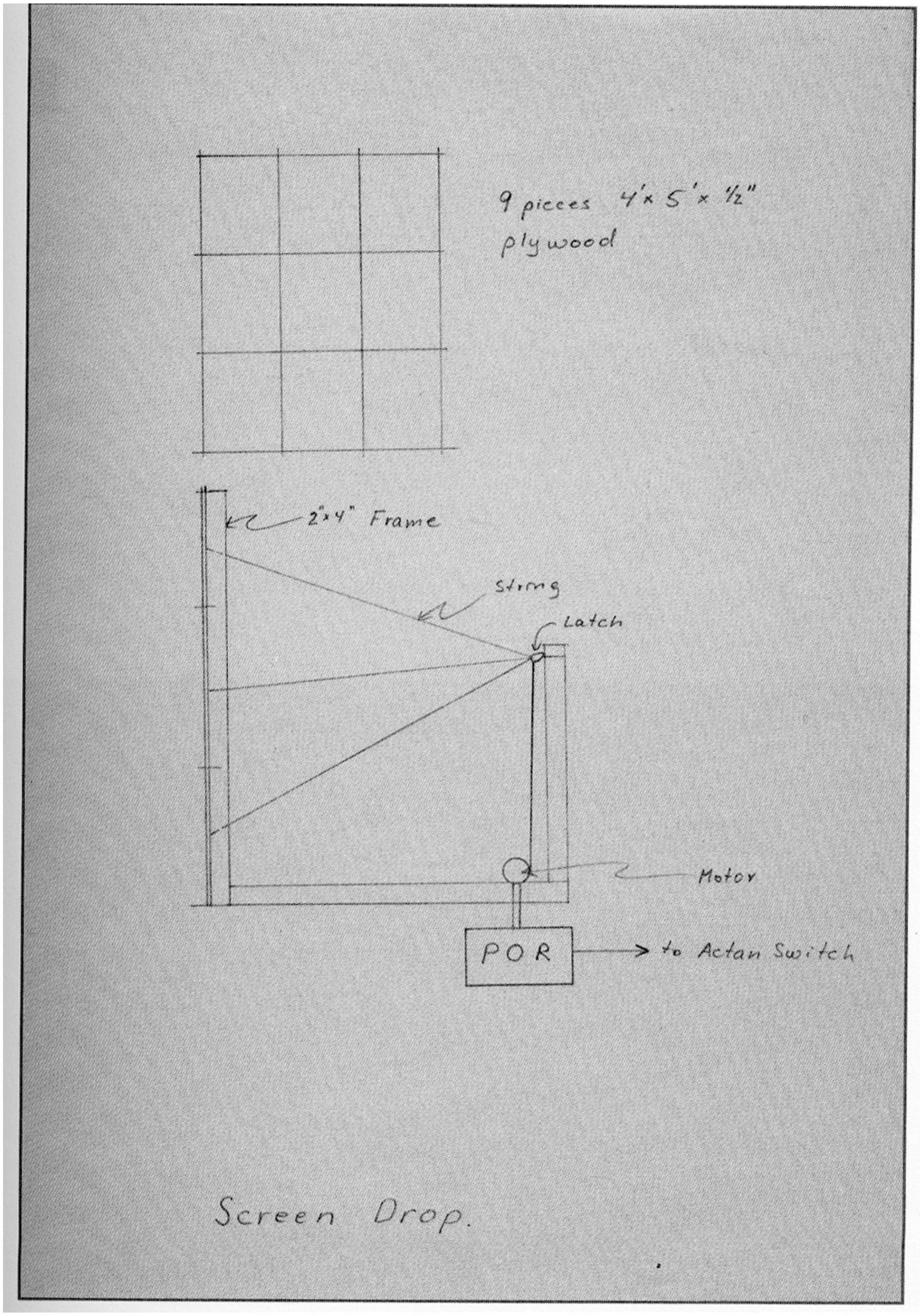
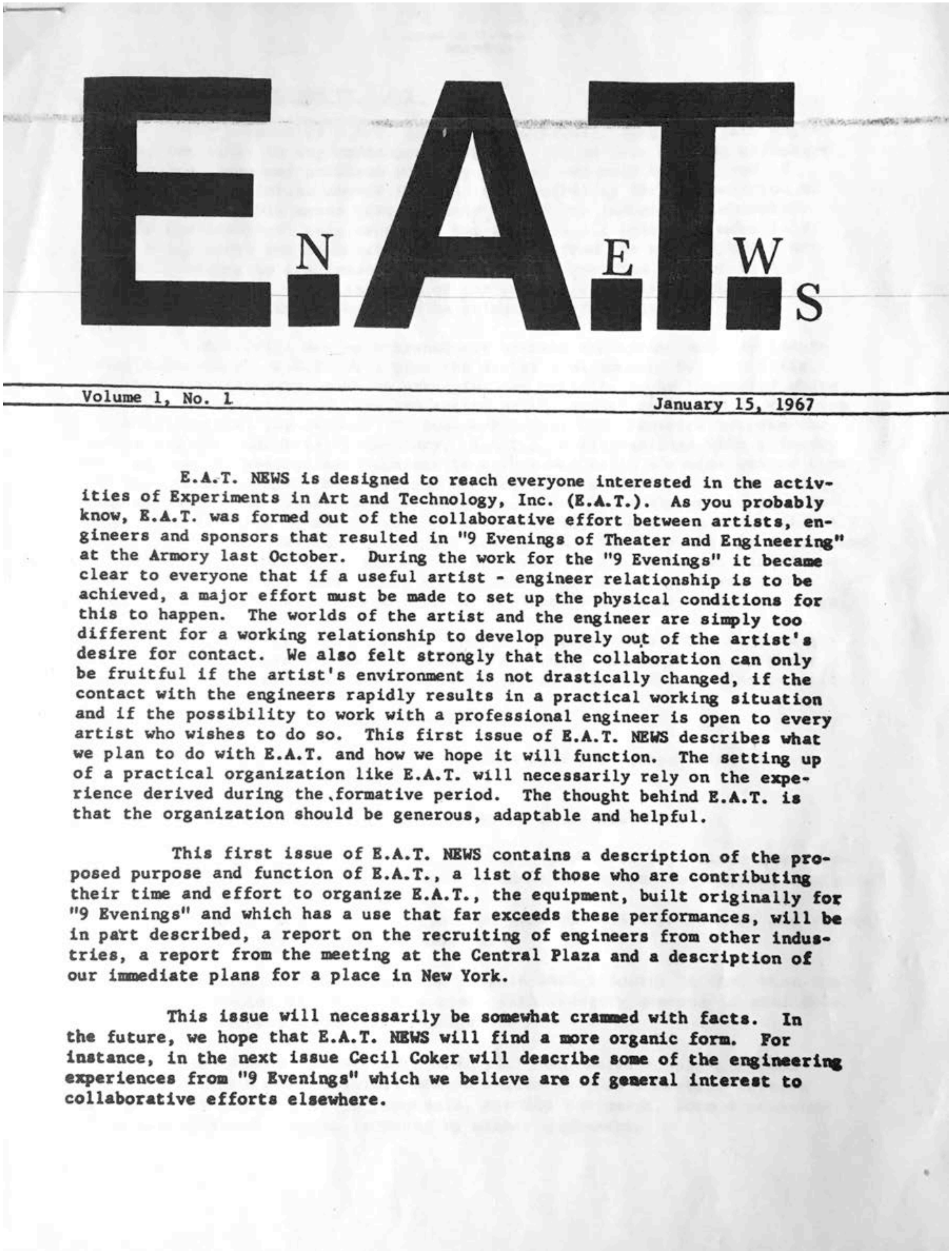


Figure 2.35.
Per Biorn, diagram for *Carriage Discreteness*, 1966.
Collection of Getty Research Institute, Los Angeles.

Figure 3.1.
First E.A.T. meeting, November 30, 1966, Central Plaza Hotel, New York.
Photo: Peter Moore. E.A.T./GRI Box 187.



E.A.T. NEWS

Volume 1, No. 1 — January 15, 1967

E.A.T. NEWS is designed to reach everyone interested in the activities of Experiments in Art and Technology, Inc. (E.A.T.). As you probably know, E.A.T. was formed out of the collaborative effort between artists, engineers and sponsors that resulted in "9 Evenings of Theater and Engineering" at the Armory last October. During the work for the "9 Evenings" it became clear to everyone that if a useful artist - engineer relationship is to be achieved, a major effort must be made to set up the physical conditions for this to happen. The worlds of the artist and the engineer are simply too different for a working relationship to develop purely out of the artist's desire for contact. We also felt strongly that the collaboration can only be fruitful if the artist's environment is not drastically changed, if the contact with the engineers rapidly results in a practical working situation and if the possibility to work with a professional engineer is open to every artist who wishes to do so. This first issue of E.A.T. NEWS describes what we plan to do with E.A.T. and how we hope it will function. The setting up of a practical organization like E.A.T. will necessarily rely on the experience derived during the formative period. The thought behind E.A.T. is that the organization should be generous, adaptable and helpful.

This first issue of E.A.T. NEWS contains a description of the proposed purpose and function of E.A.T., a list of those who are contributing their time and effort to organize E.A.T., the equipment, built originally for "9 Evenings" and which has a use that far exceeds these performances, will be in part described, a report on the recruiting of engineers from other industries, a report from the meeting at the Central Plaza and a description of our immediate plans for a place in New York.

This issue will necessarily be somewhat crammed with facts. In the future, we hope that E.A.T. NEWS will find a more organic form. For instance, in the next issue Cecil Coker will describe some of the engineering experiences from "9 Evenings" which we believe are of general interest to collaborative efforts elsewhere.

Figure 3.2.
E.A.T. News 1, no. 1 (January 15, 1967).

PROGRAM

Industry

Obtain active involvement and support from industrial leadership, management of research and development laboratories and labor organizations.

Seek industry's full sponsorship of projects in terms of materials engineering time and facilities.

Present technically realizable projects and areas of exploration to industry.

Work for the involvement of the employees of industry in the products of the artist-engineer collaboration.

Engineers

In the technical community, establish a positive awareness of the artists' role in contemporary society.

Work for the professional recognition within the technical and art communities of the contribution of the engineer in the artist-engineer collaboration.

Artists

Assume the responsibility of bringing the artist into an effective, rapid and permanent contact with technical processes and the engineers who are responsible.

Maintain the artists' freedom in determining the character and esthetics of his work within physical limitations.

BOARD OF DIRECTORS

Officers

Mr. John G. Powers, Chairman of the Board
Mr. Theodore W. Kheel, Chairman of Executive Committee
Dr. J. Wilhelm Klüver, President
Mr. Robert Rauschenberg, Vice President
Mr. Fred D. Waldhauer, Secretary
Mr. Robert Whitman, Treasurer

Figure 3.3.
E.A.T. Board of Directors, Officers.
Reprinted from *E.A.T. News* 1, no. 3 (November 1, 1967).

Directors

Mr. Walter H. Allner, Art Director of Fortune Magazine
Mr. Richard Bellamy, Gallery Director
Mr. Rubin Gorewitz, Certified Public Accountant
Mrs. Jacob K. Javits
Mr. Herman D. Kenin, President, American Federation of Musicians
Professor Gyorgy Kepes, Professor of Visual Design,
Massachusetts Institute of Technology
Mr. Edwin S. Langsam, Film Project Supervision,
American Telephone & Telegraph Company
Mr. Paul A. Lepercq, President, Lepercq deNeuflize & Company, Inc.
Dr. Max V. Mathews, Director of the Behavioral Research
Laboratory, Bell Telephone Laboratories, Incorporated
Mr. Jerald Ordover, Attorney
Mr. Seymour Schweber, President, Schweber Electronics
Mrs. Simone Swan, Public Relations Consultant
Mrs. Marie-Christophe Thurman

AGENTS

A Council of Agents, will, according to their authority and sympathy, use their influence in behalf of E.A.T. These individuals will be selected from industry, labor, politics, the technical community and the arts.

The Agents will assist E.A.T. with issues and problems of a special nature and will be contacted as individuals.

Mr. Robert O. Anderson, Chairman of the Board,
Atlantic Richfield Corporation
Mr. Alfred H. Barr, Former Director of Museum Collections,
Museum of Modern Art, New York
Mr. John Cage, Composer
Mr. Jacob K. Javits, U. S. Senator
Mr. Philip C. Johnson, Architect
Dr. Gyorgy Kepes, Professor of Visual Design,
Massachusetts Institute of Technology
Mr. Lane Kirkland, Executive Assistant to the President, AFL-CIO
Mr. Jack Masey, USIA
Dr. John R. Pierce, Executive Director. Research, Communication
Sciences Division, Bell Telephone Laboratories, Inc.
Mr. Walter W. Straley, Vice President, Public Relations,
American Telephone & Telegraph Company
Mr. Harry Van Arsdale, Jr., President, Central Labor Council

Figure 3.4.
E.A.T. Board of Directors, Directors; and Council of Agents.
Reprinted from *E.A.T. News* 1, no. 3 (November 1, 1967).

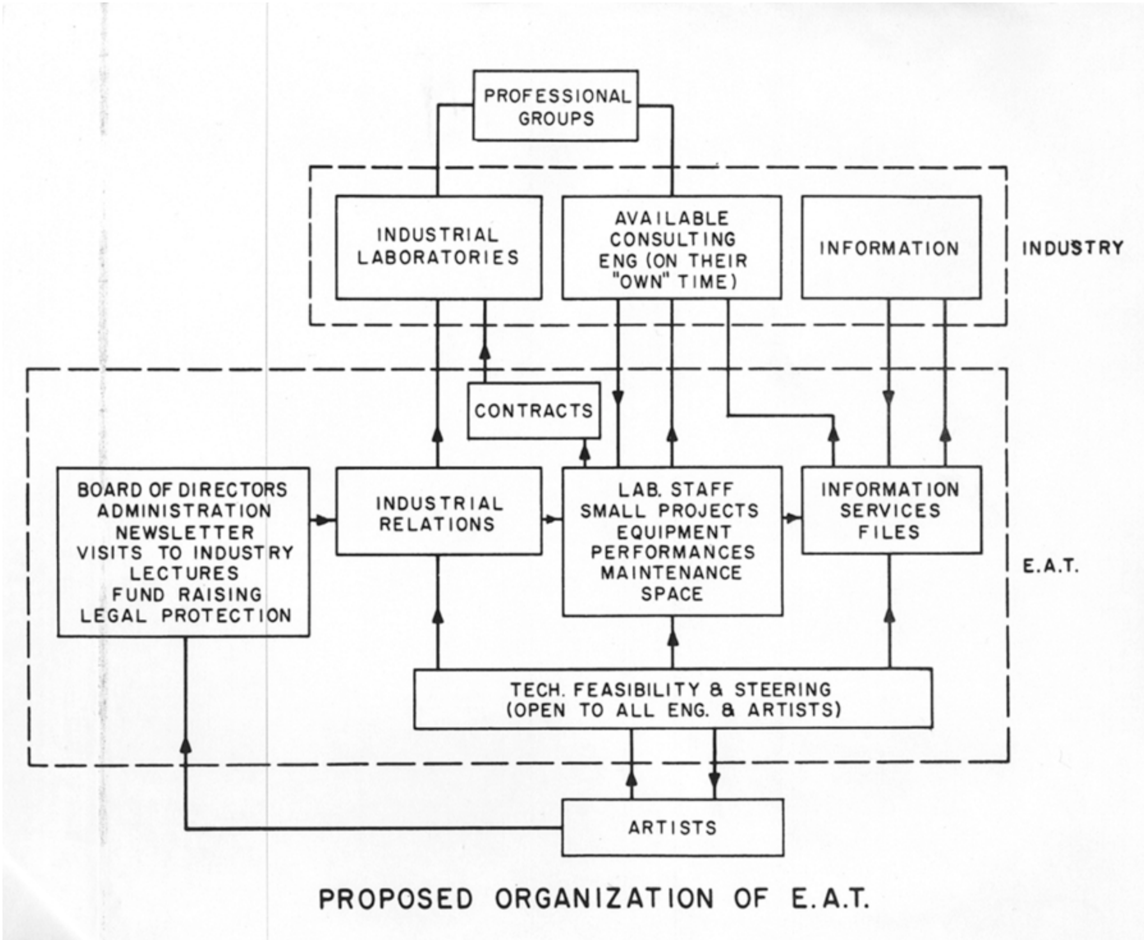


Figure 3.5.
"Proposed Organization of E.A.T.," December 1966.
Reprinted from *E.A.T. News* 1, vol. 1 (January 15, 1967).

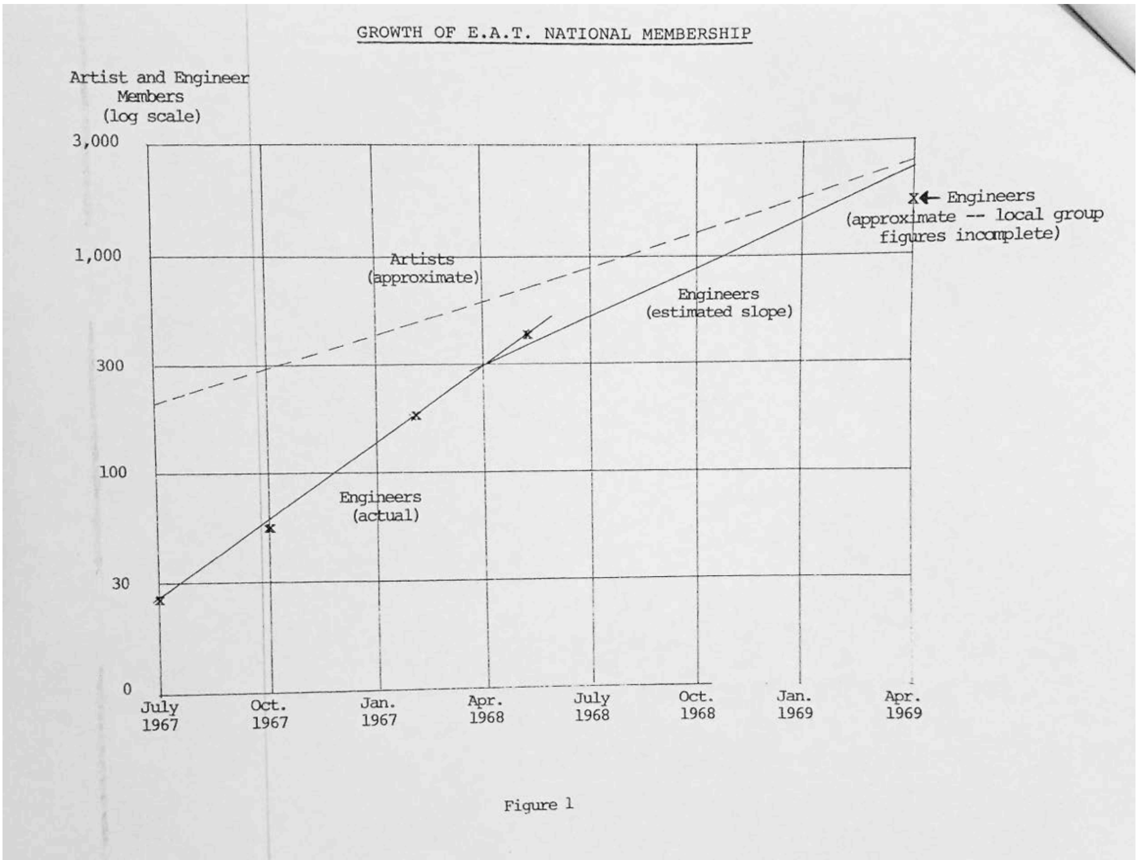
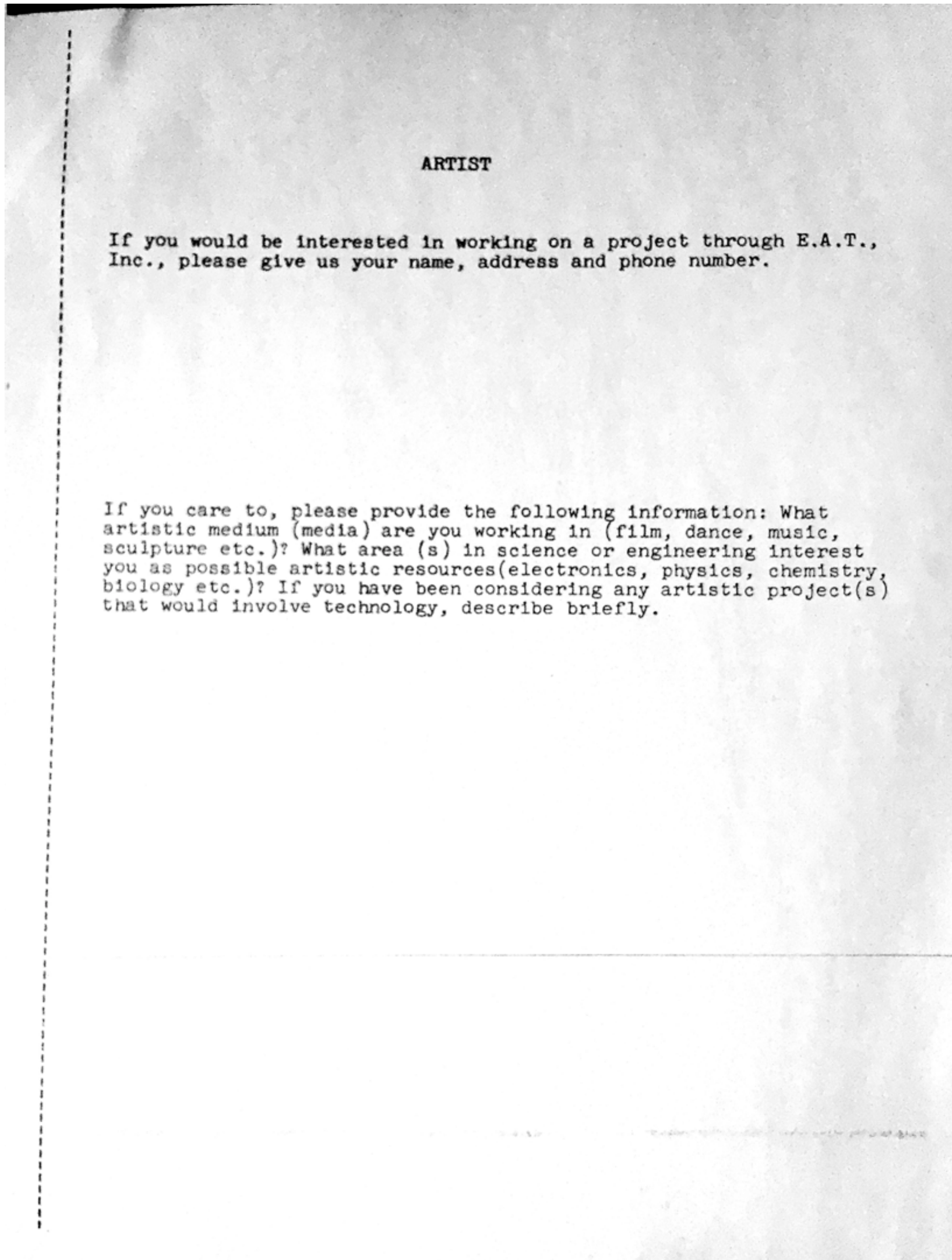


Figure 3.6.
"Growth of E.A.T. National Membership," 1969, reprinted from E.A.T., "Ford Proposal—Version 2: Complete copies—May 19, 1969," Appendix I.
E.A.T./GRI Box 42, Folder 15.

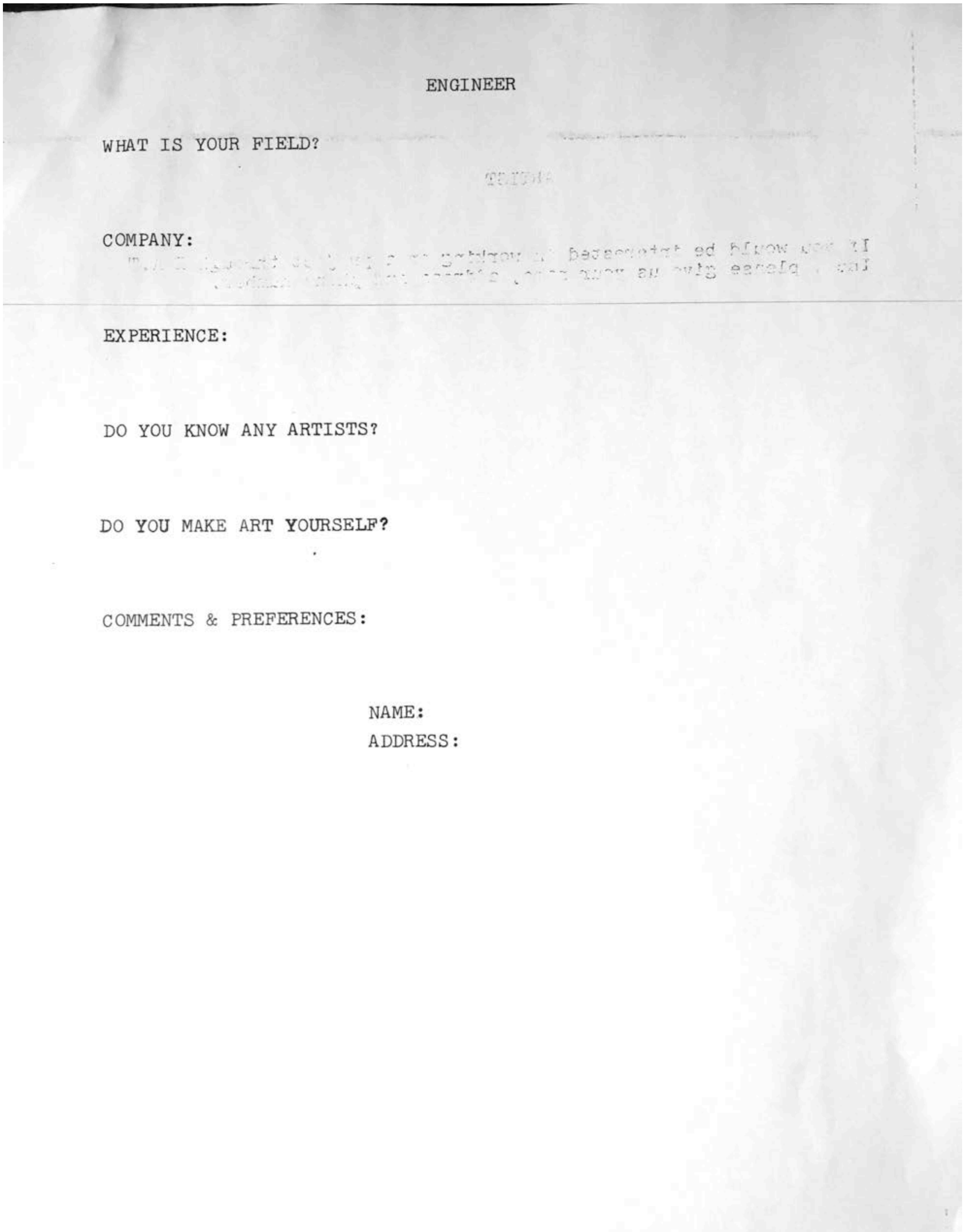


ARTIST

If you would be interested in working on a project through E.A.T., Inc., please give us your name, address and phone number.

If you care to, please provide the following information: What artistic medium (media) are you working in (film, dance, music, sculpture etc.)? What area (s) in science or engineering interest you as possible artistic resources(electronics, physics, chemistry, biology etc.)? If you have been considering any artistic project(s) that would involve technology, describe briefly.

Figure 3.7.
E.A.T. artist membership form, reprinted from *E.A.T. News* 1, no. 2 (June 1, 1967).



ENGINEER

WHAT IS YOUR FIELD?

COMPANY:

EXPERIENCE:

DO YOU KNOW ANY ARTISTS?

DO YOU MAKE ART YOURSELF?

COMMENTS & PREFERENCES:

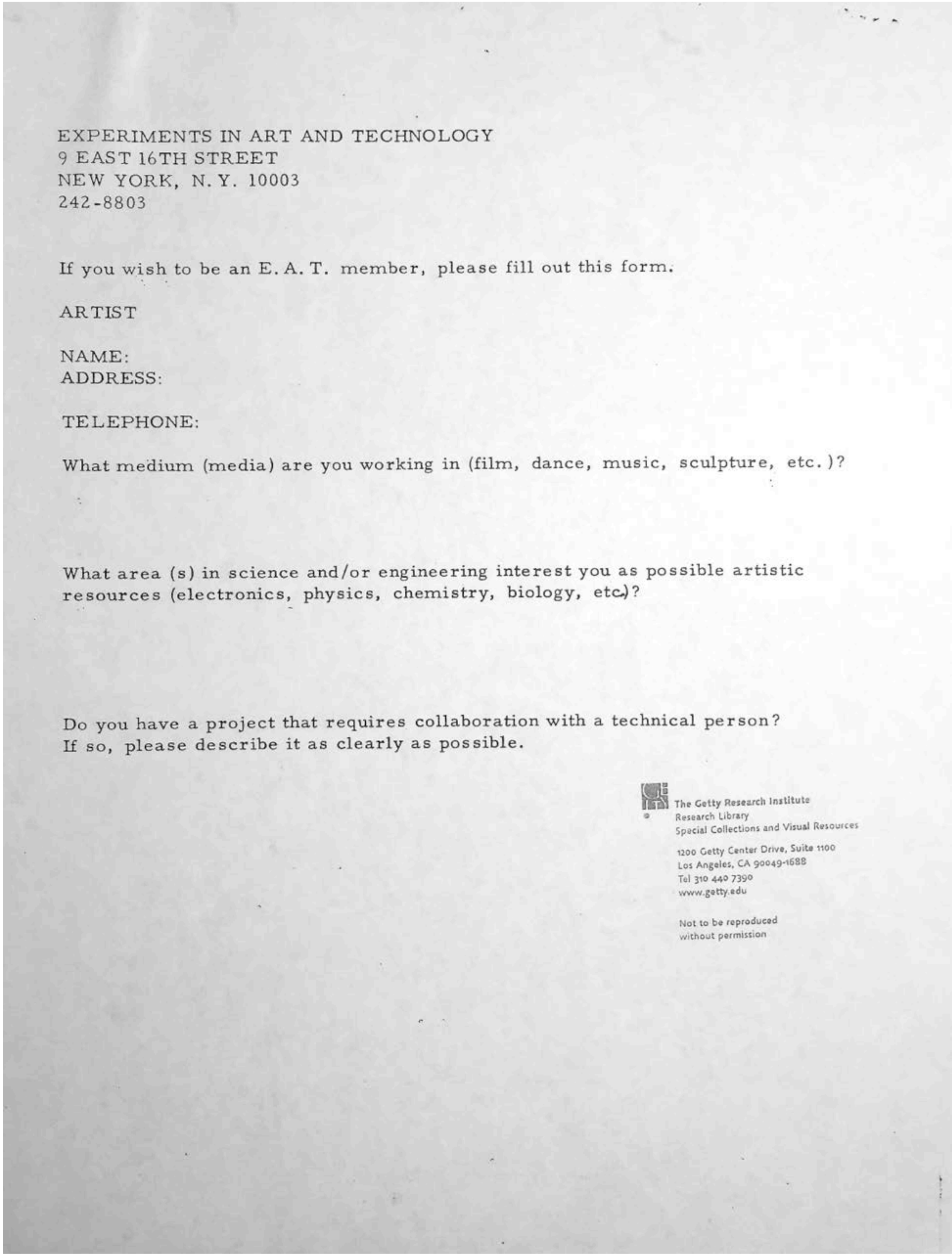
NAME:
ADDRESS:

Figure 3.8.
E.A.T. engineer membership form, reprinted from *E.A.T. News* 1, no. 2 (June 1, 1967).

Figure 3.9.
First E.A.T. press conference, Robert Rauschenberg's studio, New York, October 10, 1967. Photo: Peter Moore. At podium: John Pierce of Bell Laboratories. E.A.T./GRI Box 187.

Figure 3.10.
First E.A.T. press conference, Robert Rauschenberg’s studio, New York, October 10, 1967. Robert Rauschenberg.
Photo: Richard Knapp. E.A.T./GRI Box 187.

Figure 3.11.
First E.A.T. press conference, Robert Rauschenberg's studio, New York, October 10, 1967. At podium, Ralph Gross, President, Commerce and Industry Association of New York. Photo: Peter Moore. E.A.T./GRI Box 187.



EXPERIMENTS IN ART AND TECHNOLOGY
9 EAST 16TH STREET
NEW YORK, N. Y. 10003
242-8803

If you wish to be an E. A. T. member, please fill out this form.

ARTIST

NAME:
ADDRESS:

TELEPHONE:

What medium (media) are you working in (film, dance, music, sculpture, etc.)?

What area (s) in science and/or engineering interest you as possible artistic resources (electronics, physics, chemistry, biology, etc.)?

Do you have a project that requires collaboration with a technical person? If so, please describe it as clearly as possible.

Figure 3.12.
E.A.T. artist membership form, 1967. E.A.T./GRI Box 8, Folder 7.

EXPERIMENTS IN ART AND TECHNOLOGY
9 EAST 16TH STREET
NEW YORK, N.Y. 10003
242-8803

If you wish to be an E.A.T. member, please fill out this form.

ENGINEER/SCIENTIST

NAME: Laurence Silverstein

ADDRESS: 84-41 171 Street, Jamaica, New York, 11432

TELEPHONE: 212-AX-7-4237

WHAT IS YOUR FIELD? Electrophysics and electrical engineering. This includes laser and laser-related technology, holography, and various aspects of optics and solid-state physics, and microwave engineering.

COMPANY: Polytechnic Institute of Brooklyn, Long Island Graduate Center
Route 110, Farmingdale, N.Y. 11735
Department of Electrophysics (Senior Research Fellow)

EXPERIENCE:

My work has been primarily on various aspects of optical physics, including theoretical and experimental studies in the laser field. I have been involved in the construction of various kinds of gas lasers, and in the production of holograms.

COMMENTS AND INTERESTS:

I was strongly impressed by the ideas motivating E.A.T. as they were explained to me by people at the IEEE Show booth, and after reading the March issue of E.A.T. News. I think that E.A.T. has a tremendous potential for bridging the gap between the arts and the sciences, and, even more important, between art-and-science and the layman. Obviously, contemporary art and science can help one another explain themselves to the lay public. However, to increase your effectiveness, and the dissemination of information about E.A.T. and its goals, I would suggest the following:

(1) Increased advertising in certain selected scientific and engineering oriented technical publications and trade journals.

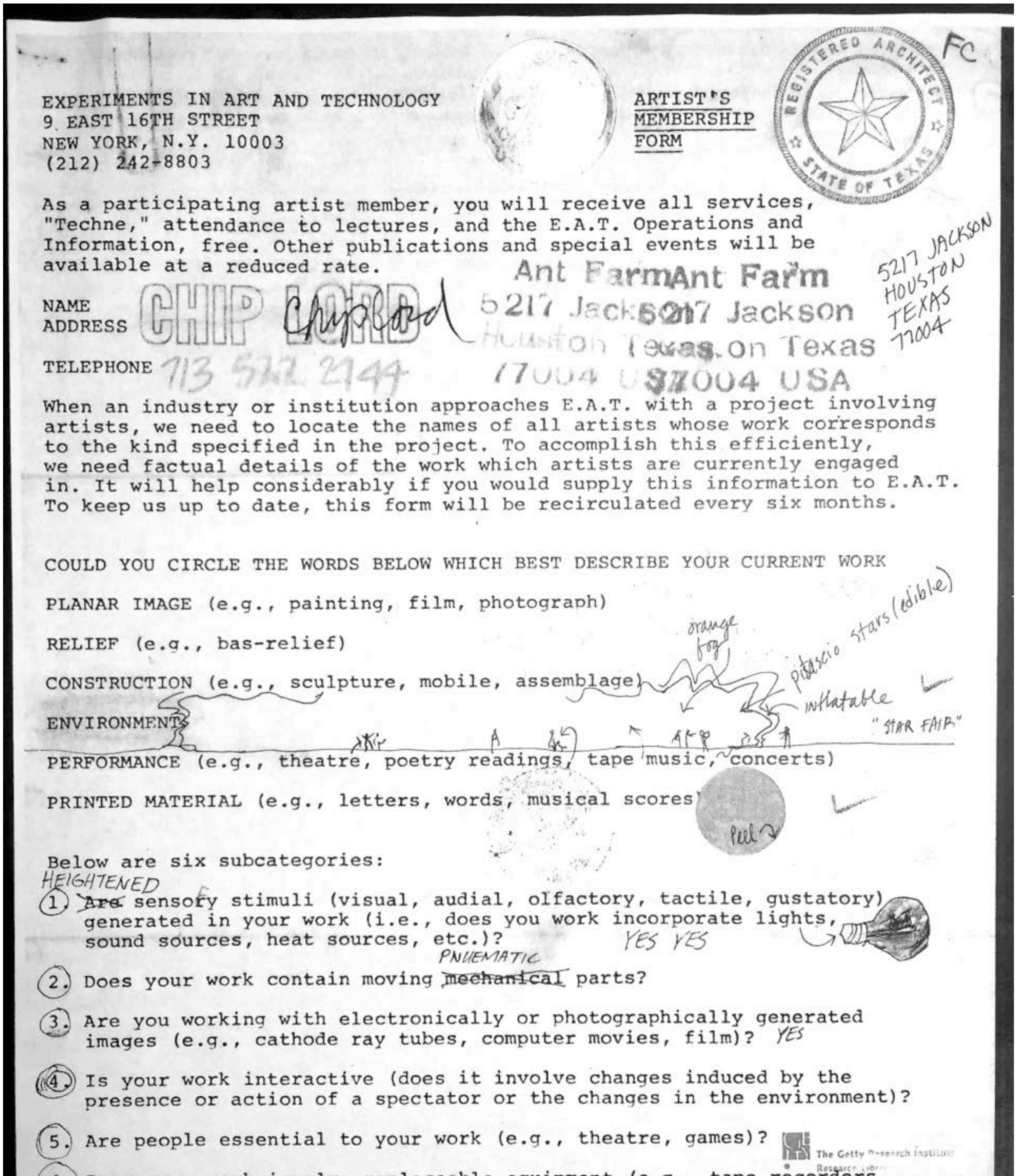
(2) E.A.T. publications, e.g. the March News, give the impression that the attitude towards the technologist is essentially that he is merely a tool or technical dictionary to be made use of and manipulated by the artist. I have heard comments to this effect when discussing E.A.T. with friends. A better approach would be to emphasize the collaborative aspects of various projects, and to attempt a greater appeal to the engineer's creative abilities.

(3) An appeal to graduate students, rather than merely to university faculty might be very fruitful. This might be done by communicating with various student organizations, and sending material to be posted on bulletin boards.

(4) Open Houses are periodically held by the engineering and science departments of many universities and technical schools, such as the Polytechnic Institute of Brooklyn. These are primarily for the benefit of prospective students, but outside groups are not turned away if their numbers are relatively limited. These open houses generally have numerous lectures and displays (presented with the intelligent layman in mind) concerning recent scientific and technical developments, and research being carried out by the university. They would provide a useful opportunity for artists to meet technologists (both faculty and graduate students) and to ask questions and keep up to date about new technology. One function of E.A.T. could be to obtain information about such open houses, and to publish it in the E.A.T. News and other places such as the Village Voice.

My own interests center about laser technology, optics, holography, optics, and related studies, as indicated above, and I would be prepared to answer technical questions and consult on projects which fall within my fields of competence.

Figure 3.13.
Laurence Silverstein, E.A.T. engineer/scientist membership form, 1967.
E.A.T./GRI Box 8, Folder 7.



EXPERIMENTS IN ART AND TECHNOLOGY
9 EAST 16TH STREET
NEW YORK, N.Y. 10003
(212) 242-8803

ARTIST'S MEMBERSHIP FORM

FC

As a participating artist member, you will receive all services, "Techne," attendance to lectures, and the E.A.T. Operations and Information, free. Other publications and special events will be available at a reduced rate.

NAME CHIP LORD Chip Lord
ADDRESS Ant Farm 5217 Jackson Houston Texas 77004 USA

5217 JACKSON HOUSTON TEXAS 77004

TELEPHONE 713 522 2144

When an industry or institution approaches E.A.T. with a project involving artists, we need to locate the names of all artists whose work corresponds to the kind specified in the project. To accomplish this efficiently, we need factual details of the work which artists are currently engaged in. It will help considerably if you would supply this information to E.A.T. To keep us up to date, this form will be recirculated every six months.

COULD YOU CIRCLE THE WORDS BELOW WHICH BEST DESCRIBE YOUR CURRENT WORK

PLANAR IMAGE (e.g., painting, film, photograph)

RELIEF (e.g., bas-relief)

CONSTRUCTION (e.g., sculpture, mobile, assemblage)

ENVIRONMENT

orange fog

pistascio stars (edible)

inflatable

"STAR FAIR"

PERFORMANCE (e.g., theatre, poetry readings, tape music, concerts)

PRINTED MATERIAL (e.g., letters, words, musical scores)

peel

Below are six subcategories:

1. ~~Are~~ HEIGHTENED sensory stimuli (visual, audial, olfactory, tactile, gustatory) generated in your work (i.e., does you work incorporate lights, sound sources, heat sources, etc.)? YES YES

2. Does your work contain moving ~~mechanical~~ PNUEMATIC parts?

3. Are you working with electronically or photographically generated images (e.g., cathode ray tubes, computer movies, film)? YES

4. Is your work interactive (does it involve changes induced by the presence or action of a spectator or the changes in the environment)?

5. Are people essential to your work (e.g., theatre, games)?

6. Does your work involve replaceable equipment (e.g., tape recorders, musical instruments, projectors, TV sets)?

of my 'WORKS' →

Union Celery Gardens
Island Grove, Fla

Figure 3.14.
Chip Lord, E.A.T. artist membership form, 1969. E.A.T./GRI Box 9, Folder 12.

6

EXPERIMENTS IN ART AND TECHNOLOGY
9 EAST 16TH STREET
NEW YORK, N.Y. 10003
(212) 242-8803

ARTIST'S MEMBERSHIP FORM

As a participating artist member, you will receive all services, "Techne," attendance to lectures, and the E.A.T. Operations and Information, free. Other publications and special events will be available at a reduced rate.

NAME RON BRODIGAN
ADDRESS 1414 HENNEPIN AVE. SO. Minneapolis Minn. 55403

TELEPHONE NONE

When an industry or institution approaches E.A.T. with a project involving artists, we need to locate the names of all artists whose work corresponds to the kind specified in the project. To accomplish this efficiently, we need factual details of the work which artists are currently engaged in. It will help considerably if you would supply this information to E.A.T. To keep us up to date, this form will be recirculated every six months.

COULD YOU CIRCLE THE WORDS BELOW WHICH BEST DESCRIBE YOUR CURRENT WORK

PLANAR IMAGE (e.g., painting, film, photograph)

RELIEF (e.g., bas-relief)

CONSTRUCTION (e.g., sculpture, mobile, assemblage)

ENVIRONMENT

PERFORMANCE (e.g., theatre, poetry readings, tape music, concerts)

PRINTED MATERIAL (e.g., letters, words, musical scores)

Below are six subcategories:

1. Are sensory stimuli (visual, audial, olfactory, tactile, gustatory) generated in your work (i.e., does you work incorporate lights, sound sources, heat sources, etc.)? no
2. Does your work contain moving mechanical parts? no
3. Are you working with electronically or photographically generated images (e.g., cathode ray tubes, computer movies, film)? no
4. Is your work interactive (does it involve changes induced by the presence or action of a spectator or the changes in the environment)? no
5. Are people essential to your work (e.g., theatre, games)? no
6. Does your work involve replaceable equipment (e.g., tape recorders, musical instruments, projectors, TV sets)? no

Figure 3.15.
Ron Brodigan, E.A.T. artist membership form, 1969 (p. 1).
E.A.T./GRI Box 7, Folder 6.

-7-

THE FOLLOWING INFORMATION WILL ASSIST US IN ARTIST PLACEMENT AND RESIDENCE

Would you be prepared to be an "artist in residence" in an industrial situation? ...... If so, for what maximum period? yes, any period of time.

If an opportunity arose to work in an industrial situation, would you be prepared to travel? .yes.. **How far?** anywhere.

Do you wish to work with a computer? ...... Would you be prepared to reside at a computer center if the opportunity arose? yes.

Do you need to operate in an industrial situation to execute your work? yes ...... Do you anticipate this possibility? yes

Would you collaborate with other artists on a specific project? yes.

Would you collaborate with people from other fields--for example: labor, industry, engineering, local government--on large-scale projects demanding contributions from a variety of talents? definitely.

Would you participate in projects, instigated and sponsored by industries and institutions, where the presentations are of a documentary nature and the objectives fairly tightly specified; for example, demonstrations of materials or processes in an exhibition/fair situation? yes

Have you ever collaborated with a technical person? yes

Regarding the distinctions made between collaboration, technical assistance, and technical information, which, if any, do you prefer?
technical assistance

ADDITIONAL INFORMATION (INCLUDING PHOTOGRAPH OR WRITTEN MATERIAL IF YOU LIKE)

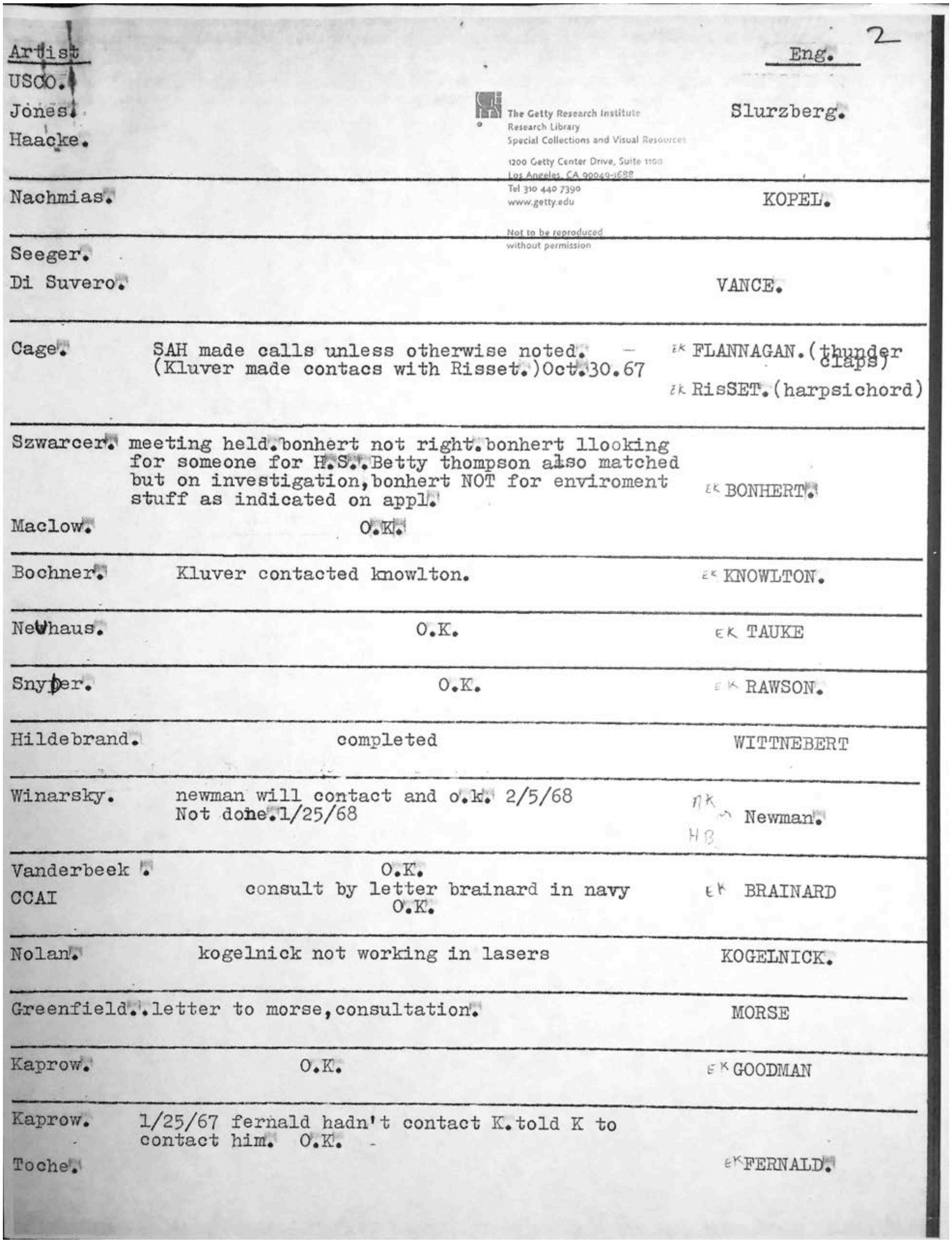
I am very much interested in an artist-in-residence position in a school or industry.

Figure 3.16.
Ron Brodigan, E.A.T. artist membership form, 1969 (p. 2).
E.A.T./GRI Box 7, Folder 6.

Matches By Letter To Both Parties

Artists	Eng.
Beck. first boxes. has interesting questions. Fry Billick. Isolanai. excellent coll. Fry. Gilberston. after beginning no contact from her. Fry Lobb.	FRY & Friends
Citron. Jacobs. Haack.	RANGANATH
Werner. Green-Pepper Wells	DAVID ISRAEL
Wisniewski. Harper. Summers.	KRONFELD
USCO. Slamm. Szwarcer.	SHAPIRO
USCO. Rahmani. Toche.	CORWIN.
Rubin. Kolin. Yalkut.	FRETZ.
Monk. C. Brown.	Scott.
Stromsten.	WoLFF.
Reilly. Antin.	SHEAR.
Antin.	KRAFT.

Figure 3.17.
E.A.T., "Matches by letter to both parties," 1968. E.A.T./GRI Box 9, Folder 3.



Artist		Eng.
USCO. Jones. Haacke.		Slurzberg.
Nachmias.		KOPEL.
Seeger. Di Suvero.		VANCE.
Cage.	SAH made calls unless otherwise noted. (Kluver made contacs with Risset.)Oct.30.67	EK FLANNAGAN.(thunder claps) EK RisSET.(harpsichord)
Szwarcer.	meeting held.bonhert not right.bonhert llooking for someone for H.S..Betty thompson also matched but on investigation,bonhert NOT for enviroment stuff as indicated on appl.	EK BONHERT.
Maclow.	O.K.	
Bochner.	Kluver contacted knowlton.	EK KNOWLTON.
Newhaus.	O.K.	EK TAUKE
Snyder.	O.K.	EK RAWSON.
Hildebrand.	completed	WITTNEBERT
Winarsky.	newman will contact and o.k. 2/5/68 Not done.1/25/68	NK HB Newman.
Vanderbeek. CCAI	O.K. consult by letter brainard in navy O.K.	EK BRAINARD
Nolan.	kogelnick not working in lasers	KOGELNICK.
Greenfield..	letter to morse, consultation.	MORSE
Kaprow.	O.K.	EK GOODMAN
Kaprow. Toche.	1/25/67 fernald hadn't contact K.told K to contact him. O.K.	EK FERNALD.

Figure 3.18.
E.A.T., “Matches by letter to both parties,” 1968. E.A.T./GRI Box 9, Folder 3.

4

Artists	ENG.
Erikson.(1074-8825)	FLEISCHNER
S.Bandit.(Carmalt) S.Berkley.	A.HART.
Neil Chas	M.AARON
D'Arcangelo.	VAN VECHTEN
A.Douglas.	P.POLLACK
Corner.	C.LEE
C.F. Beck.	MYER.
Greene-Pepper S.Gross.(call.does she have project?)	LEEMAN.
Lye. talked to Len,Winter possibility,will send me a list of problems.	G.WINTER.
Mallory	WERNT HARTZ
Ringelheim.BK wrote instructions for ringelheim to do own.	
Wirtschaften. must tighten up first.	
Kirschenbaum if Van Vechten isn't good try Stevens.	VAN VECHTEN STEVENS
Kragen. Haney in France.	HANEY.
Sansegundo. OK 2/14	FRY
Laing. laing found guy on own.will let me know if problem.	WINTER (find student)

Figure 3.19.
E.A.T., "Matches by letter to both parties," 1968. E.A.T./GRI Box 9, Folder 3.

Feb 6. 69

EXPERIMENTS IN ART AND TECHNOLOGY
9 EAST 16TH STREET
NEW YORK, N.Y. 10003
(212) 242-8803

SCIENTIST
ENGINEER
MEMBERSHIP
FORM

FC

Completing this form registers you as a participating or associate member of E.A.T. Associate members are those who do not wish to participate, but wish to be kept informed of E.A.T. activities.

As a participating engineer/scientist member, you will receive "Techne," E.A.T. Operations and Information, all services, and attendance to lectures free. Other publications and special events will be available at a reduced rate or free.

Scientists and engineers may participate in one or more of three ways: by collaborating with artists on a project, by giving technical assistance in executing a preconceived design, by giving technical information to artists. If you wish to become a participating member, could you indicate which you prefer by circling one or more of the categories below and by providing the information requested on the other side of this form.

NAME: ROBERT MOOG

ADDRESS: R.D. #3 TRUMANSBURG, N.Y.

TELEPHONE: 607-387-6101

COMPANY: R.A. MOOG, INC

I WISH TO BECOME A PARTICIPATING/~~ASSOCIATE~~ MEMBER. (delete one)

AS A PARTICIPATING MEMBER, I AM PREPARED TO: (please circle one or more)

COLLABORATE WITH ARTISTS

GIVE TECHNICAL ASSISTANCE

GIVE TECHNICAL INFORMATION

Figure 3.20.
Robert Moog, scientist/engineer membership form (p. 1), February 9, 1969.
E.A.T./GRI Box 8, Folder 14.

Below is a list of technical fields and terms which frequently appear in artists' descriptions of their projects. Could you circle those in which you feel qualified to help artists and add further information when necessary.

electrical engineering
mechanical engineering
chemical engineering
civil engineering
industrial engineering
structural engineering
bio-engineering/medicine
aeronautics/aerospace
geology
meteorology
oceanography
biology
psychology
sociology
mathematics
chemistry
physics
hydraulics
fluidics
pneumatics

computers
cybernetics/control theory
information systems
programming
computers: graphics/film
computers: sound/music
computers: language/poetry

metallurgy/metals
brazing/welding/casting/grinding
ceramics
glass
crystallography
liquid crystals
adhesives
fiberglass
plastics/polymers
acrylics
foam
elastomers
honeycombs
paper
paint
dyes
fluorescence
fabrics/textiles

optics
spectroscopy
light
light equipment/projection
lasers
strobes
holography
radar
X-rays
electro-luminescence
neon
ultraviolet
fiber optics

acoustics
sound generation
sonar
ultrasonics
audio systems
audio-visual conversions

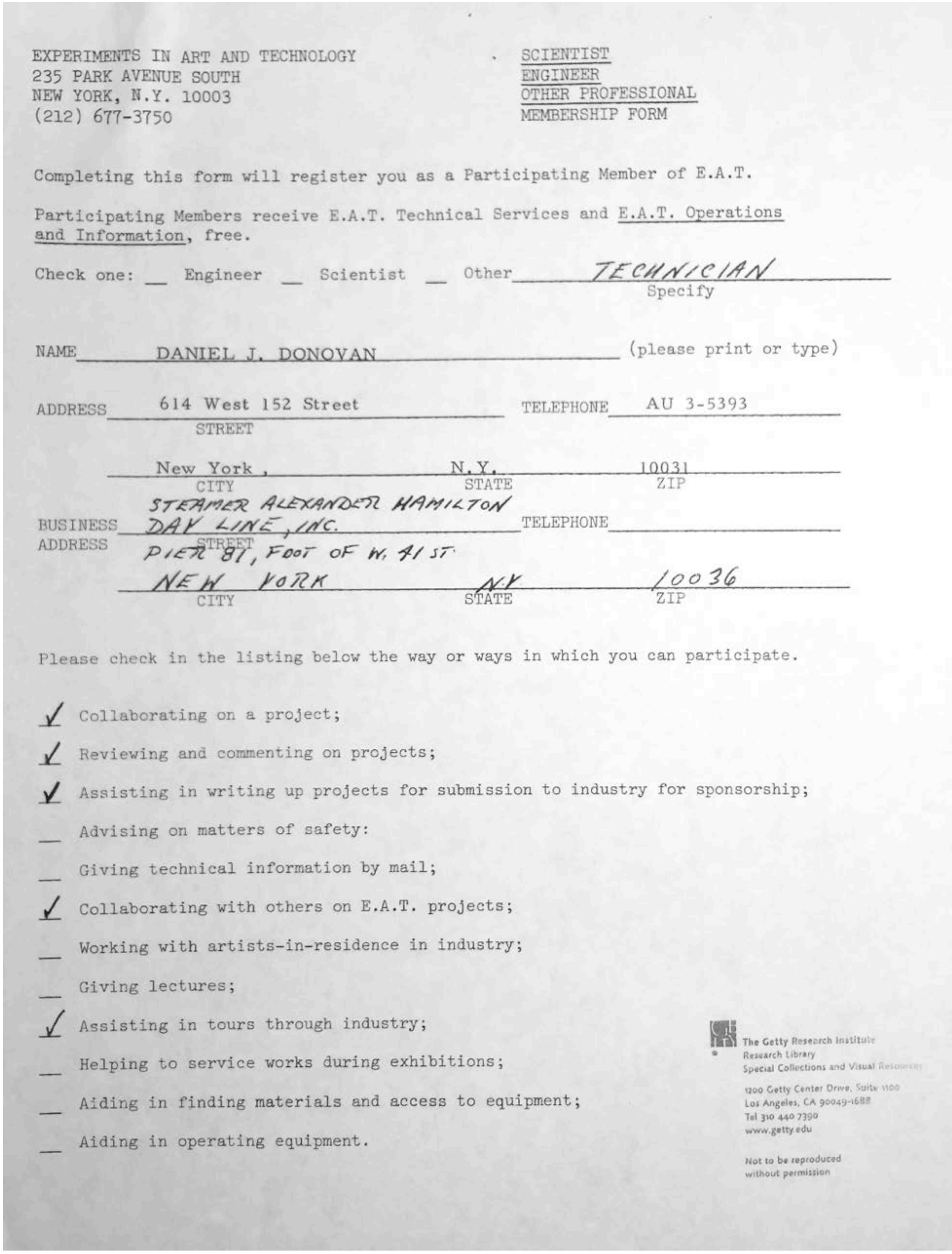
communications
television
cathode rays
video tape
tape recording
film technology
photography

digital systems
instrumentation and control systems
remote control
motors
circuit design
integrated circuits
transistors
microwaves

environmental simulation

architecture
industrial design
scientific journalist/editor

Figure 3.21.
Robert Moog, scientist/engineer membership form (p. 2), February 9, 1969.
E.A.T./GRI Box 8, Folder 14.



EXPERIMENTS IN ART AND TECHNOLOGY
235 PARK AVENUE SOUTH
NEW YORK, N.Y. 10003
(212) 677-3750

SCIENTIST
ENGINEER
OTHER PROFESSIONAL
MEMBERSHIP FORM

Completing this form will register you as a Participating Member of E.A.T.

Participating Members receive E.A.T. Technical Services and E.A.T. Operations and Information, free.

Check one: __ Engineer __ Scientist __ Other TECHNICIAN (Specify)

NAME DANIEL J. DONOVAN (please print or type)

ADDRESS 614 West 152 Street (STREET) TELEPHONE AU 3-5393

New York, (CITY) N.Y. (STATE) 10031 (ZIP)

BUSINESS ADDRESS STEAMER ALEXANDER HAMILTON
DAY LINE, INC. (STREET) TELEPHONE
PIER 81, FOOT OF W. 41 ST
NEW YORK (CITY) N.Y (STATE) 10036 (ZIP)

Please check in the listing below the way or ways in which you can participate.

✓ Collaborating on a project;

✓ Reviewing and commenting on projects;

✓ Assisting in writing up projects for submission to industry for sponsorship;

__ Advising on matters of safety:

__ Giving technical information by mail;

✓ Collaborating with others on E.A.T. projects;

__ Working with artists-in-residence in industry;

__ Giving lectures;

✓ Assisting in tours through industry;

__ Helping to service works during exhibitions;

__ Aiding in finding materials and access to equipment;

__ Aiding in operating equipment.

Figure 3.22.
Daniel J. Donovan, E.A.T. engineer membership form, 1969 (p. 1).
E.A.T./GRI Box 8, Folder 17.

Below is a list of technical fields and terms which frequently appear in artist's descriptions of their projects. Could you circle those in which you feel qualified to help artists and add further information when necessary.

electrical engineering
mechanical engineering
chemical engineering
civil/structural/indust. engineering
pneumatics/fluids
hydraulics
aeronautics/aviation/aerospace
submarine engineering
transport engineering
bio-engineering/medicine
physics
chemistry
mathematics
geology/meteorology/oceanography
biology/zoology/ecology
sociology/psychology
architecture
urban planning
scientific journalist/editor
industrial design

optics
spectroscopy
color theory
mirrors
light
light equipment/projection
lasers
strobes
holography
x-rays
neon
electro-luminescence
ultra-violet
fiber optics
phosphorescence/fluorescence

television
video tape
electronic video recording
film technology
radio
tape recording
photography
printing
image systems general

acoustics
sound generation
sonar
ultrasonics
audio systems
audio-visual conversion

plastics, general
plastics forming techniques
foams
elastomers
adhesives
fiberglass
honeycomb materials
paper
paints/dyes
metals
brazing/welding/casting/grinding
ceramics/glass
liquid crystals
fabrics/textiles

cybernetics/information theory
computer programming, general
computers: graphics/film
computers: language/poetry
computers: sound/music
computers: systems simulation

PLEASE ADD EXTRA INFORMATION

Figure 3.23.
Daniel J. Donovan, E.A.T. engineer membership form, 1969 (p. 2).
E.A.T./GRI Box 8, Folder 17.

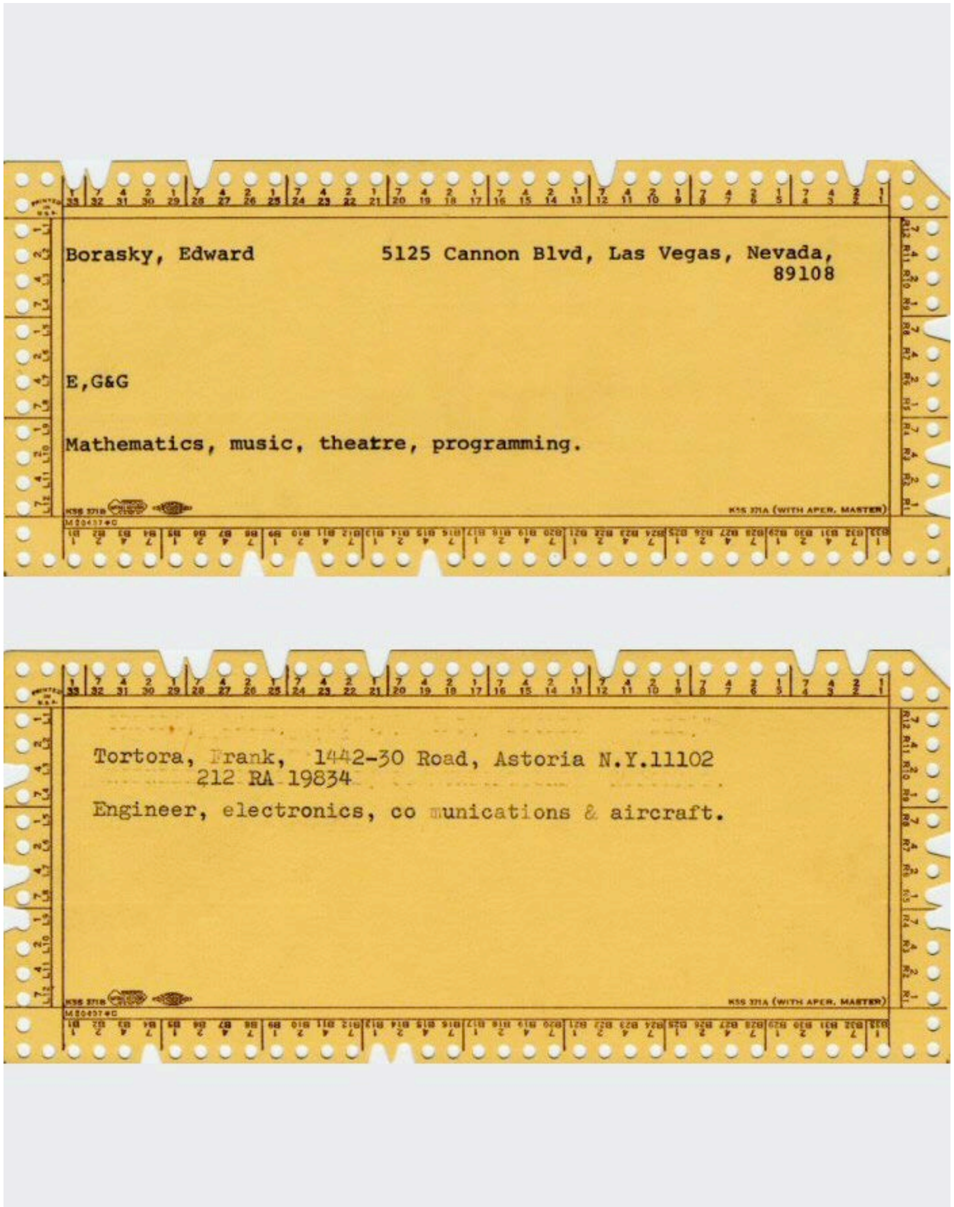
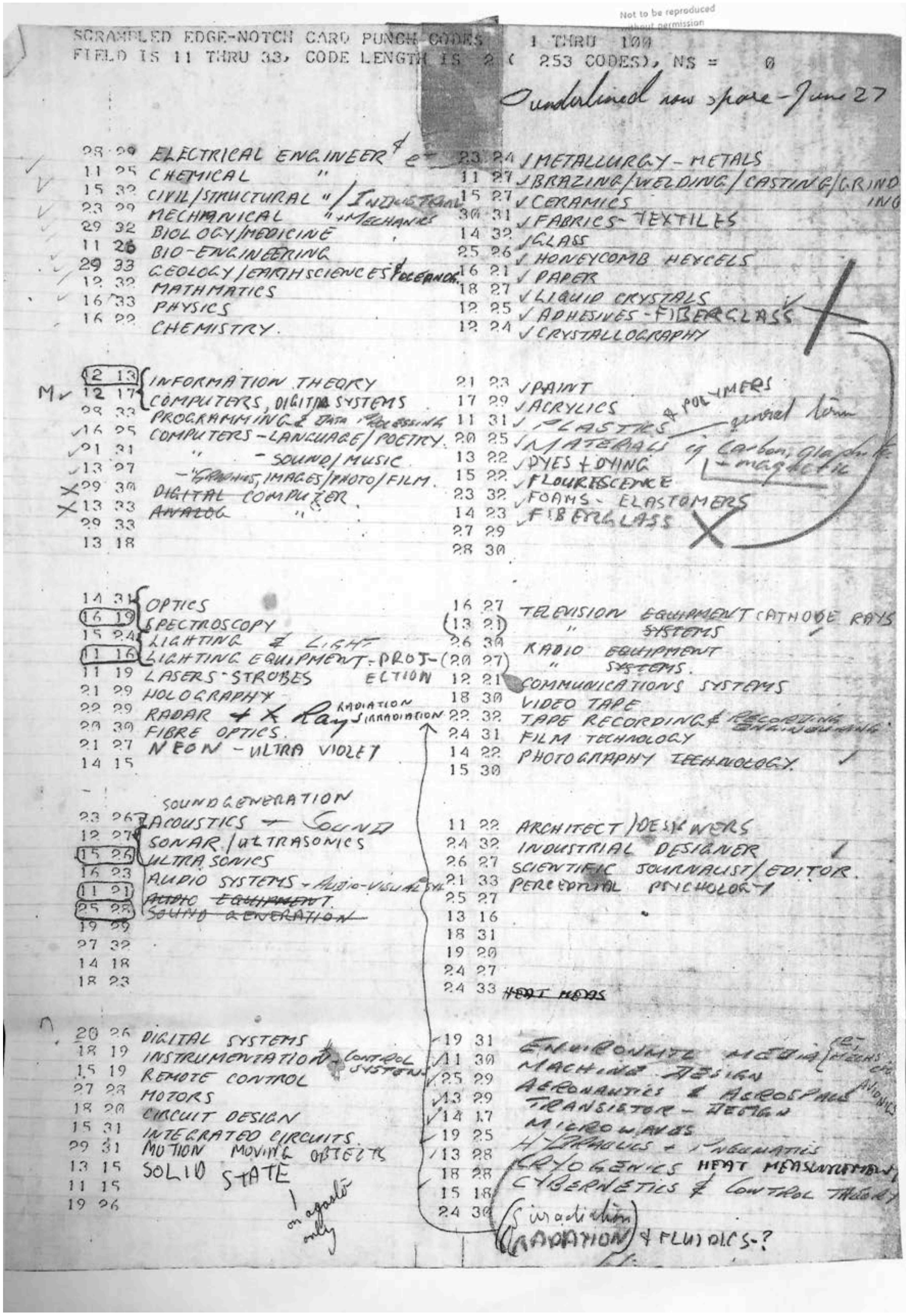


Figure 3.24.
E.A.T. Technical Services Program files, McBee Keysort cards, 1968. Each 4" x 9".
Notched edges, where holes have been punched out, are evident on all sides of the cards.
E.A.T./GRI Box 14.



SCRAMBLED EDGE-NOTCH CARD PUNCH CODES 1 THRU 100
FIELD IS 11 THRU 33, CODE LENGTH IS 2 (253 CODES), NS = 0

Ounderlined now spare - June 27

28 29 ELECTRICAL ENGINEER
11 25 CHEMICAL "
15 32 CIVIL/STRUCTURAL " / INDUSTRIAL
23 29 MECHANICAL " + MECHANICS
29 32 BIOLOGY/MEDICINE
11 26 BIO-ENGINEERING
29 33 GEOLOGY/EARTH SCIENCES & OCEANOG.
12 32 MATHMATICS
16 33 PHYSICS
16 22 CHEMISTRY.

23 24 METALLURGY - METALS
11 27 BRAZING/WELDING/CASTING/GRINDING
15 27 CERAMICS
30 31 FABRICS - TEXTILES
14 32 GLASS
25 26 HONEYCOMB HEXCELS
16 21 PAPER
18 27 LIQUID CRYSTALS
12 25 ADHESIVES - FIBERGLASS
12 24 CRYSTALLOGRAPHY

12 13 INFORMATION THEORY
12 17 COMPUTERS, DIGITAL SYSTEMS
28 33 PROGRAMMING & DATA PROCESSING
16 25 COMPUTERS - LANGUAGE/POETRY.
21 31 " - SOUND/MUSIC
13 27 - GRAPHICS, IMAGES/PHOTO/FILM.
29 30 DIGITAL COMPUTER
13 23 ANALOG "
29 33
13 18

21 23 PAINT
17 29 ACRYLICS & POLYMERS
11 31 PLASTICS general term
20 25 MATERIALS of Carbon, graphite
13 22 DYES & DYING
15 22 FLOURESCENCE - magnetic
23 32 FOAMS - ELASTOMERS
14 23 FIBERGLASS
27 29
28 30

14 31 OPTICS
16 19 SPECTROSCOPY
15 24 LIGHTING & LIGHT
11 16 LIGHTING EQUIPMENT - PROJ - ECTION
11 19 LASERS - STROBES
21 29 HOLOGRAPHY
22 29 RADAR + X Rays RADIATION / IRRADIATION
20 30 FIBRE OPTICS.
21 27 NEON - ULTRA VIOLET
14 15

16 27 TELEVISION EQUIPMENT CATHODE RAYS
13 21 " SYSTEMS
26 30 RADIO EQUIPMENT
20 27 " SYSTEMS.
12 21 COMMUNICATIONS SYSTEMS
18 30 VIDEO TAPE
22 32 TAPE RECORDING & RECORDING ENGINEERING
24 31 FILM TECHNOLOGY
14 22 PHOTOGRAPHY TECHNOLOGY.
15 30

SOUND GENERATION
23 26 ACOUSTICS - SOUND
12 27 SONAR / ULTRASONICS
15 26 ULTRA SONICS
16 23 AUDIO SYSTEMS - Audio-Visual Sys.
11 21 AUDIO EQUIPMENT.
25 28 SOUND GENERATION
19 29
27 32
14 18
18 23

11 22 ARCHITECT / DESIGNERS
24 32 INDUSTRIAL DESIGNER
26 27 SCIENTIFIC JOURNALIST/EDITOR.
21 33 PERCEPTUAL PSYCHOLOGY
25 27
13 16
18 31
19 20
24 27
24 33 HEAT MEAS

20 26 DIGITAL SYSTEMS
18 19 INSTRUMENTATION CONTROL SYSTEMS
15 19 REMOTE CONTROL
27 28 MOTORS
18 20 CIRCUIT DESIGN
15 31 INTEGRATED CIRCUITS.
29 31 MOTION MOVING OBJECTS
13 15 SOLID STATE
11 15
19 26

on agaslo only

19 31 ENVIRONMENTAL MEDIA
11 30 MACHINE DESIGN
25 29 AERONAUTICS & AEROSPACE AVIONICS
13 29 TRANSISTOR - DESIGN
14 17 MICROWAVES
19 25 HYDRAULICS + PNEUMATICS
13 28 CRYOGENICS HEAT MEASUREMENT
18 28 CYBERNETICS & CONTROL THEORY
15 18
24 30 irradiation RADIATION & FLUIDICS-?

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Figure 3.25.
E.A.T., "Scrambled Edge-notch Punch Card Codes," 1969.
E.A.T./GRI Box 11, Folder 9.

INSTRUCTIONS FOR USING EAT TECHNICAL MEMBERSHIP FORM

THE FOLLOWING ALPHABET CODE IS USED FOR SELECTING CARDS BY COMPANY OR BY NAME. THE CODES ARE NUMBERED 1 THROUGH 23 AND REFER TO THE NUMBERED HOLES IN THE COMPANY FIELD AND THE NAME FIELD LOCATED AT THE BOTTOM OF THE MEMBERSHIP CARD. TO SELECT CARDS FIND THE CODE FROM THE LIST BELOW AND SIMULTANEOUSLY NEEDLE BOTH APPROPRIATE HOLES (e.g. KAISER INC. is between JORD and KAND and the code is 3 21)

AAAA - ADAL	22	23	GLOB - GOLC	3	9	OLIP - ORWA	8	15
ADAM - ALBA	12	18	GOLD - GORN	2	16	ORWA - PALL	5	18
ALBB - ALPA	6	16	GORO - GRED	7	15	PALM - PAUK	7	21
ALPB - AMEQ	11	12	GREE - GRIM	20	23	PAUL - PERJ	1	14
AMER - APAQ	13	17	GRIN - GUTH	10	14	PERK - PHOS	5	7
APAR - ARTG	9	17	GUTI - HALO	4	20	PHOT - PLUL	10	21
ARTH - AUTG	11	16	HALP - HARP	9	18	PLUM - POWD	9	11
AUTH - BAKD	1	18	HARR - HAYS	6	21	POWE - PUGG	8	19
BAKE - BARN	7	16	HAYT - HENR	3	10	PUGH - RAHL	2	12
BARO - BEAS	3	4	HENS - HIGF	1	8	RAHM - RECN	6	8
BEAT - BENI	2	18	HIGG - HOLC	6	14	RECO - RESG	9	14
BENJ - BERM	1	2	HOLD - HORS	17	23	RESH - RILD	13	23
BERN - BIRM	1	23	HORT - HULK	1	10	RILE - ROBH	7	8
BIRN - BLUL	8	14	HULL - INFA	20	22	ROBI - ROMA	4	16
BLUM - BOUS	7	9	INFB - ITAK	3	16	ROMB - ROSD	2	10
BOUT - BREM	8	23	ITAL - JAMH	4	9	ROSE - RUBA	3	15
BREN - BROT	8	22	JAMI - JOHM	7	22	RUBB - SABQ	10	12
BROU - BUCJ	5	6	JOHN - JORC	5	23	SABR - SAMT	4	14
BUCK - BUTS	6	22	JORD - KAND	3	21	SAMU - SAVA	5	13
BUTT - CAMO	1	13	KANE - KAUE	14	18	SAVB - SCHK	11	15
CAMP - CARO	2	21	KAUF - KENS	15	23	SCHL - SCHV	13	15
CARP - CENS	12	17	KENT - KIRR	12	16	SCHW - SEGA	12	15
CENT - CHEL	3	20	KIRS - KOER	10	13	SEGB - SHAO	2	23
CHEM - CICD	7	14	KOES - KRAR	15	21	SHAP - SHMD	6	20
CICE - COCA	1	4	KRAS - LACN	9	22	SHME - SIMJ	9	13
COCB - COLK	3	22	LACO - LARA	1	19	SIMK - SLAS	2	19
COLL - CONM	16	19	LARB - LECN	2	20	SLAT - SNAO	13	18
CONN - CORP	3	13	LECO - LEOM	4	6	SNAP - STAM	14	15
CORR - CROK	13	21	LEON - LEVX	7	17	STAN - STEQ	14	16
CROL - DAGF	10	11	LEVY - LILK	12	14	STER - STOU	2	9
DAGG - DAVH	1	7	LILL - LOCJ	10	18	STOV - SUNR	7	18
DAVI - DELF	11	20	LOCK - LOVD	10	19	SUNS - TAIK	8	12
DELG - DEVN	12	21	LOVE - MACB	10	22	TAIL - TEOT	2	6
DEVO - DOAJ	12	20	MACC - MALH	12	13	TEOU - THRD	5	11
DOAK - DOYK	11	22	MALI - MARB	15	20	THRE - TORQ	18	22
DOYL - DURA	5	15	MARC - MARS	6	10	TORR - TRUD	4	10
DURB - EDUB	1	3	MART - MAUQ	16	22	TRUE - UNIB	21	23
EDUC - ELLH	1	22	MAUR - MCDN	8	11	UNIC - URBA	15	22
ELLI - EPSS	9	20	MCDO - MCWH	7	11	URBB - VEDN	6	18
EPST - FACH	4	17	MCWI - MERD	16	23	VEDO - VOND	11	18
FACI - FEEK	12	23	MERE - MIDV	17	21	VONE - WABD	3	7
FEEL - FIEK	9	12	MIDW - MINN	6	7	WABE - WALS	2	8
FIEL - FISG	7	10	MINO - MONS	18	21	WALT - WEIR	5	19
FISH - FORL	7	13	MONT - MORQ	7	20	WEIS - WHIS	4	19
FORM - FRAM	2	5	MORS - MURO	7	22	WHIT - WILK	8	16
FRAN - FRID	3	14	MURP - NATH	21	22	WILL - WODD	4	11
FRIE - GALK	2	13	NATI - NEWL	5	10	WODE - WORY	4	15
GALL - GEEQ	17	20	NEWM - NICG	2	4	WORZ - YOUM	11	14
GEER - GIAM	6	19	NICH - NUND	16	21	YOUN - YUCK	4	18
GIAN - GLOA	13	20	NUNE - OLIO	14	19	YUCL - ZZZZ	16	18

Figure 3.26.
E.A.T., "Instructions for Using E.A.T. Technical Membership Form,"
list of edge-notch punch card codes for selecting cards by company or by name, 1969.
E.A.T./GRI Box 11, Folder 9.

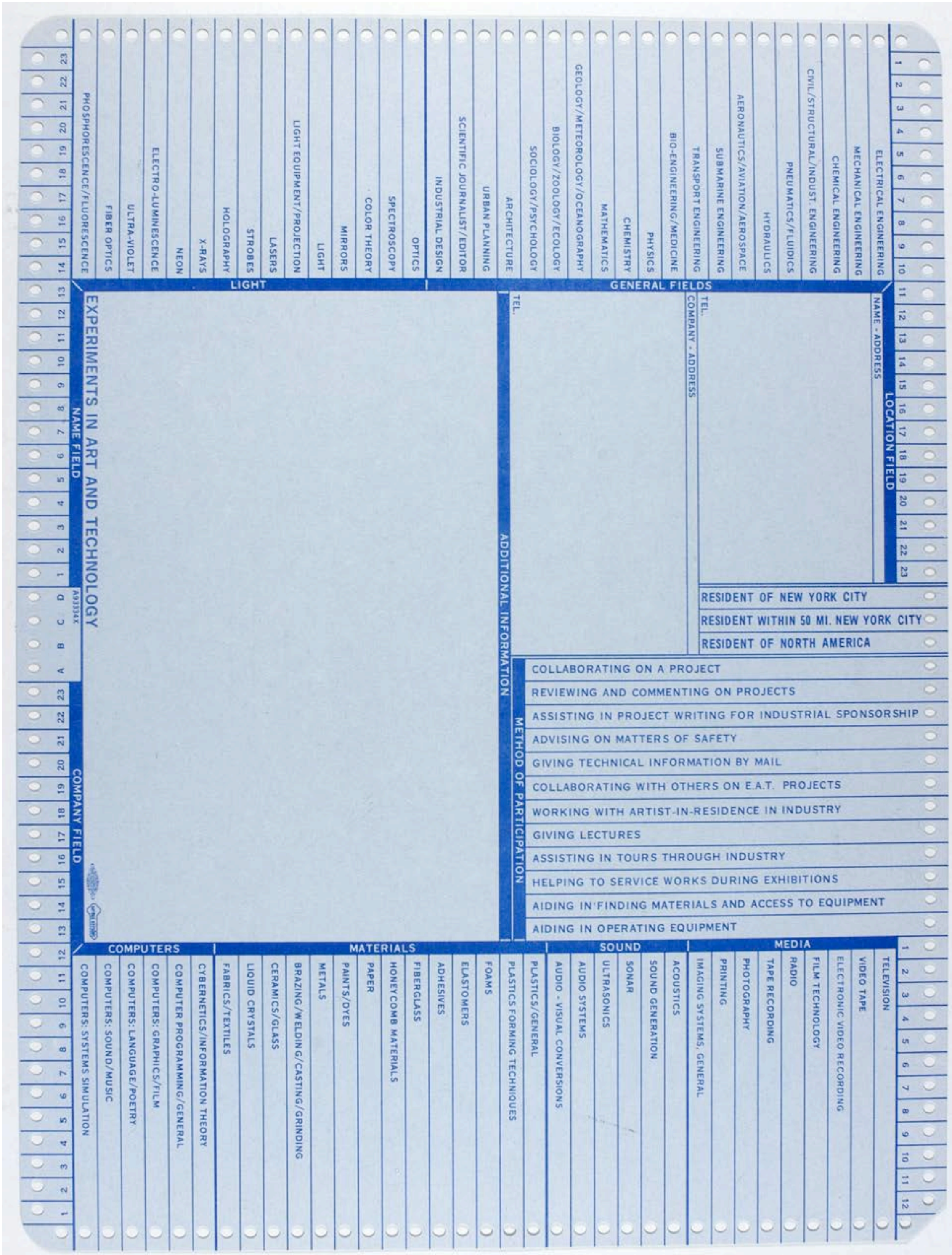


Figure 3.27.
E.A.T., blue McBee Keysort edge-notched card, 1968 (recto). 8.5" x 11".
E.A.T./GRI Box 11, Folder 14.

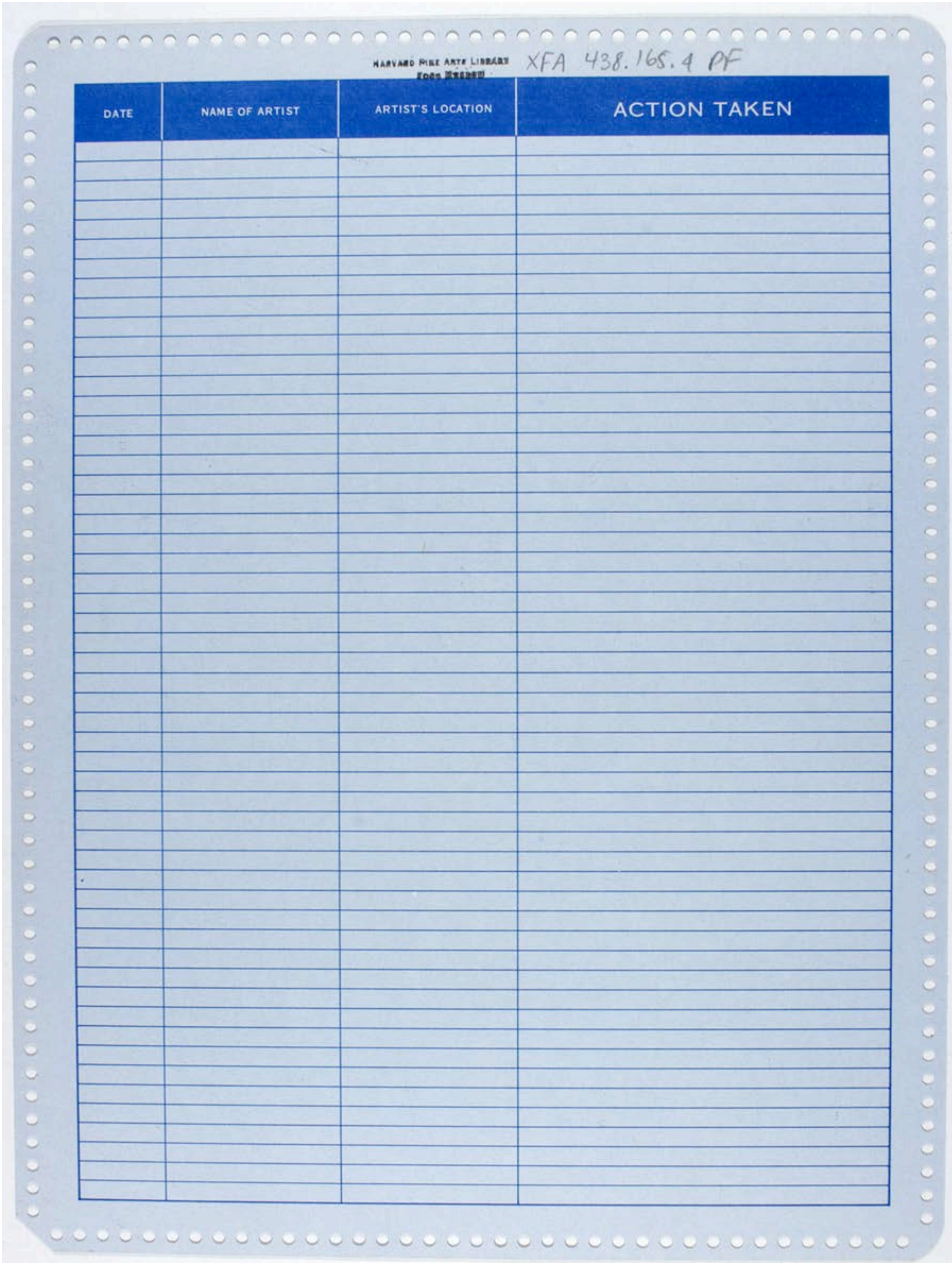
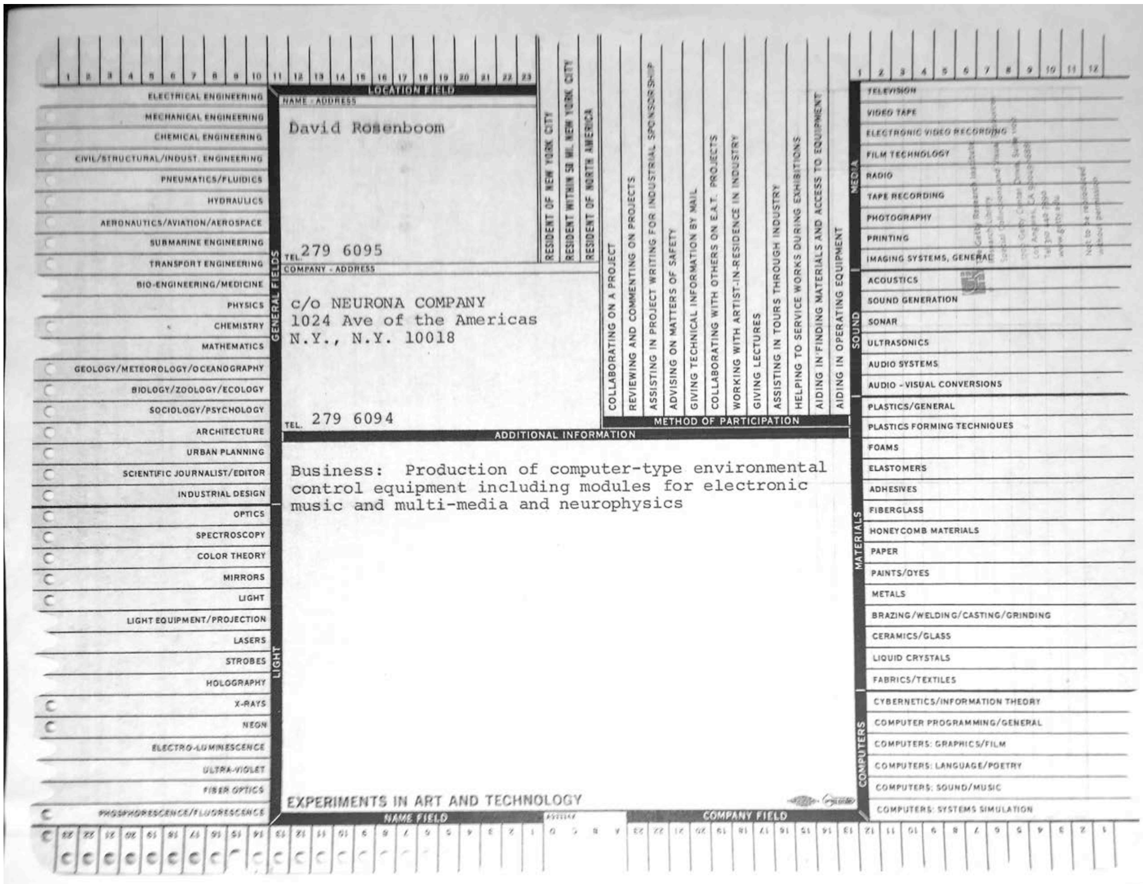


Figure 3.28.
E.A.T., blue McBee Keysort edge-notched card, 1968 (verso). 8.5" x 11".
E.A.T./GRI Box 11, Folder 14.



LOCATION FIELD
NAME - ADDRESS
David Rosenboom
TEL. 279 6095
COMPANY - ADDRESS
c/o NEURONA COMPANY
1024 Ave of the Americas
N.Y., N.Y. 10018
TEL. 279 6094
RESIDENT OF NEW YORK CITY
RESIDENT WITHIN 50 MI. NEW YORK CITY
RESIDENT OF NORTH AMERICA
ADDITIONAL INFORMATION
Business: Production of computer-type environmental
control equipment including modules for electronic
music and multi-media and neurophysics

GENERAL FIELDS
ELECTRICAL ENGINEERING
MECHANICAL ENGINEERING
CHEMICAL ENGINEERING
CIVIL/STRUCTURAL/INDUST. ENGINEERING
PNEUMATICS/FLUIDICS
HYDRAULICS
AERONAUTICS/AVIATION/AEROSPACE
SUBMARINE ENGINEERING
TRANSPORT ENGINEERING
BIO-ENGINEERING/MEDICINE
PHYSICS
CHEMISTRY
MATHEMATICS
GEOLOGY/METEOROLOGY/OCEANOGRAPHY
BIOLOGY/ZOOLOGY/ECOLOGY
SOCIOLOGY/PSYCHOLOGY
ARCHITECTURE
URBAN PLANNING
SCIENTIFIC JOURNALIST/EDITOR
INDUSTRIAL DESIGN

LIGHT
OPTICS
SPECTROSCOPY
COLOR THEORY
MIRRORS
LIGHT
LIGHT EQUIPMENT/PROJECTION
LASERS
STROBES
HOLOGRAPHY
X-RAYS
NEON
ELECTRO-LUMINESCENCE
ULTRA-VIOLET
FIBER OPTICS
PHOSPHORESCENCE/FLUORESCENCE

METHOD OF PARTICIPATION
COLLABORATING ON A PROJECT
REVIEWING AND COMMENTING ON PROJECTS
ASSISTING IN PROJECT WRITING FOR INDUSTRIAL SPONSORSHIP
ADVISING ON MATTERS OF SAFETY
GIVING TECHNICAL INFORMATION BY MAIL
COLLABORATING WITH OTHERS ON E.A.T. PROJECTS
WORKING WITH ARTIST-IN-RESIDENCE IN INDUSTRY
GIVING LECTURES
ASSISTING IN TOURS THROUGH INDUSTRY
HELPING TO SERVICE WORKS DURING EXHIBITIONS
AIDING IN FINDING MATERIALS AND ACCESS TO EQUIPMENT
AIDING IN OPERATING EQUIPMENT

MEDIA
TELEVISION
VIDEO TAPE
ELECTRONIC VIDEO RECORDING
FILM TECHNOLOGY
RADIO
TAPE RECORDING
PHOTOGRAPHY
PRINTING
IMAGING SYSTEMS, GENERAL

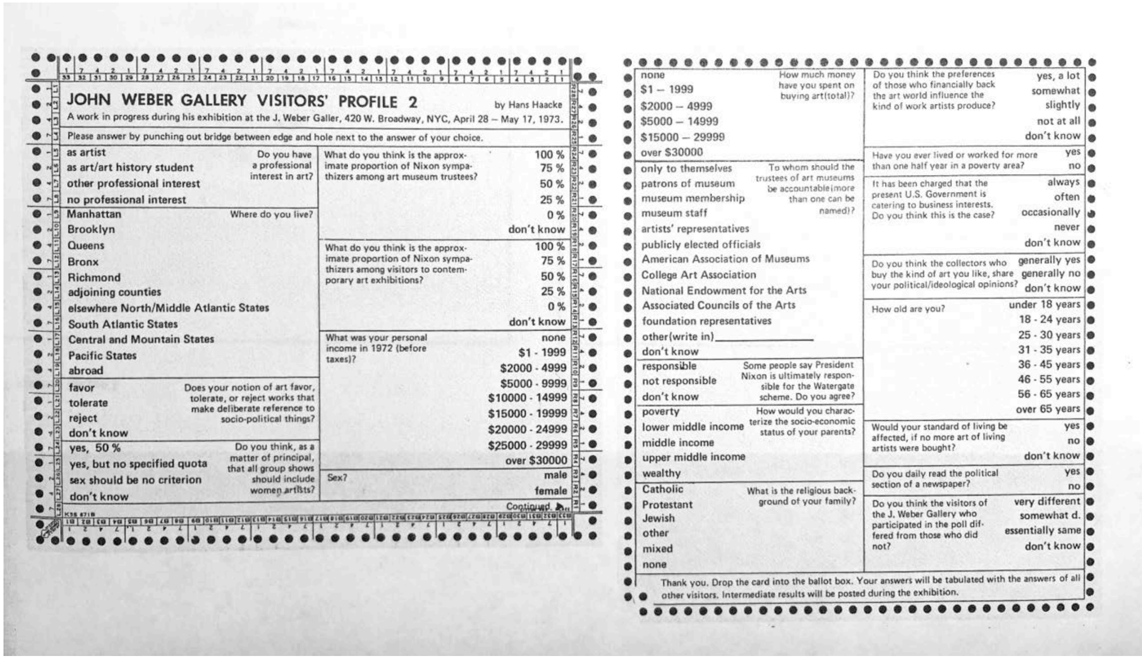
SOUND
ACOUSTICS
SOUND GENERATION
SONAR
ULTRASONICS
AUDIO SYSTEMS
AUDIO - VISUAL CONVERSIONS

MATERIALS
PLASTICS/GENERAL
PLASTICS FORMING TECHNIQUES
FOAMS
ELASTOMERS
ADHESIVES
FIBERGLASS
HONEYCOMB MATERIALS
PAPER
PAINTS/DYES
METALS
BRAZING/WELDING/CASTING/GRINDING
CERAMICS/GLASS
LIQUID CRYSTALS
FABRICS/TEXTILES

COMPUTERS
CYBERNETICS/INFORMATION THEORY
COMPUTER PROGRAMMING/GENERAL
COMPUTERS: GRAPHICS/FILM
COMPUTERS: LANGUAGE/POETRY
COMPUTERS: SOUND/MUSIC
COMPUTERS: SYSTEMS SIMULATION

EXPERIMENTS IN ART AND TECHNOLOGY
NAME FIELD
COMPANY FIELD

Figure 3.29.
David Rosenboom, E.A.T. artist membership form, blue McBee Keysort card, 1968.
E.A.T./GRI Box 11, Folder 14.



JOHN WEBER GALLERY VISITORS' PROFILE 2

by Hans Haacke

A work in progress during his exhibition at the J. Weber Galler, 420 W. Broadway, NYC, April 28 – May 17, 1973.

Please answer by punching out bridge between edge and hole next to the answer of your choice.

Do you have a professional interest in art?
as artist
as art/art history student
other professional interest
no professional interest

Where do you live?
Manhattan
Brooklyn
Queens
Bronx
Richmond
adjoining counties
elsewhere North/Middle Atlantic States
South Atlantic States
Central and Mountain States
Pacific States
abroad

Does your notion of art favor, tolerate, or reject works that make deliberate reference to socio-political things?
favor
tolerate
reject
don't know

Do you think, as a matter of principal, that all group shows should include women artists?
yes, 50 %
yes, but no specified quota
sex should be no criterion
don't know

What do you think is the approximate proportion of Nixon sympathizers among art museum trustees?
100 %
75 %
50 %
25 %
0 %
don't know

What do you think is the approximate proportion of Nixon sympathizers among visitors to contemporary art exhibitions?
100 %
75 %
50 %
25 %
0 %
don't know

What was your personal income in 1972 (before taxes)?
none
$1 - 1999
$2000 - 4999
$5000 - 9999
$10000 - 14999
$15000 - 19999
$20000 - 24999
$25000 - 29999
over $30000

Sex?
male
female

Continued

How much money have you spent on buying art (total)?
none
$1 – 1999
$2000 – 4999
$5000 – 14999
$15000 – 29999
over $30000

To whom should the trustees of art museums be accountable (more than one can be named)?
only to themselves
patrons of museum
museum membership
museum staff
artists' representatives
publicly elected officials
American Association of Museums
College Art Association
National Endowment for the Arts
Associated Councils of the Arts
foundation representatives
other (write in)________________
don't know

Some people say President Nixon is ultimately responsible for the Watergate scheme. Do you agree?
responsible
not responsible
don't know

How would you characterize the socio-economic status of your parents?
poverty
lower middle income
middle income
upper middle income
wealthy

What is the religious background of your family?
Catholic
Protestant
Jewish
other
mixed
none

Do you think the preferences of those who financially back the art world influence the kind of work artists produce?
yes, a lot
somewhat
slightly
not at all
don't know

Have you ever lived or worked for more than one half year in a poverty area?
yes
no

It has been charged that the present U.S. Government is catering to business interests. Do you think this is the case?
always
often
occasionally
never
don't know

Do you think the collectors who buy the kind of art you like, share your political/ideological opinions?
generally yes
generally no
don't know

How old are you?
under 18 years
18 - 24 years
25 - 30 years
31 - 35 years
36 - 45 years
46 - 55 years
56 - 65 years
over 65 years

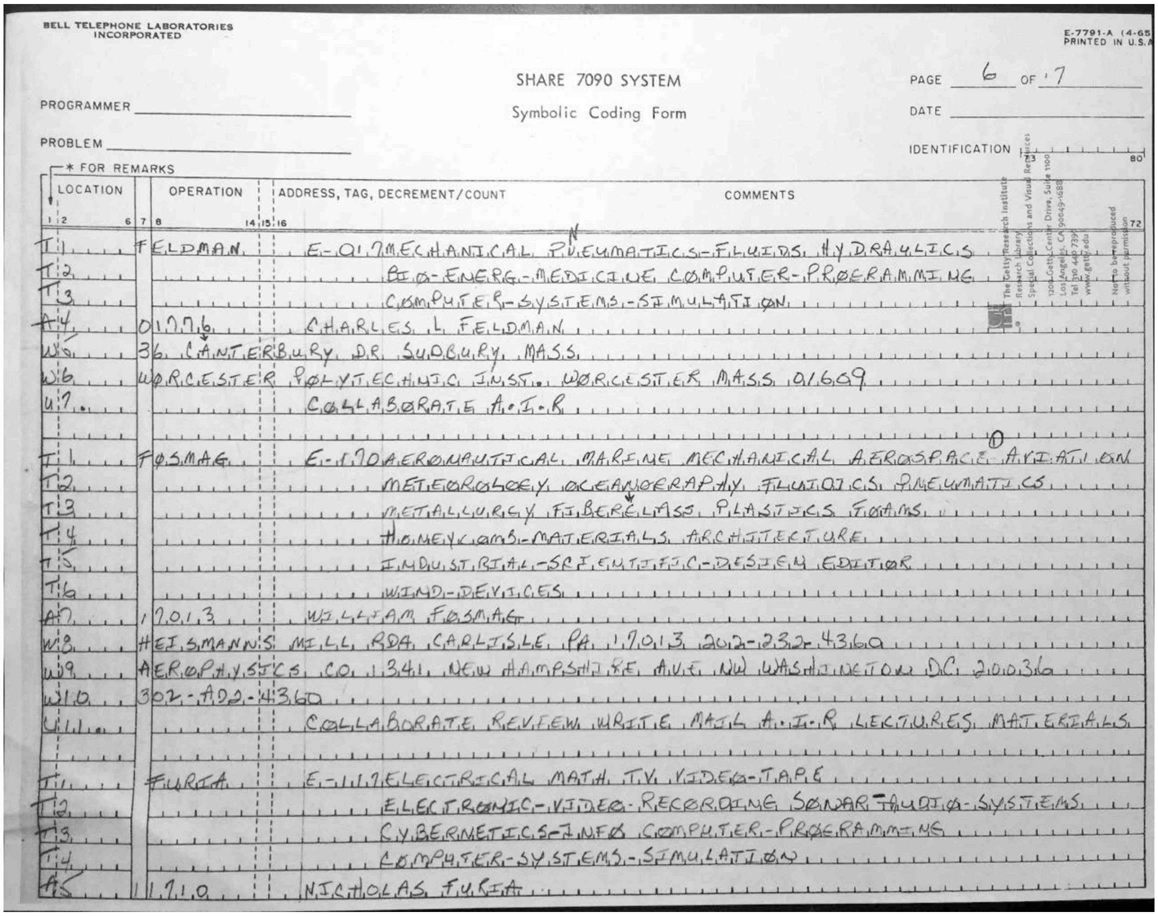
Would your standard of living be affected, if no more art of living artists were bought?
yes
no
don't know

Do you daily read the political section of a newspaper?
yes
no

Do you think the visitors of the J. Weber Gallery who participated in the poll differed from those who did not?
very different
somewhat d.
essentially same
don't know

Thank you. Drop the card into the ballot box. Your answers will be tabulated with the answers of all other visitors. Intermediate results will be posted during the exhibition.

Figure 3.30.
Hans Haacke, edge-notched card for questionnaire,
John Weber Gallery Visitors' Profile 2, 1973.


BELL TELEPHONE LABORATORIES
INCORPORATED

E-7791-A (4-65)
PRINTED IN U.S.A.

SHARE 7090 SYSTEM

Symbolic Coding Form

PAGE 6 OF 7

PROGRAMMER

DATE

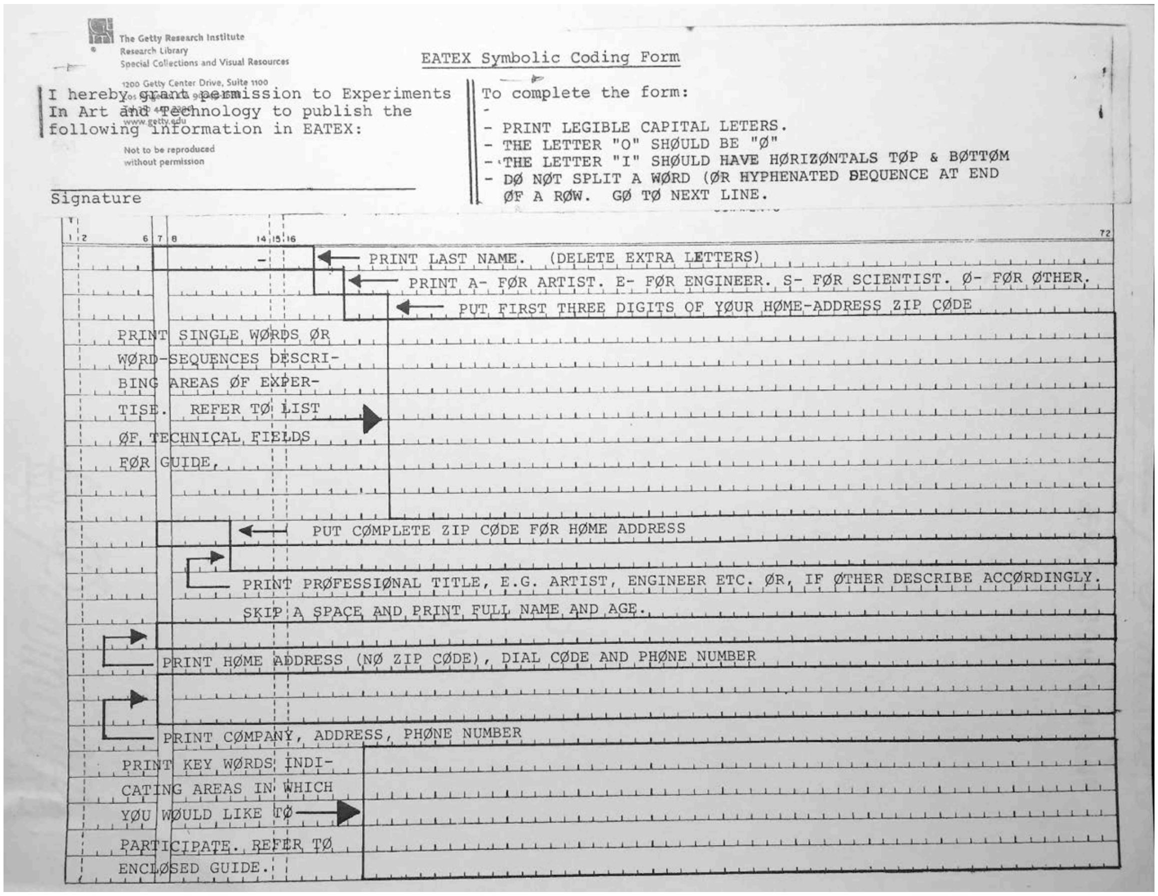
PROBLEM

IDENTIFICATION

* FOR REMARKS

LOCATION	OPERATION	ADDRESS, TAG, DECREMENT/COUNT / COMMENTS
T1	FELDMAN	E-017 MECHANICAL PNEUMATICS-FLUIDS HYDRAULICS
T2		BIO-ENERG-MEDICINE COMPUTER-PROGRAMMING
T3		COMPUTER-SYSTEMS-SIMULATION
A4	01776	CHARLES L FELDMAN
W5	36 CANTERBURY DR SUDBURY MASS	
W6	WORCESTER POLYTECHNIC INST. WORCESTER MASS 01609	
U7		COLLABORATE A.I.R
T1	FOSMAG	E-170 AERONAUTICAL MARINE MECHANICAL AEROSPACE AVIATION
T2		METEOROLOGY OCEANOGRAPHY FLUIDICS PNEUMATICS
T3		METALLURGY FIBERGLASS PLASTICS FOAMS
T4		HONEYCOMB-MATERIALS ARCHITECTURE
T5		INDUSTRIAL-SCIENTIFIC-DESIGN EDITOR
T6		WIND-DEVICES
A7	17013	WILLIAM FOSMAG
W8	HEISMANNS MILL RDA CARLISLE PA 17013 202-232-4360	
W9	AEROPHYSICS CO 1341 NEW HAMPSHIRE AVE NW WASHINGTON DC 20036	
W10	302-402-4360	
U11		COLLABORATE REVIEW WRITE MAIL A.I.R LECTURES MATERIALS
T1	FURIA	E-117 ELECTRICAL MATH T.V. VIDEO-TAPE
T2		ELECTRONIC-VIDEO-RECORDING SONAR-AUDIO-SYSTEMS
T3		CYBERNETICS-INFO COMPUTER-PROGRAMMING
T4		COMPUTER-SYSTEMS-SIMULATION
A5	11710	NICHOLAS FURIA

Figure 3.31.
EATEX Symbolic Coding Form for IBM 7090, list of engineer members, January 1971.
E.A.T./GRI Box 11, Folder 13.



EATEX Symbolic Coding Form

I hereby grant permission to Experiments In Art and Technology to publish the following information in EATEX:

Signature

To complete the form:

- PRINT LEGIBLE CAPITAL LETERS.
- THE LETTER "O" SHØULD BE "Ø"
- THE LETTER "I" SHØULD HAVE HØRIZØNTALS TØP & BØTTØM
- DØ NØT SPLIT A WØRD (ØR HYPHENATED SEQUENCE AT END ØF A RØW. GØ TØ NEXT LINE.

1 2 6 7 8 14 15 16 72

PRINT LAST NAME. (DELETE EXTRA LETTERS)

PRINT A- FØR ARTIST. E- FØR ENGINEER. S- FØR SCIENTIST. Ø- FØR ØTHER.

PUT FIRST THREE DIGITS ØF YØUR HØME-ADDRESS ZIP CØDE

PRINT SINGLE WØRDS ØR WØRD-SEQUENCES DESCRIBING AREAS ØF EXPERTISE. REFER TØ LIST ØF TECHNICAL FIELDS FØR GUIDE.

PUT CØMPLETE ZIP CØDE FØR HØME ADDRESS

PRINT PRØFESSIØNAL TITLE, E.G. ARTIST, ENGINEER ETC. ØR, IF ØTHER DESCRIBE ACCØRDINGLY.

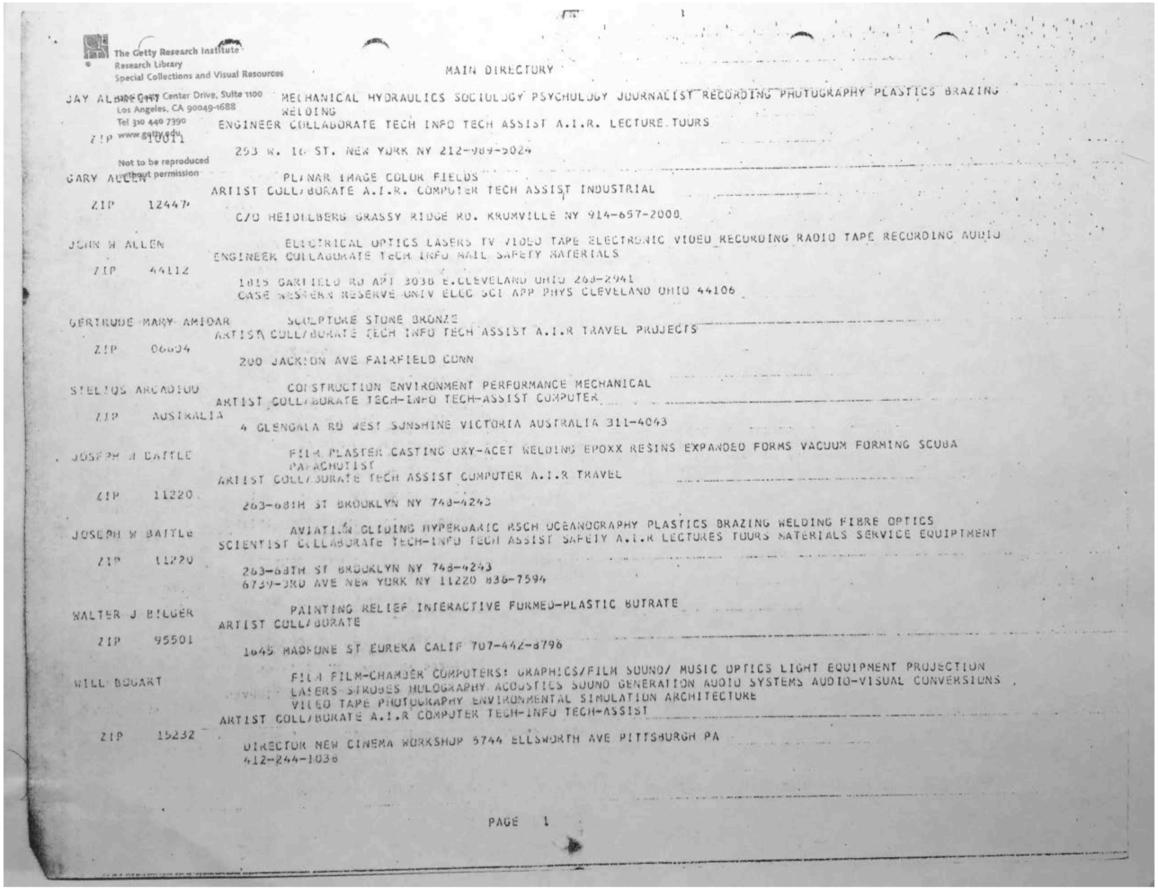
SKIP A SPACE AND PRINT FULL NAME AND AGE.

PRINT HØME ADDRESS (NØ ZIP CØDE), DIAL CØDE AND PHØNE NUMBER

PRINT CØMPANY, ADDRESS, PHØNE NUMBER

PRINT KEY WØRDS INDICATING AREAS IN WHICH YØU WØULD LIKE TØ PARTICIPATE. REFER TØ ENCLØSED GUIDE.

Figure 3.32.
EATEX Symbolic Coding Form for IBM 7090, instructions for completing form, 1970.
E.A.T./GRI Box 65, Folder 1.



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PAGE 1

Figure 3.33.
EATEX Main Directory printout, n.d. E.A.T./GRI Box 65, Folder 1.

Jan 21 22 27 28 29 Feb 3 4 5 1967
Martinique Theatre
32nd Street and Broadway, NYC

Paul Libin presents

<u>S N O W S</u> Kinetic Theater by

C A R O L E E   S C H N E E M A N N

with SHIGEKO KUBOTA   TYRONE MITCHELL   PHOEBE NEVILLE
CAROLEE SCHNEEMANN   JAMES TENNEY   PETER WATTS

* *

revolving light sculpture -- Laurence Warshaw
lights & sound controlled light system -- Robert Schultz
technical coordinator -- Ralph Flynn
sound collage -- James Tenney
entire environment, "Viet-Flakes" film, flyer -- Carolee Schneemann
projectionists -- Karl Schenzer Jack Agüeros

* *

technical assistance -- Robby Robinson   Per Biorn   Mike Yareck

builders -- Karl Schenzer Peter Watts Jack Agüeros June Ekman
James Tenney Per Biorn James Finney

snow machine -- Jack Agüeros

roustabouts -- James Carroll   James Finney   Jim Kuo

* *

<u>SNOWS</u> is dedicated to poet friends.

<u>SNOWS</u> supports and is one of the events of Angry Arts Week.

grateful thanks to: Foundation for Experiments in Art & Technology
Consolidated Aluminum Reynolds Aluminum
Thomas Morley Alphonse Schilling Judy Kass

taking of photographs is absolutely forbidden

Figure 3.34.
Program for Carolee Schneemann, *SNOWS*, 1967. E.A.T./GRI Box 41, Folder 1.

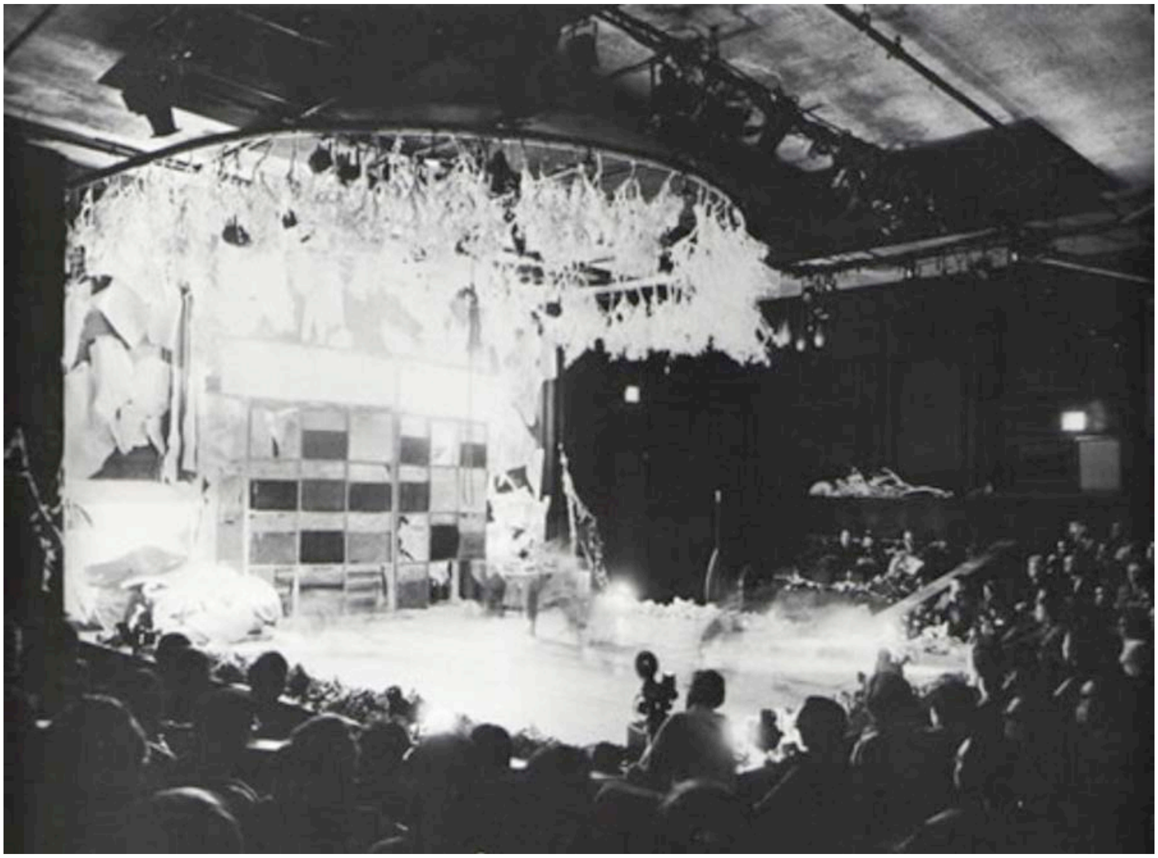


Figure 3.35.
Carolee Schneemann, *SNOWS*, January 1967, Martinique Theater, New York.
Photo: Alphonse Schilling.

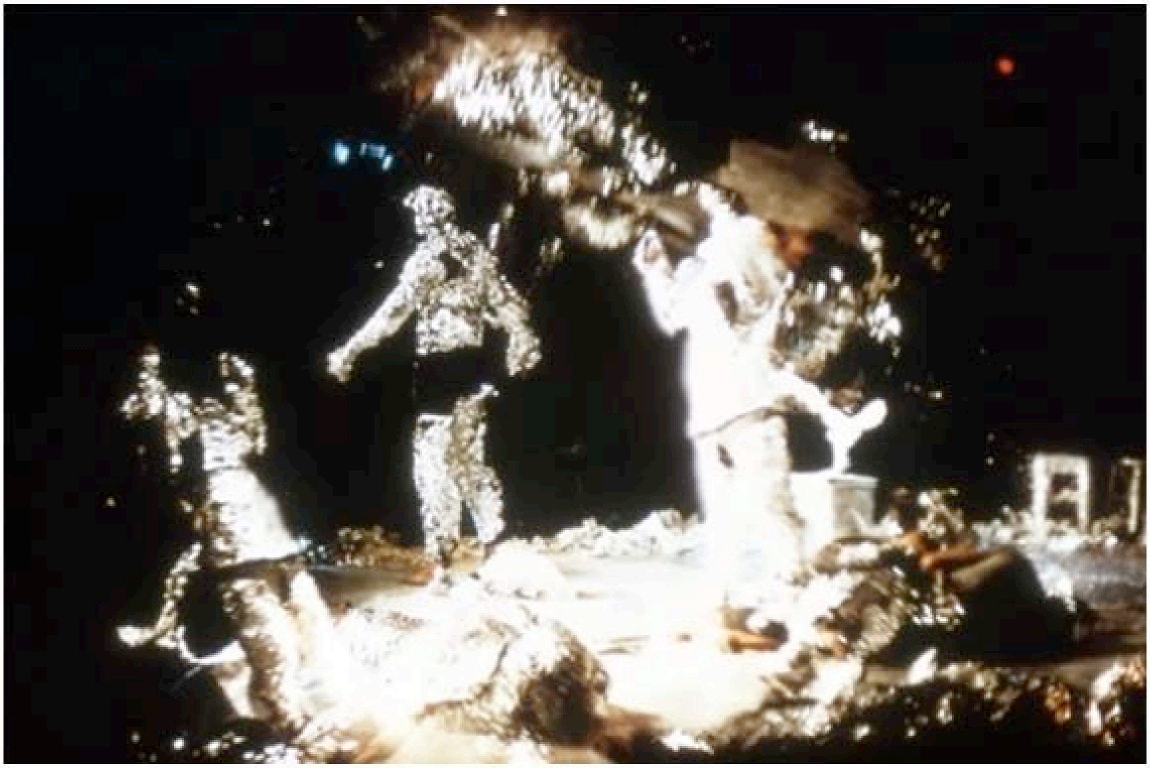


Figure 3.36.
Carolee Schneemann, *SNOWS*, January 1967, Martinique Theater, New York.
Photo: Herbert Migdoll.

Figure 3.37.
Marta Minujin, *Minuphone*, 1967. Telephone booth, electronic parts, dimensions variable. Engineer: Per Biorn. Installation view, Howard Wise Gallery, 1967. Inside booth: Marta Minujin.

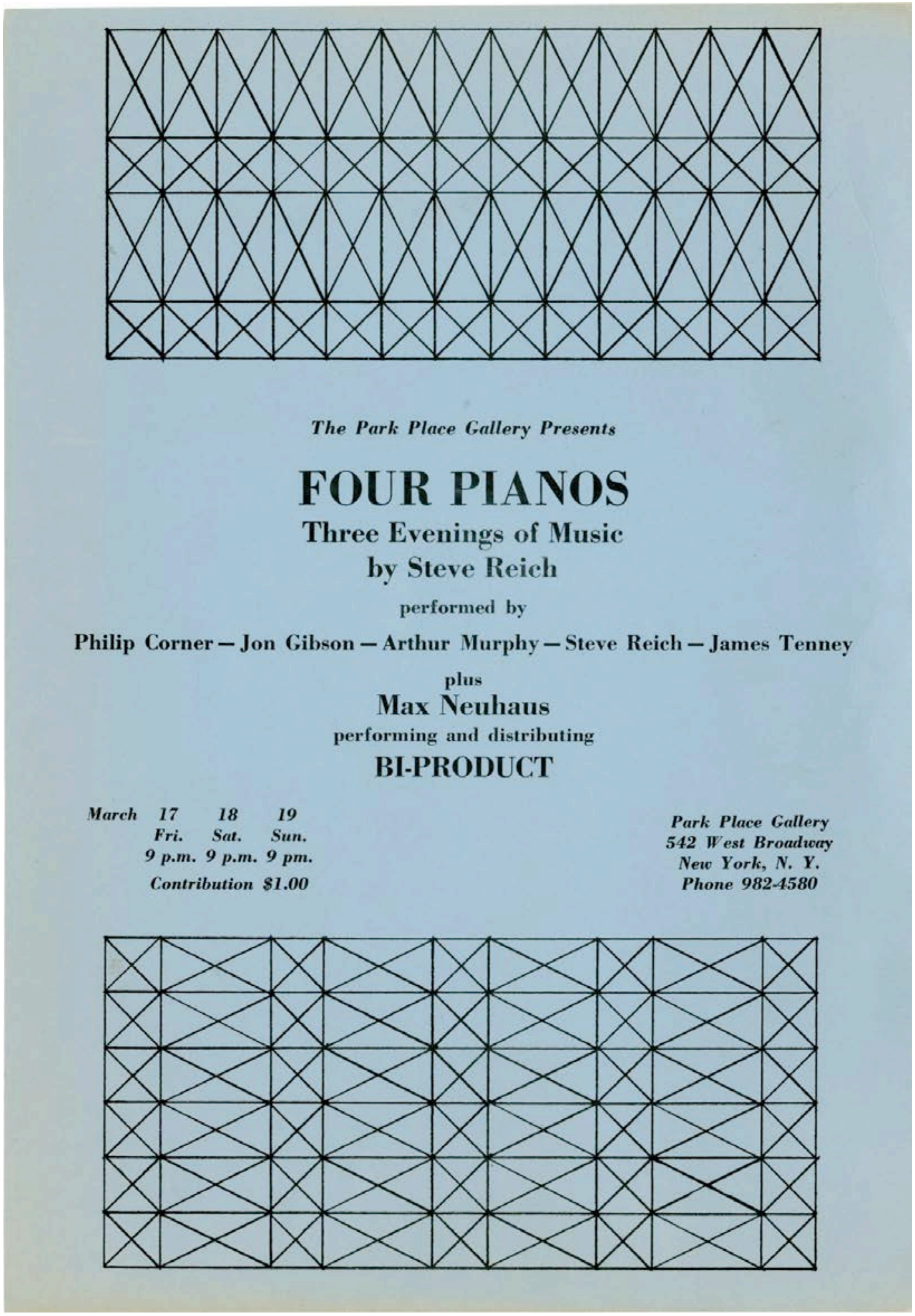


Figure 3.38.
Program for Steve Reich, *Four Pianos*, and Max Neuhaus, *Bi-Product*, 1967.
E.A.T./GRI Box 11, Folder 12.

Figure 3.39.
Robert Rauschenberg, *Soundings*, 1968. Mirrored Plexiglas and silkscreen ink on Plexiglas with concealed electric lights and electronic components, 96" x 432" x 54". Engineers: Billy Klüver, L. J. Robinson, Fred Waldhauer, Cecil Coker, Per Biorn, and Ralph Flynn. Museum Ludwig, Cologne. Photo: Rauschenberg Foundation.

Figure 3.40.
Robert Rauschenberg, *Solstice*, 1968. Silkscreen ink on motorized Plexiglas doors in metal frame mounted on platform with concealed electric lights and electronic components. 120" x 172" x 172".
Engineers: L. J. Robinson, Per Biorn, Tony Tedona, and Ralph Flynn.
National Museum of Art, Osaka, Japan. Photo: Rauschenberg Foundation.

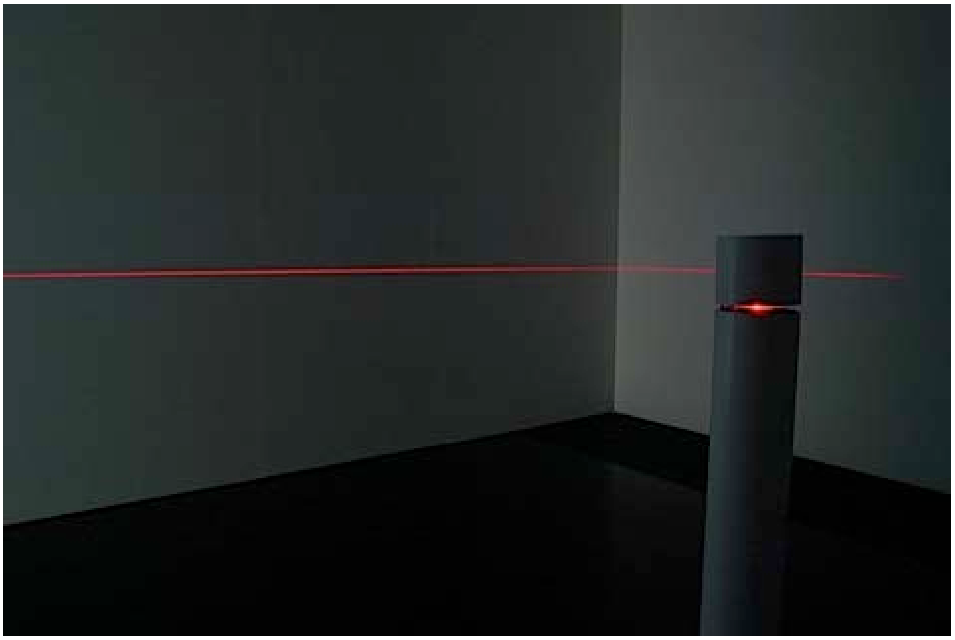


Figure 3.41.
Robert Whitman, *Solid Red Line*, 1967. Machined metal, helium-neon laser, mirrors, motor, 1' x 1 ½ ' x 2 ½ '. Engineers: Larry Heilos, Eric Rawson. Dia Art Foundation.

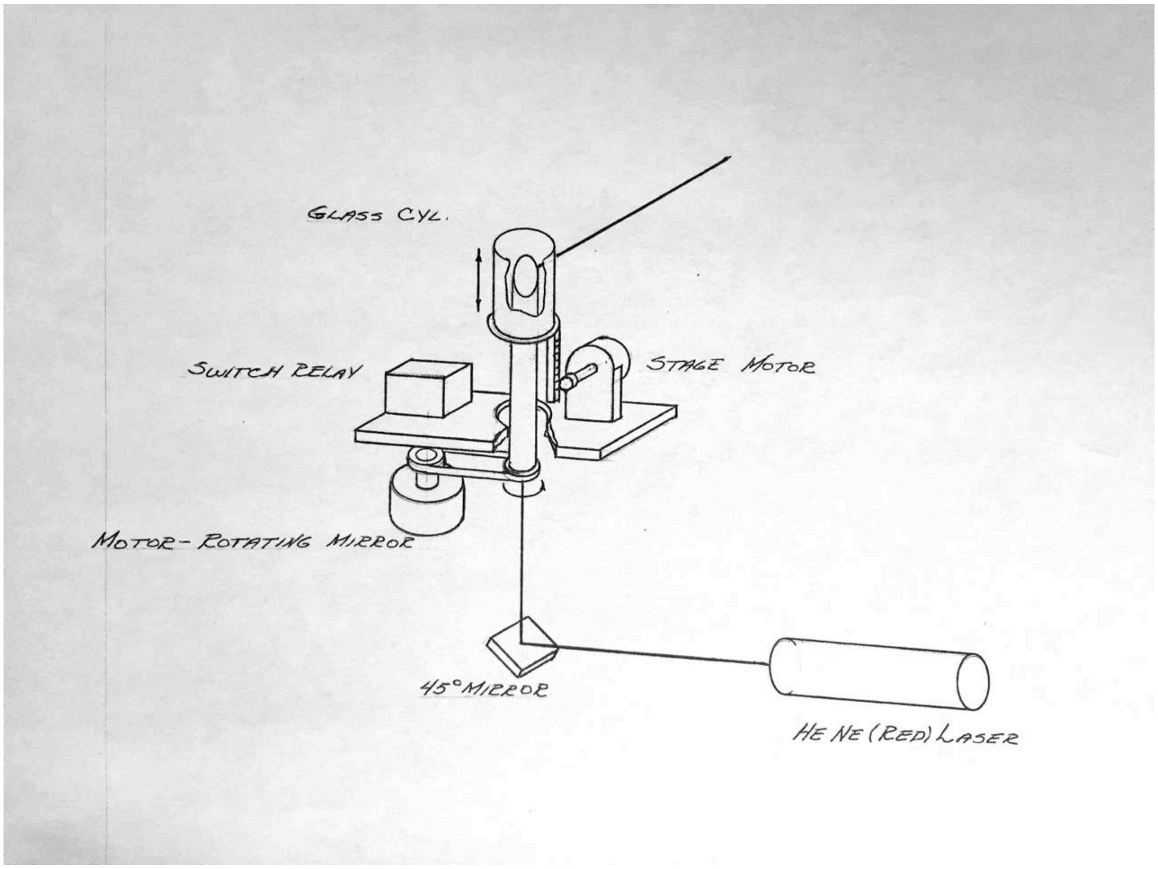


Figure 3.42.
Robert Whitman, Larry Heilos, and Eric Rawson, diagram for laser construction for *Solid Red Line*, 1968. E.A.T./GRI Box 27, folder 18.

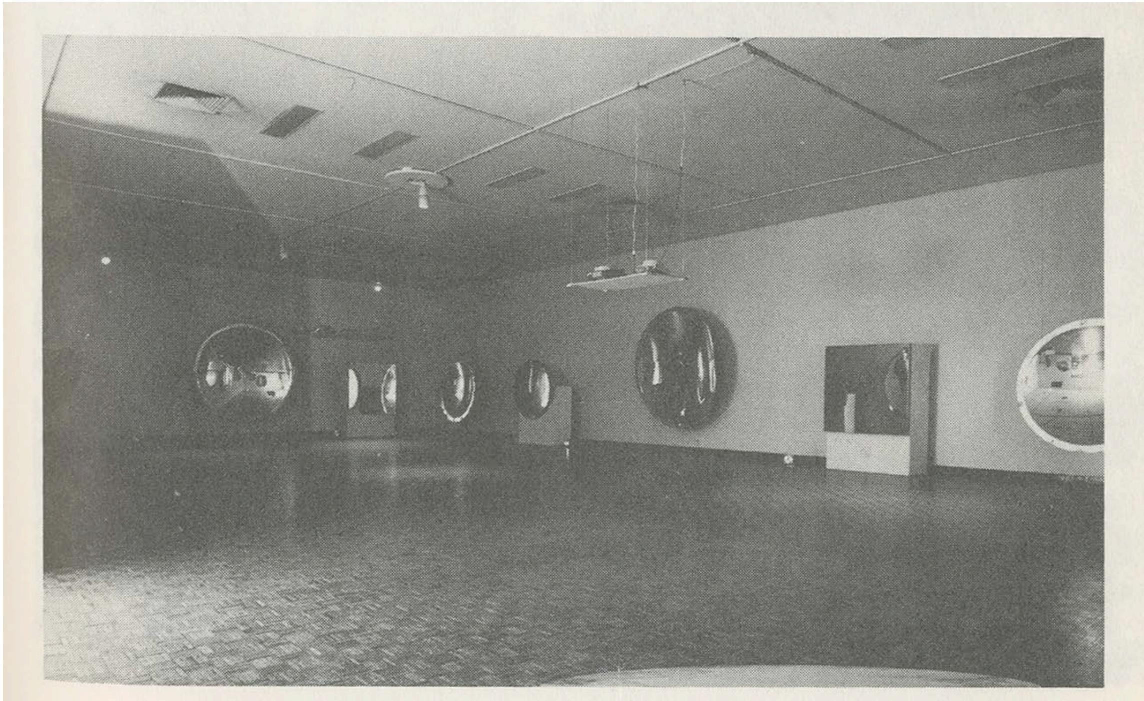


Figure 3.43.
Robert Whitman, *Pond*, installed at the Jewish Museum in New York, 1968.
Photo: Ferdinand Boesch.

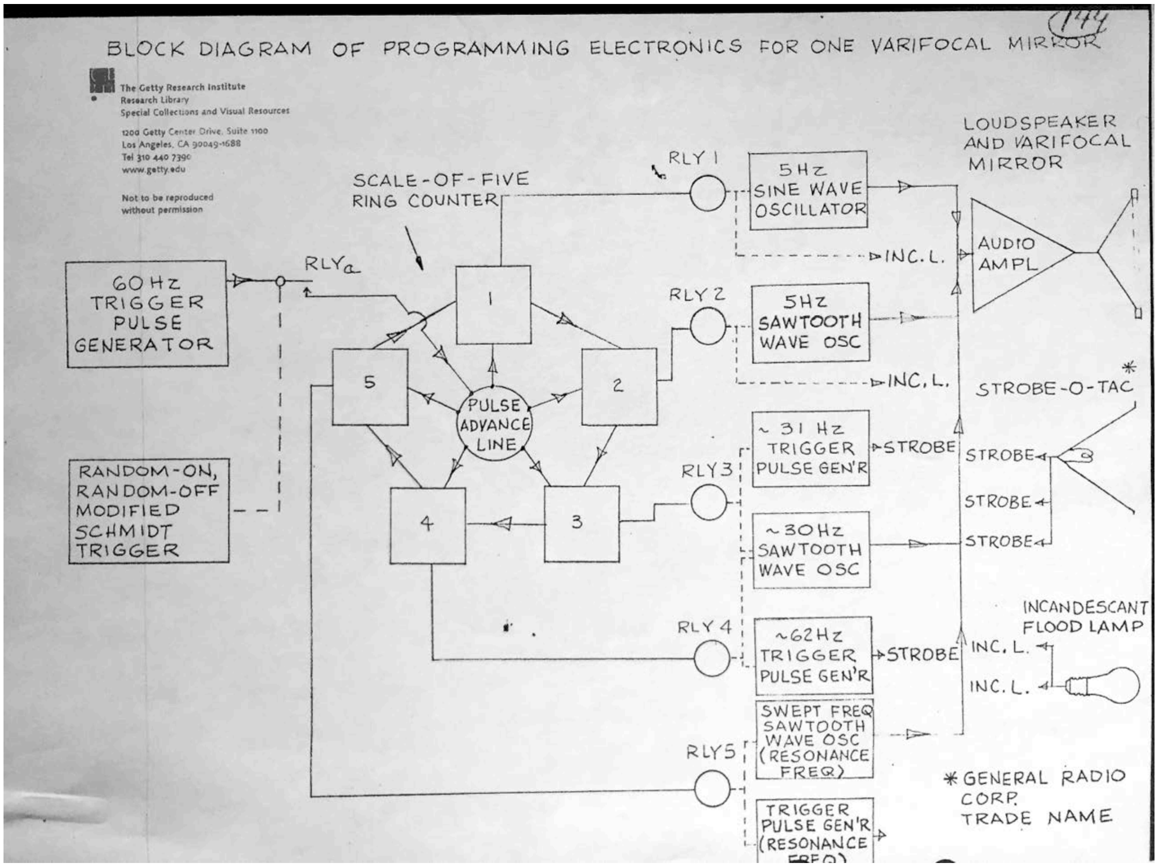


Figure 3.44.
Eric Rawson, block diagram of programming electronics for one varifocal mirror, 1968. E.A.T./GRI Box 27, Folder 18. In Eric Rawson and Robert Whitman, “Report on a Light Sculpture Using Varifocal Mirror,” n.d. E.A.T./GRI Box 27, Folder 18.

Figure 3.45.
Stan VanDerBeek, Movie Drome, interior, Stony Point, New York, 1968. Reprinted from Stewart Kranz, *Science & Technology in the Arts* (New York: Van Nostrand Reinhold, 1974), 238.

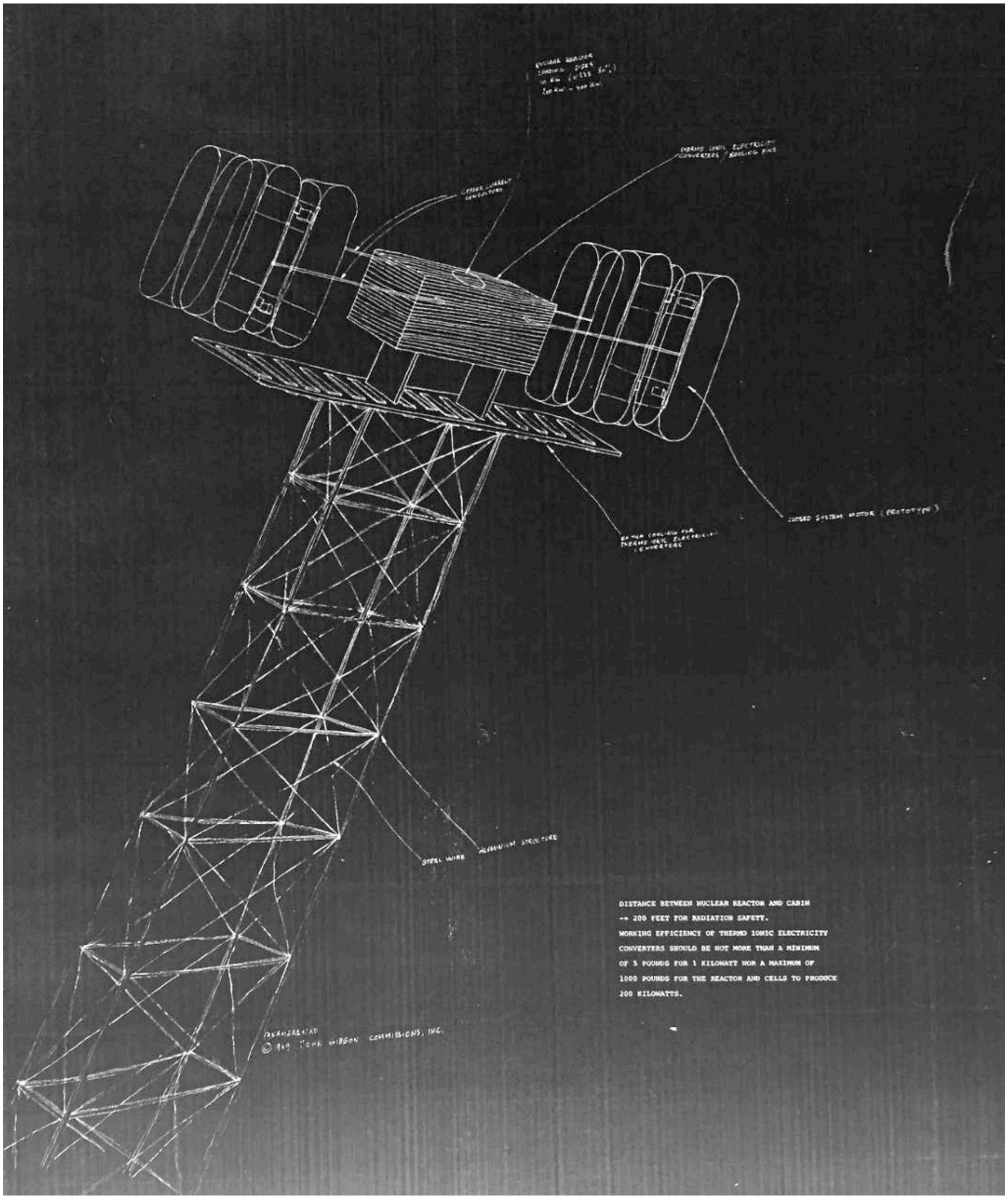


Figure 3.46.
Panamarenko, blueprint drawing, “Closed System Power Devices for Space / Portable Air Transport / Gas Turbines, 27 East 67th St., New York, April 19-May 9, 1969.” E.A.T./GRI Box 6, Folder 26.

Figure 3.47.
Hans Haacke, *Photo-Electric Viewer-Controlled Coordinate System*, 1968.
Installation view, Howard Wise Gallery, January 1968. Room: 136 x 136 x 120”; infrared photoelectric devices; lightbulbs. E.A.T./GRI Box 189.

Figure 3.48.
Hans Haacke, *Photo-Electric Viewer-Controlled Coordinate System*, 1968. Installation view, Howard Wise Gallery, January 1968. Infrared photoelectric devices, lightbulbs; room: 136" x 136" x 120"; E.A.T./GRI Box 189.

Photo-electrically sensitized "environment".
Project by Hans Haacke, 25 W 16th Street, New York, N.Y.
To be presented in one-man show January 1968 at Howard Wise Gallery, N.Y.

A dark, square room, 13 feet long and 13 feet wide, with an entrance, that equally serves as exit, of approximately 2 feet , in one corner. Along the walls, at intervals of 1 ft. and 5 ft. above the floor, incandescent light bulbs, 25 Watts each, will be installed, altogether 48 bulbs. On two adjoining walls, eually at intervals of 1 ft., but slightly lower, i.e. at approximately chest level, infra-red photo-relays will be situated. On the ooposite two adjoining walls will be the complimentary projectors. Twenty-four infra-red projectors and 24 relays are needed. It is important that these projectors emit only invisible light, and it is also desirable that the relays be silent in their operation. The incandescant bulbs are connected with the relays in such a way that, whenever the projector-relay infra-red light beam is interrupted, the bulbs directly above these respective pieces of equipment light up immediately. Assuming that a person in this room under normal circumstances breaks two beams(perpendicular to each other), four bulbs will light up at once, one on each of the four walls. If there is more than one person in the room, more lights will be on, four lights for each person. Thus the number of persons in the room determines the degree of illumination. - The gallery has A.C. current, with numerous outlets, each with a seperate 15 amp. fuse.

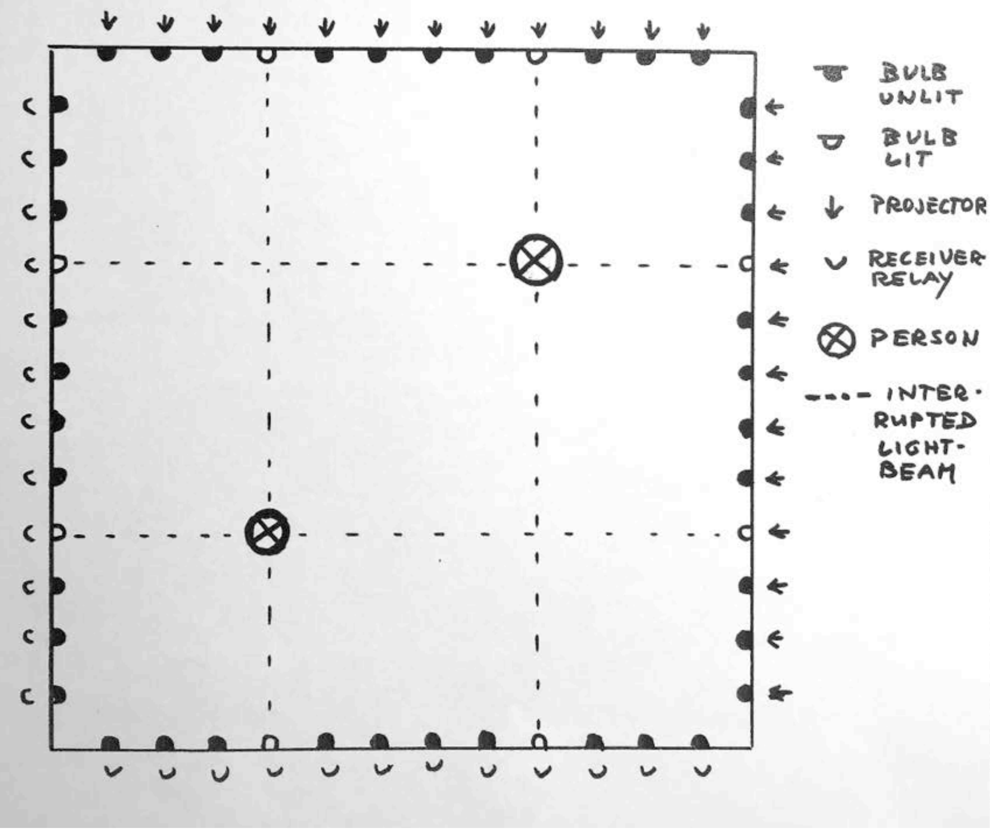


Figure 3.49.
Hans Haacke, description and diagram of "Photo-electrically sensitized environment," in Haacke's E.A.T. artist membership form and project proposal, n.d. but likely fall 1967. E.A.T./GRI Box 6, Folder 42.

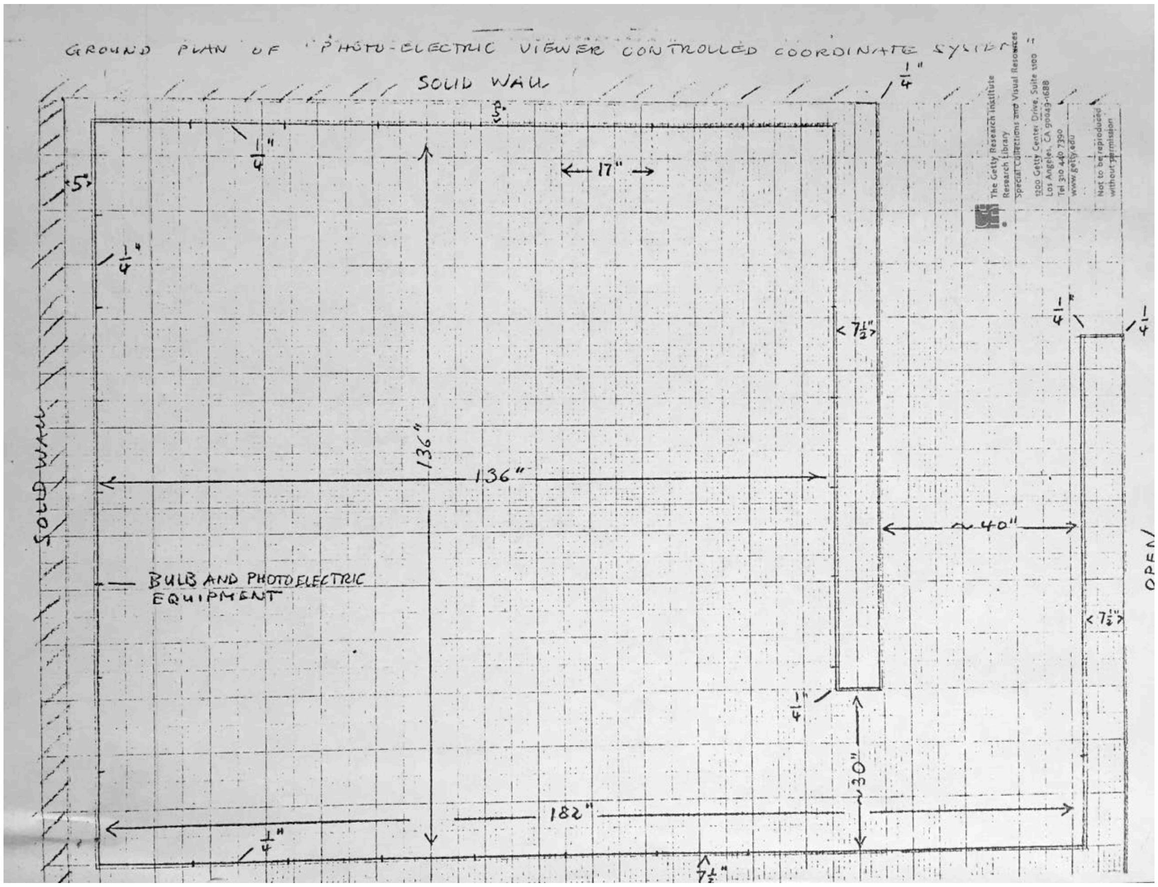


Figure 3.50.
Ground plan for Hans Haacke's *Photo-Electric Viewer-Controlled Coordinate System*, 1968. E.A.T./GRI Box 27, Folder 4.

Figure 3.51.
Mel Bochner, *Singer Lab Measurement #4*, 1968. Gelatin silver print, 10" x 8".

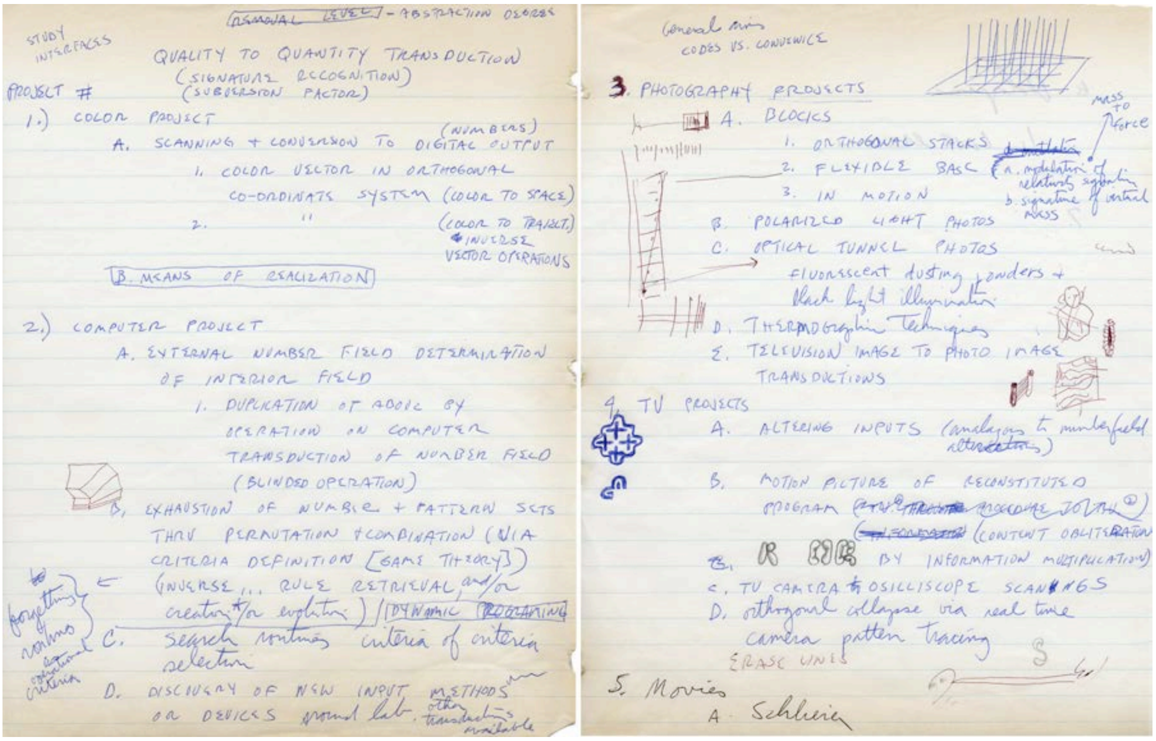


Figure 3.52.
Mel Bochner, pages from *The Singer Notes*, 1968.
Ink and pencil on paper, each 8.5" x 11".

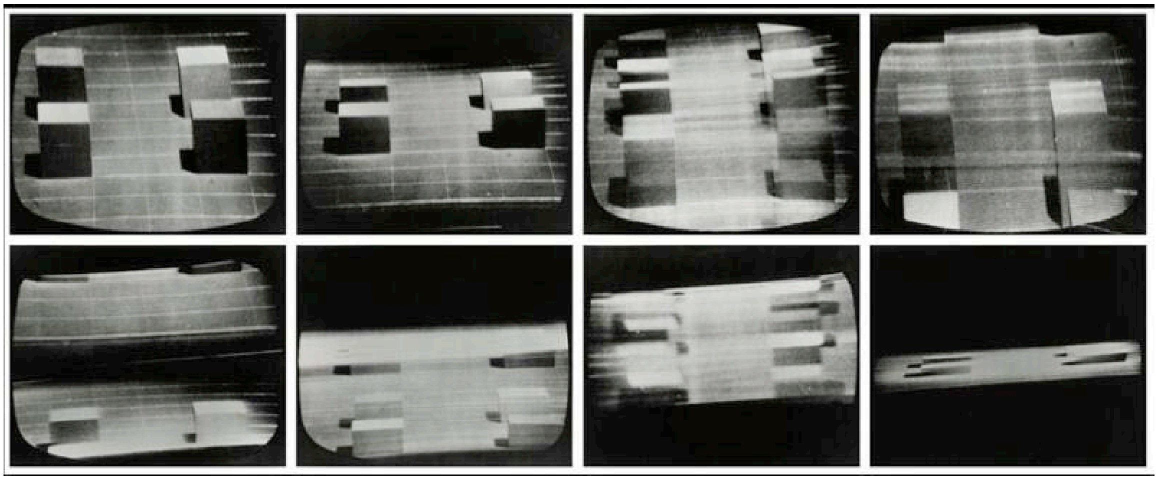


Figure 3.53.
Mel Bochner, *Roll,* 1968. Eight gelatin silver prints, each 20" x 24".

Figure 3.54.
Mel Bochner, *Singer Lab Measurement #1*, 1968. Silver gelatin print, 10" x 8".

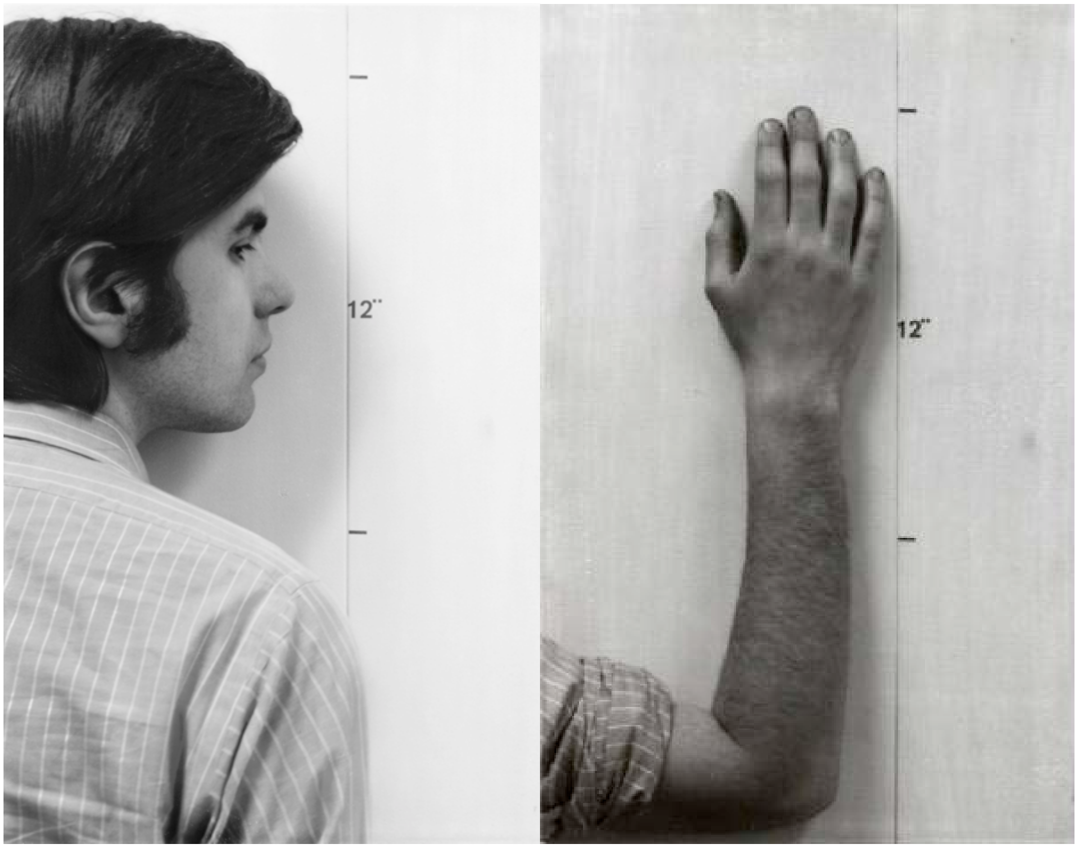


Figure 3.55.
Mel Bochner, *Actual Size (Hand and Face)*, 1968.
Two gelatin silver prints, each 22" × 14 ¼".

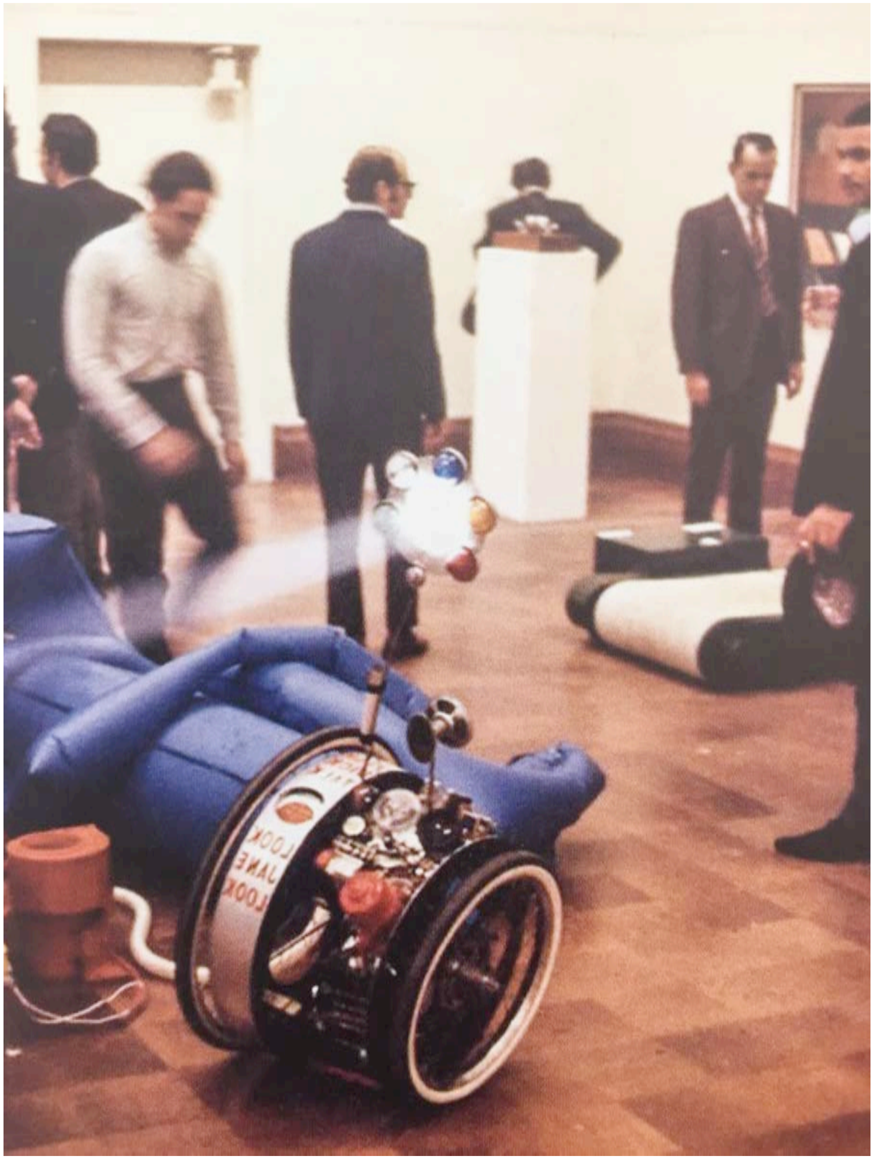


Figure 3.56.
"Some More Beginnings," Brooklyn Museum of Art, installation view, 1968.
Brooklyn Museum Archives, Records of the Department of Painting and Sculpture.

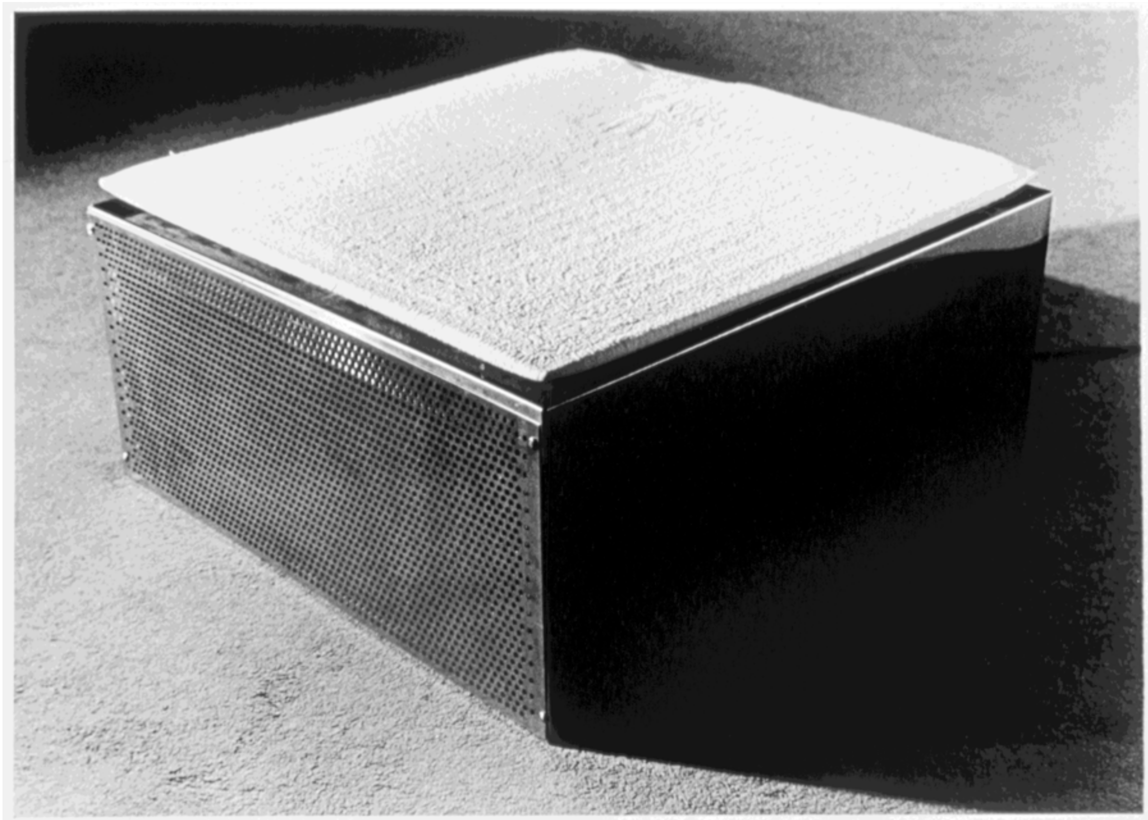


Figure 3.57.
Hans Haacke, *Ice Table*, 1967. Stainless steel freezing plate, refrigeration unit, environmental moisture, 36" x 36" x 18". E.A.T./GRI Box 189.

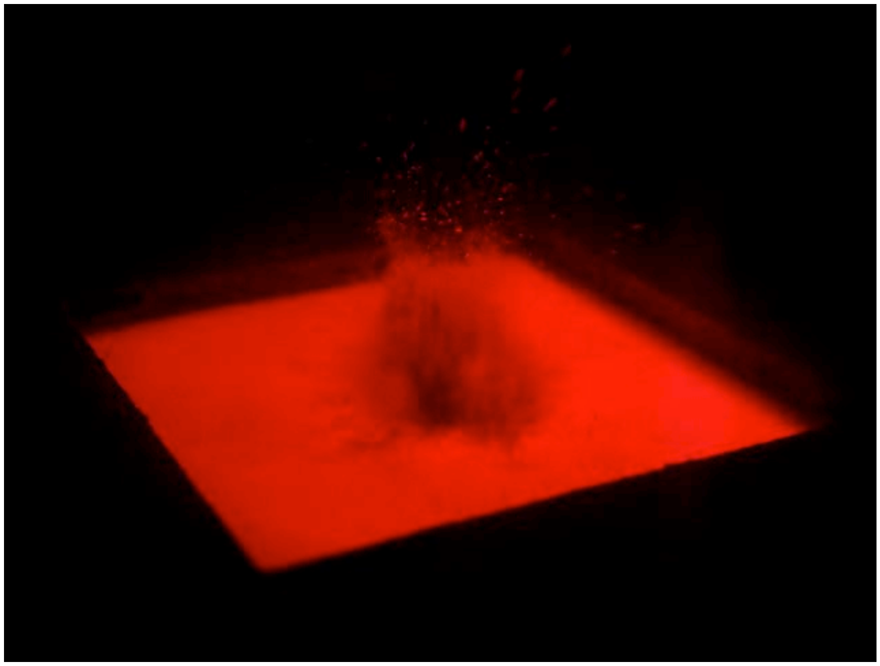


Figure 3.58.
Jean DuPuy, *Heart Beats Dust*, 1968. Wood, glass, lithol rubine, tape recorder, coaxial speaker, tungsten-halogen lamp, rubber, 72" x 22" x 22". Engineers: Ralph Martel and Harris Hyman. Photo: Terry Stevenson.

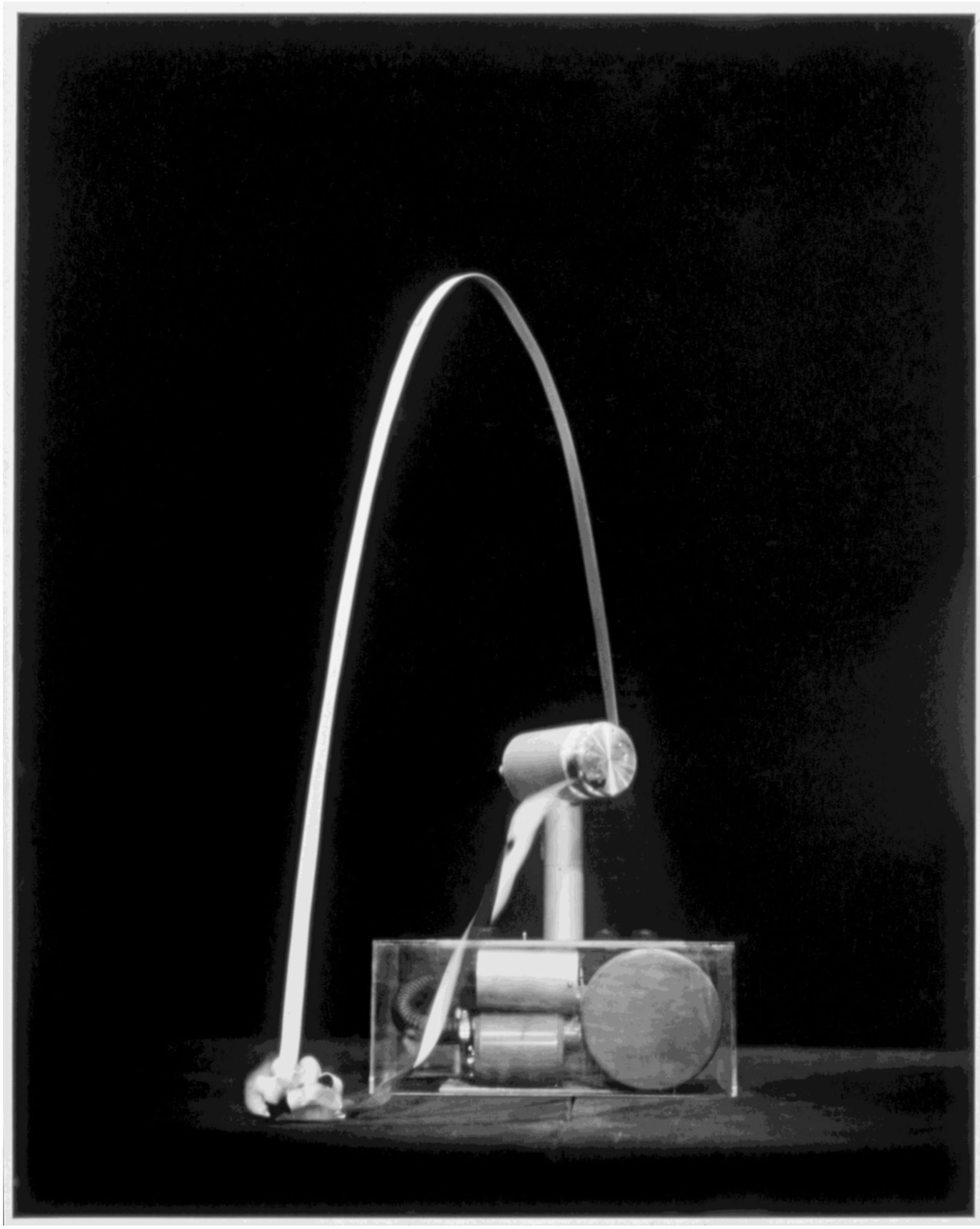


Figure 3.59.
Lucy Young, *Fakir in ¾ Time*, 1968. Aluminum, plastic, motor, textile cord, dimensions variable. Engineer: Niels O. Young. Photo: Shunk-Kender.

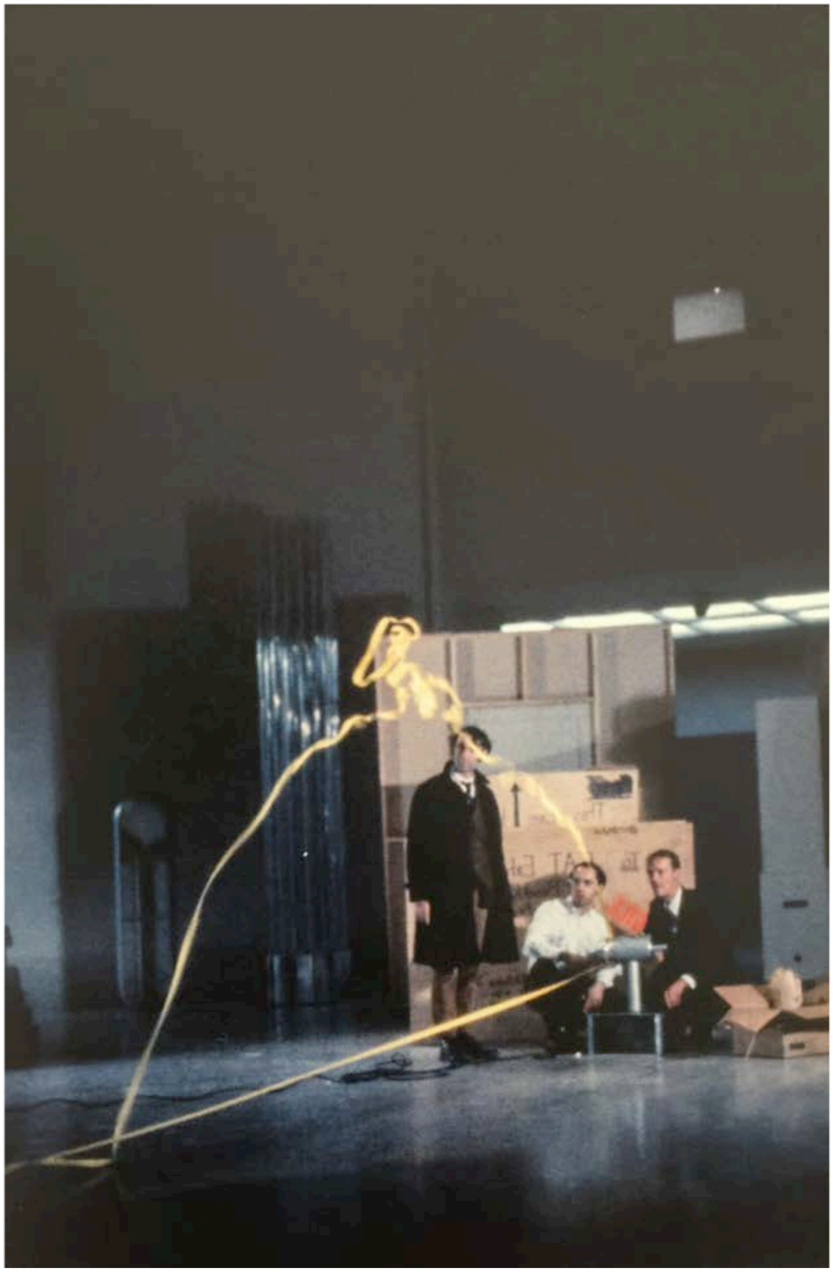


Figure 3.60.
Testing Lucy Young’s *Fakir in ¾ Time*, 1968, at the Brooklyn Museum, New York, 1968. Photo: Shunk-Kender.

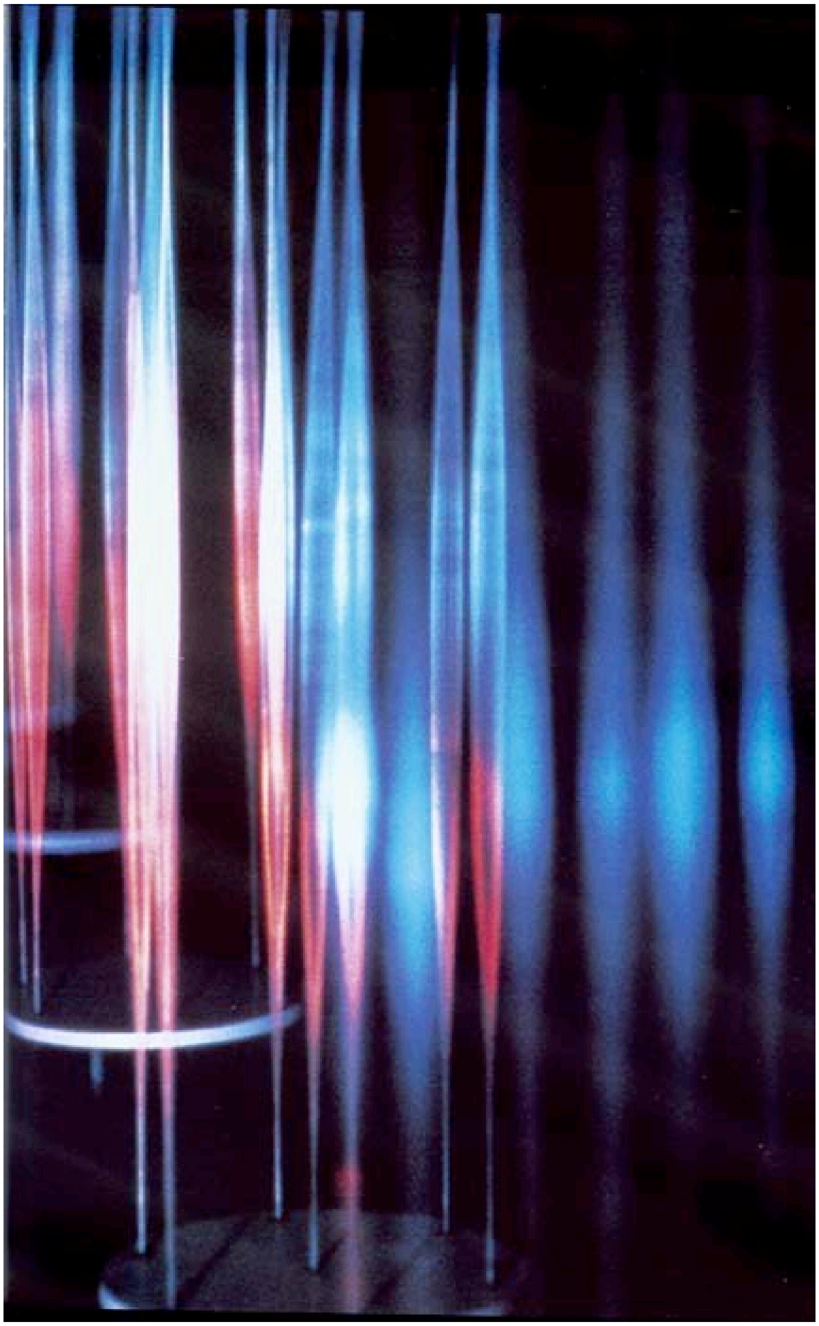


Figure 3.61.
Wen-Ying Tsai and Frank Turner, *Cybernetic Sculpture*, 1968. Multiple stainless steel units, each 9' 4" x 20" at base; oscillator, stroboscopic lights, electronic equipment.

Figure 3.62.
Takis with his *Tele-sculpture*, 1960, in the sculpture garden of the Museum of Modern Art, New York, after the artwork's removal from the museum on January 3, 1969. Photo: Mehdi Khonsari, *East Village Other*, January 24, 1969.

Figure 3.63.
Herwig Kogelnik delivering a lecture-demonstration on lasers, September 24, 1967, E.A.T. headquarters, New York. Photo: Peter Moore. E.A.T./GRI Box 187.

Figure 3.64.
"Light sources, equipment and systems," a lecture-demonstration of various types of lamps, including Kliegel lights and Xenon lamp (pictured in foreground), March 24, 1968, E.A.T. headquarters, New York. Photo: Peter Moore. E.A.T./GRI Box 188.

Figure 3.65.
Attendees at lecture on honeycomb paper structures, delivered by N. Nelson of Union Camp Co., inspecting sample of 1-inch thick pre-stiffened honeycomb paper, February 27, 1968, E.A.T. headquarters, New York. Photo: Peter Moore. E.A.T./GRI Box 188.

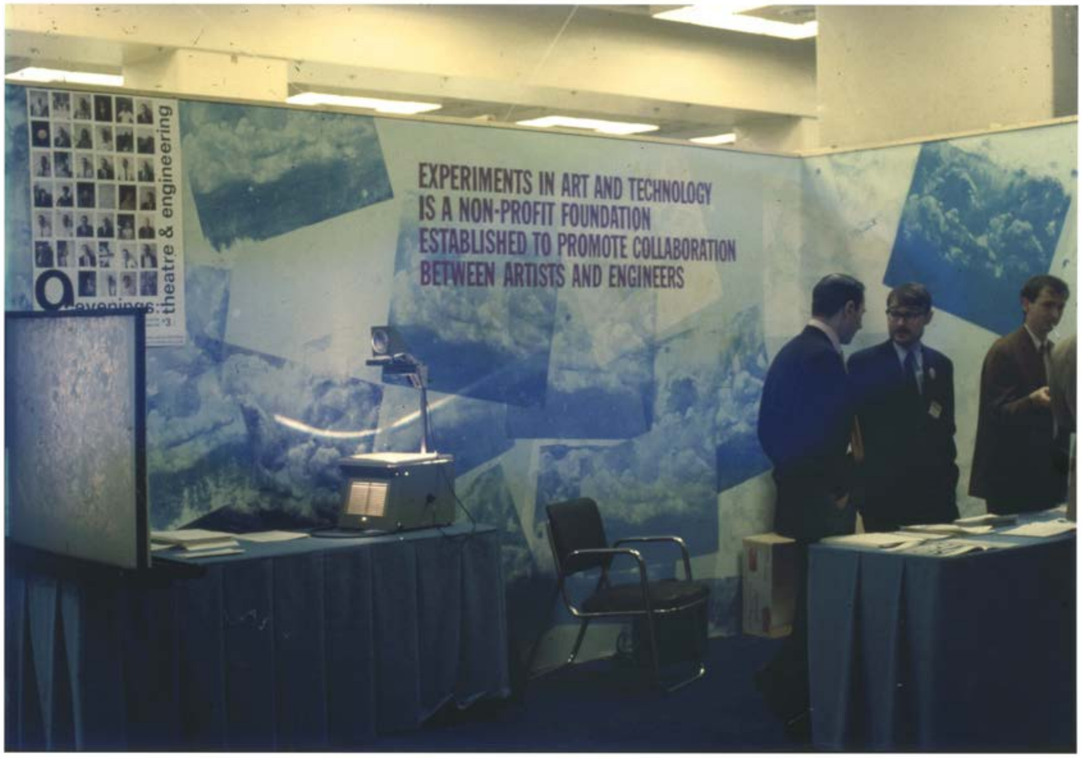


Figure 4.1.
E.A.T. Booth, IEEE (Institute of Electrical and Electronics Engineers) convention, March 1968, New York. Photo: Joseph H. Melhado, Jr. E.A.T./GRI Box 188.

Figure 4.2.
Bell Laboratories, Murray Hill, NJ. Photo: Alcatel-Lucent Bell Laboratories.

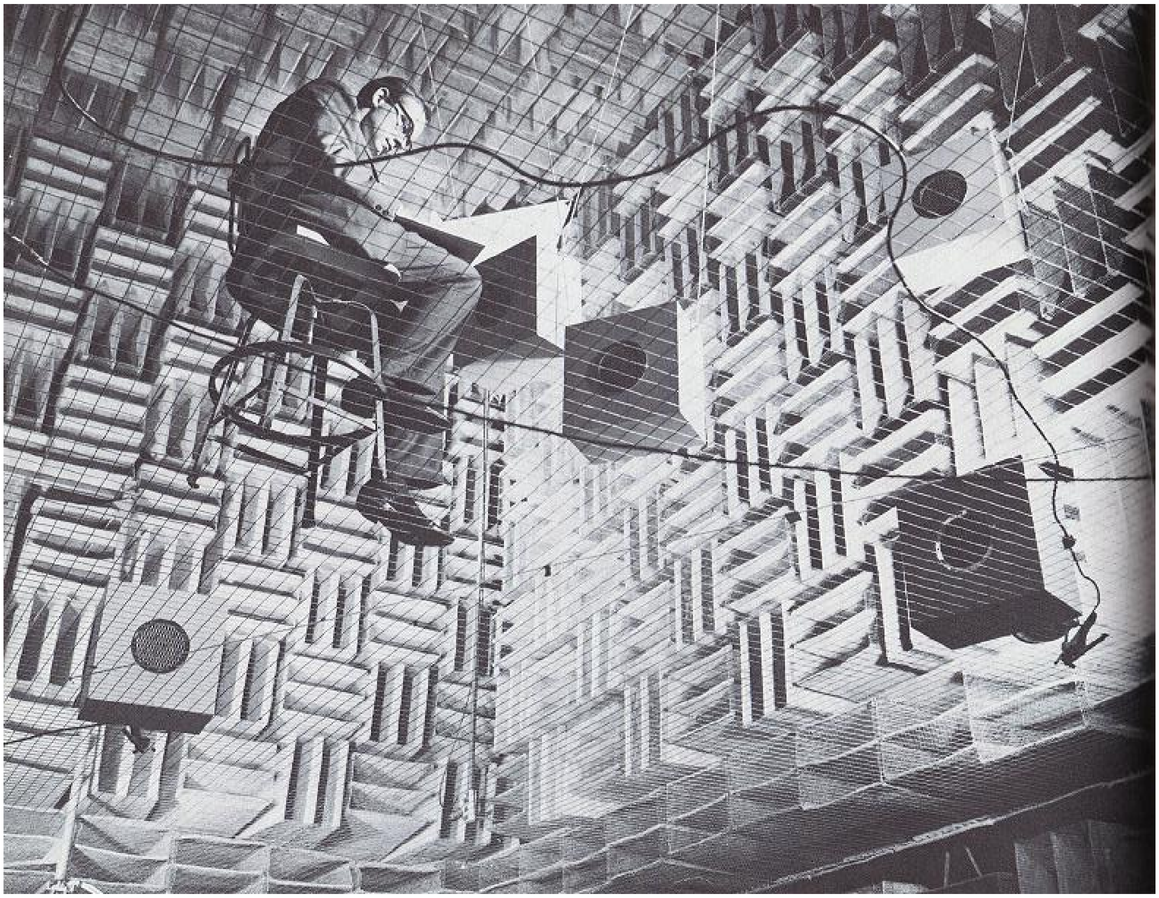


Figure 4.3.
Scientist taking psychoacoustic measurements in anechoic chamber, Bell Laboratories, 1965. Photo: Alcatel-Lucent Bell Laboratories.

Figure 4.4.
John R. Pierce at Bell Laboratories, 1960. Wikimedia Commons, last accessed March 8, 2017.

Figure 4.5.
Max Mathews, right, with Lawrence Rosler of Bell Laboratories with the Graphics 1 computer sound system, circa 1967. Photo: Alcatel-Lucent. http://120years.net/category/date/1960-1970/, last accessed March 12, 2017.

Figure 4.6.
Engineer Ted Wolff and artist Max Neuhaus, New York, 1967. E.A.T./GRI Box 187.

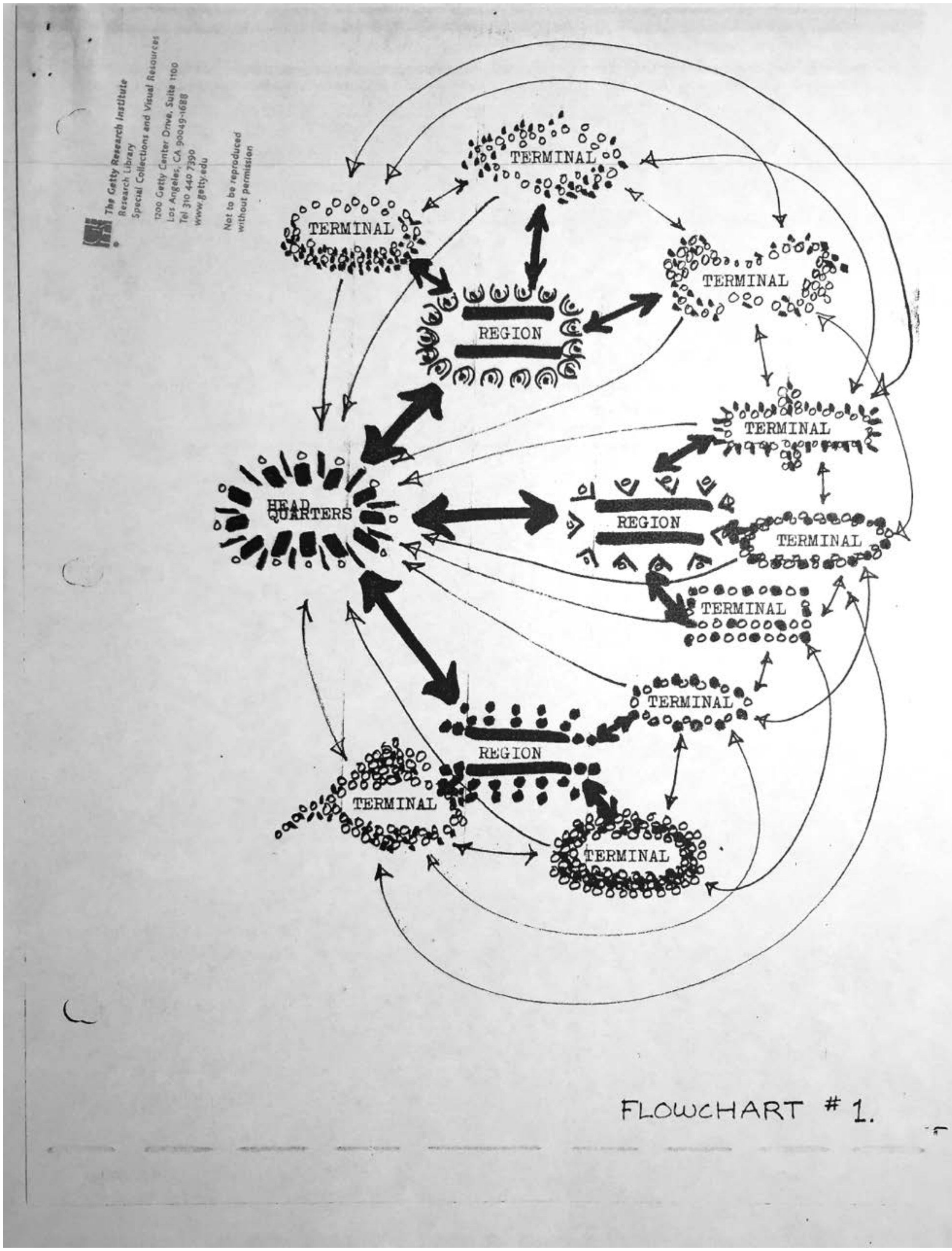


Figure 4.7.
David MacDermott, "Flowchart #1," in "Comments on E.A.T. Policy Statement," July 9, 1969. E.A.T./GRI Box 29, Folder 16.

Figure 4.8.
Cover of E.A.T./L.A. *SURVEY* 1, January 1970. Pictured: Pepsi Pavilion mirror dome model demonstration in Santa Ana, California. MoMA/E.A.T. Klüver Documents #150.

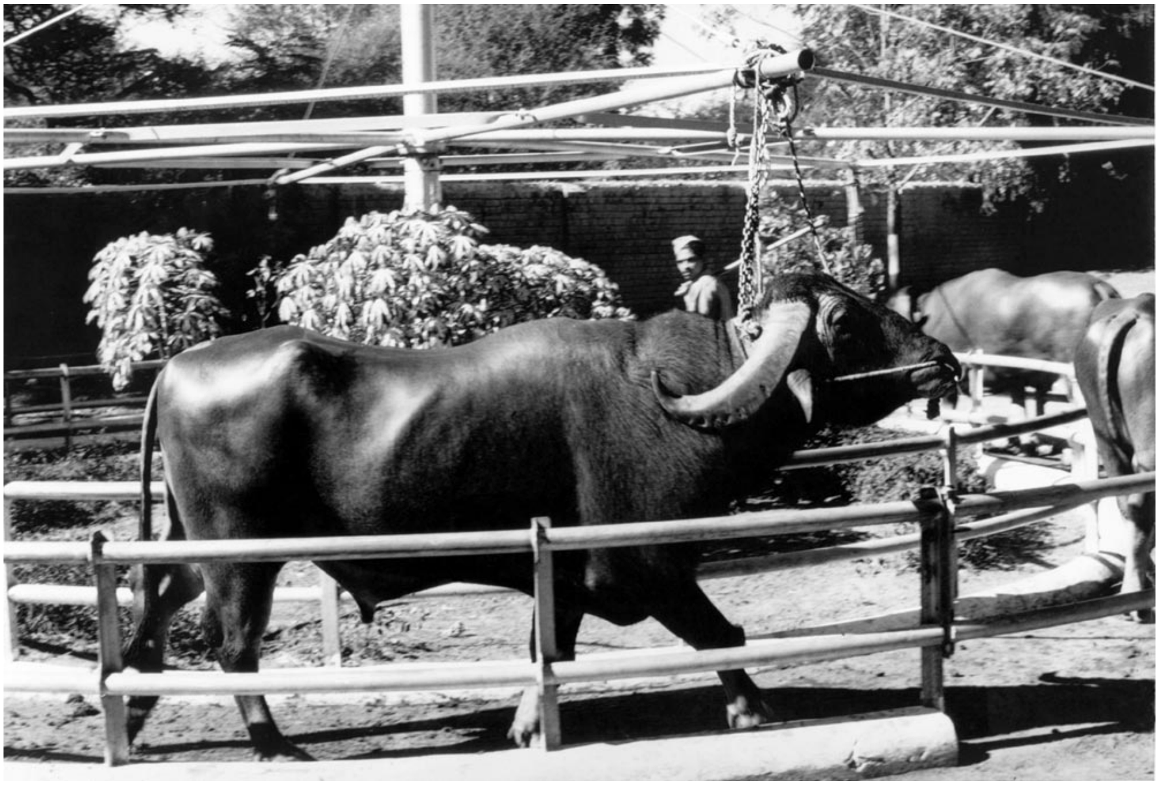


Figure 4.9.
Anand Dairy Cooperative, Gujarat, India, December 1969. Reprinted from E.A.T., “A Proposal for a Pre-Investment Study to Establish a Field Research Laboratory for Innovation in Education,” February 16, 1970. MoMA E.A.T./Klüver Documents #154.

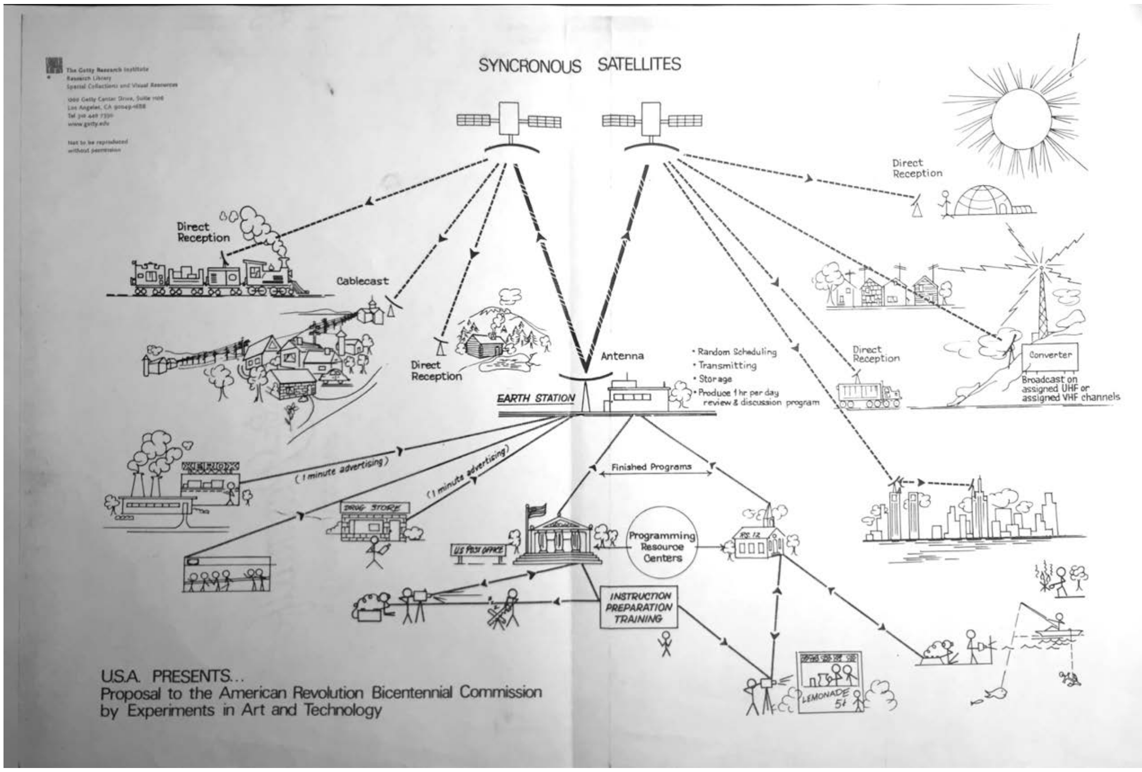


Figure 4.10.
E.A.T., "Synchronous Satellites," diagram for "U.S.A. PRESENTS... / A Proposal for a Satellite Television System Programmed by the American People," submitted to the American Revolution Bicentennial Commission, Feb. 22, 1971. E.A.T./GRI Box 95, Folder 4.

Figure 4.11.
E.A.T., Pepsi Pavilion, Expo 70, Osaka, 1970. Photo: Shunk-Kender.

Figure 4.12.
Mirror dome interior, Pepsi Pavilion, Expo 70, Osaka, 1970.
Photo: Shunk-Kender. E.A.T./GRI Box 199.

Figure 4.13.
E.A.T., Pepsi Pavilion, Expo 70, Osaka. Photo: Shunk-Kender. E.A.T./GRI Box 200.

Figure 4.14.
E.A.T. Pepsi Pavilion team, Expo 70, Osaka, opening day, March 15, 1970. Photo: Shunk-Kender. E.A.T./GRI Box 197.

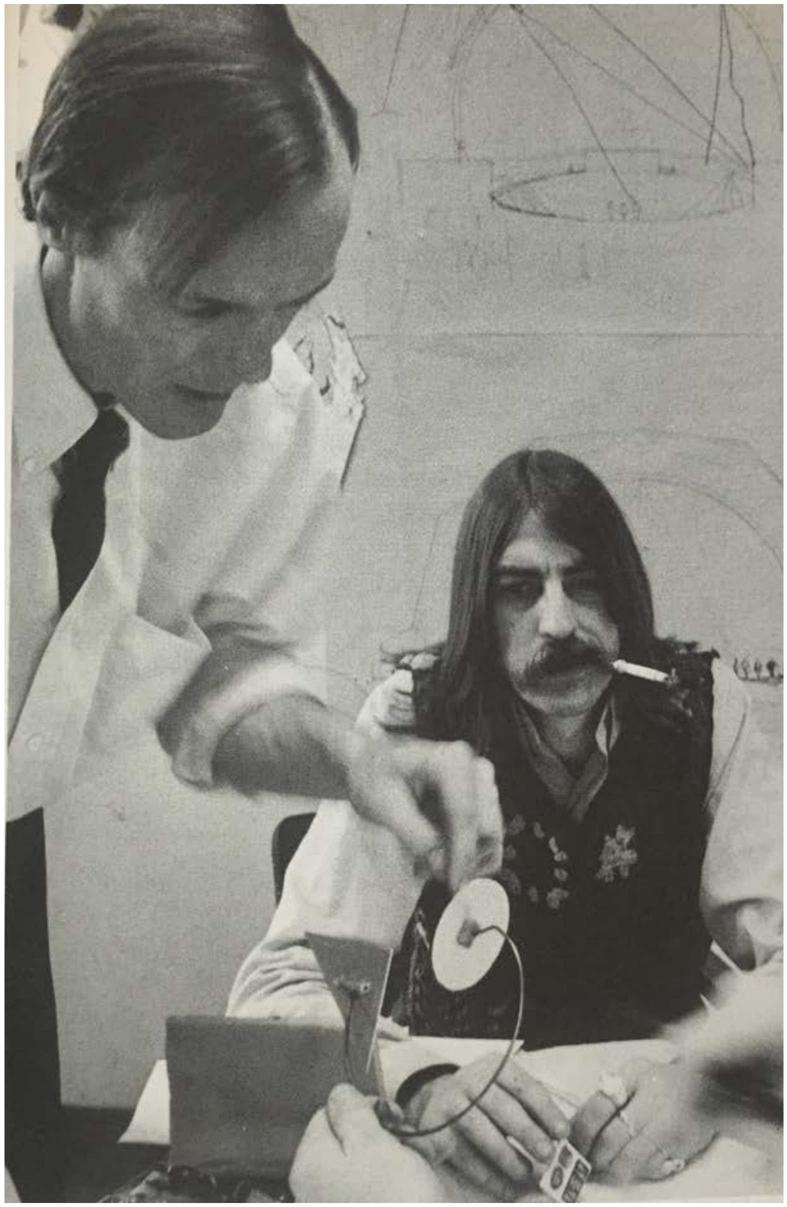


Figure 4.15.
Engineer Niels Young and artist Forrest Myers working on a model for *Suntrak*, 1969.
Reprinted from E.A.T., *Pavilion* (New York: E.P. Dutton, 1972).

Figure 4.16.
Fujiko Nakaya and Robert Breer with *Floats* in progress (base structure in foreground), Pepsi Pavilion, Expo 70, Osaka, 1970. Photo: Shunk-Kender. E.A.T./GRI Box 198.

Figure 4.17.
Expo 70 Festival Plaza, Kodak and Ricoh pavilions, April 1970.
Photo: Takato Marui / Creative Commons.

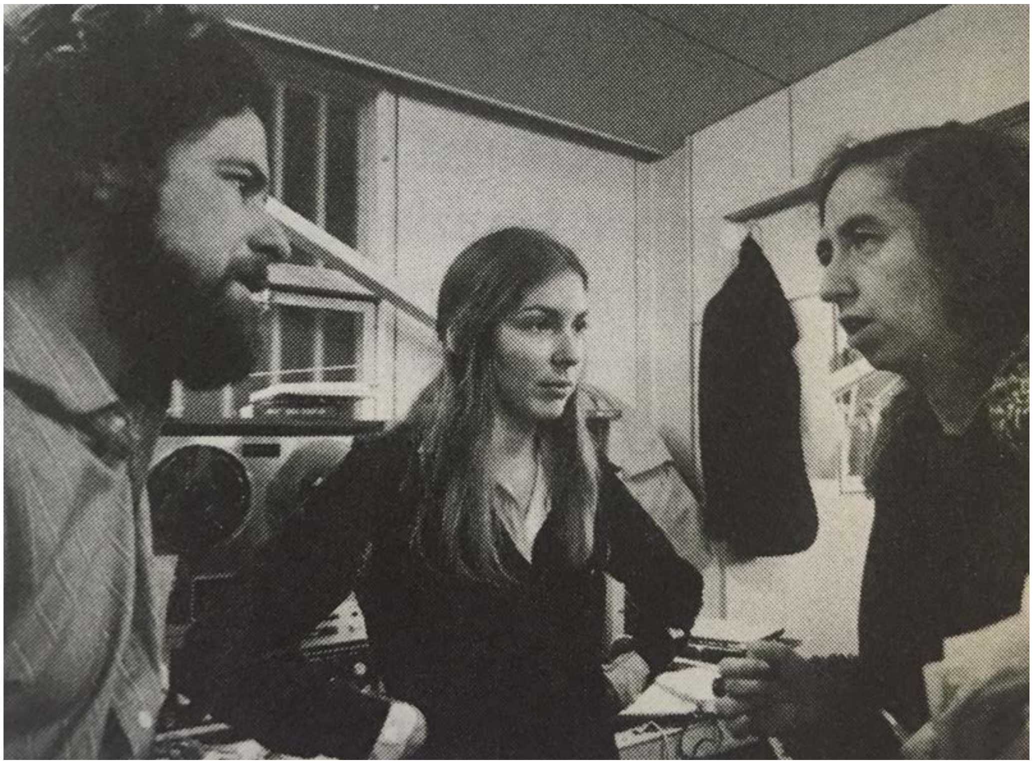


Figure 4.18.
Tony Martin, Ritty Burchfield, and Julie Martin in E.A.T. temporary office, Expo 70, Osaka, 1970. Photo: Shunk-Kender. E.A.T./GRI Box 197.

Figure 4.19.
Skip Savard and Robert Breer working in what was to become the Pavilion hostesses' powder room, Pepsi Pavilion, Expo 70, Osaka, 1970. Photo: Shunk-Kender. E.A.T./GRI Box 197.

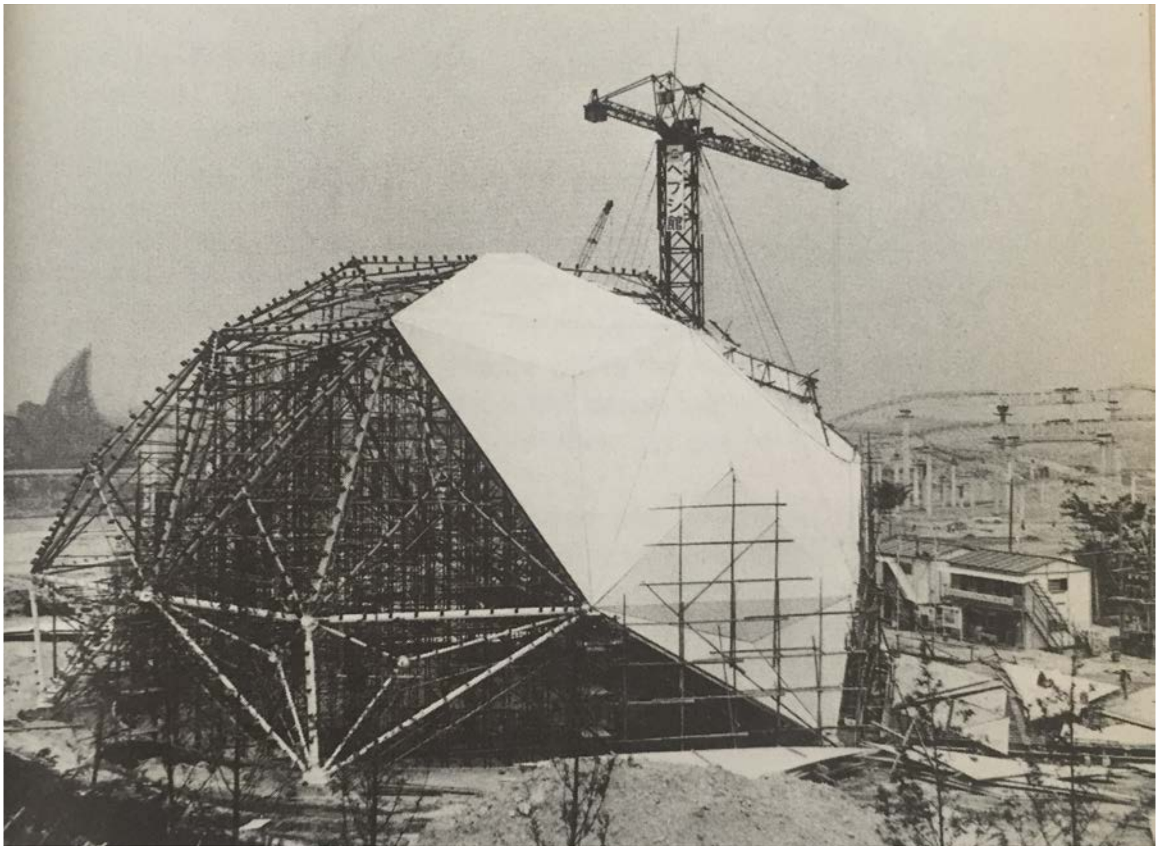


Figure 4.20.
Pepsi Pavilion dome construction, mounting polyvinyl chloride panels, summer 1969.
Photo: Fujiko Nakaya. E.A.T./GRI Box 194.

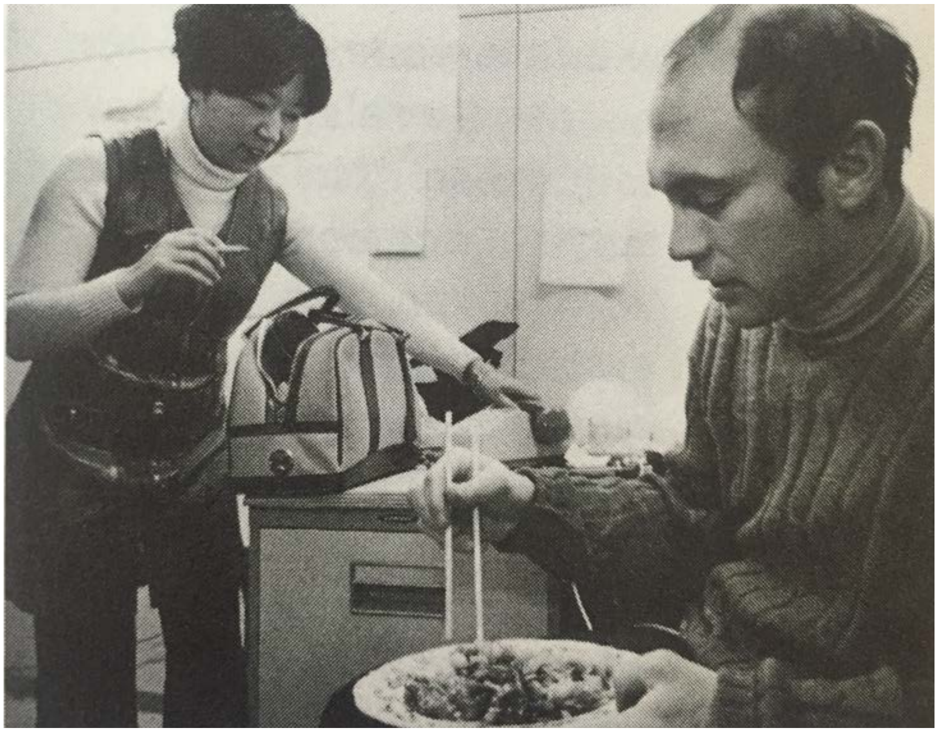
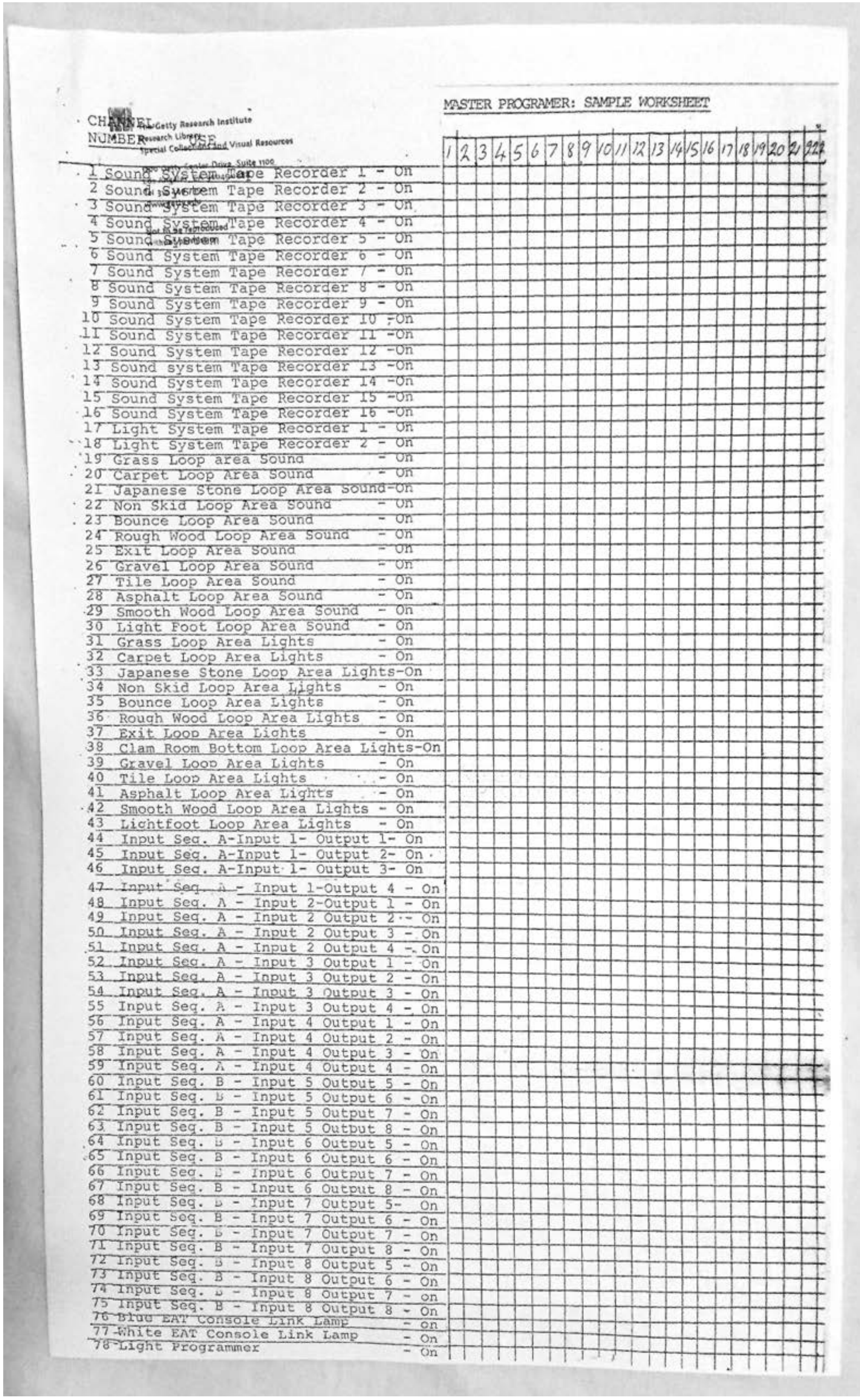


Figure 4.21.
Fujiko Nakaya and John Pearce in E.A.T. office, Expo 70, Osaka, 1970. Photo: Shunk-Kender. E.A.T./GRI Box 197.

Figure 4.22.
David Tudor and Ardison Philips working on program audio tapes, Pepsi Pavilion, Expo 70, Osaka, 1970. Photo: Shunk-Kender. E.A.T./GRI Box 197.



MASTER PROGRAMER: SAMPLE WORKSHEET
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2 Sound System Tape Recorder 2 - On
3 Sound System Tape Recorder 3 - On
4 Sound System Tape Recorder 4 - On
5 Sound System Tape Recorder 5 - On
6 Sound System Tape Recorder 6 - On
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13 Sound system Tape Recorder 13 -On
14 Sound System Tape Recorder 14 -On
15 Sound System Tape Recorder 15 -On
16 Sound System Tape Recorder 16 -On
17 Light System Tape Recorder 1 - On
18 Light System Tape Recorder 2 - On
19 Grass Loop area Sound - On
20 Carpet Loop Area Sound - On
21 Japanese Stone Loop Area Sound-On
22 Non Skid Loop Area Sound - On
23 Bounce Loop Area Sound - On
24 Rough Wood Loop Area Sound - On
25 Exit Loop Area Sound - On
26 Gravel Loop Area Sound - On
27 Tile Loop Area Sound - On
28 Asphalt Loop Area Sound - On
29 Smooth Wood Loop Area Sound - On
30 Light Foot Loop Area Sound - On
31 Grass Loop Area Lights - On
32 Carpet Loop Area Lights - On
33 Japanese Stone Loop Area Lights-On
34 Non Skid Loop Area Lights - On
35 Bounce Loop Area Lights - On
36 Rough Wood Loop Area Lights - On
37 Exit Loop Area Lights - On
38 Clam Room Bottom Loop Area Lights-On
39 Gravel Loop Area Lights - On
40 Tile Loop Area Lights - On
41 Asphalt Loop Area Lights - On
42 Smooth Wood Loop Area Lights - On
43 Lichtfoot Loop Area Lights - On
44 Input Seq. A-Input 1- Output 1- On
45 Input Seq. A-Input 1- Output 2- On
46 Input Seq. A-Input 1- Output 3- On
47 Input Seq. A - Input 1-Output 4 - On
48 Input Seq. A - Input 2-Output 1 - On
49 Input Seq. A - Input 2 Output 2 - On
50 Input Seq. A - Input 2 Output 3 - On
51 Input Seq. A - Input 2 Output 4 - On
52 Input Seq. A - Input 3 Output 1 - On
53 Input Seq. A - Input 3 Output 2 - On
54 Input Seq. A - Input 3 Output 3 - On
55 Input Seq. A - Input 3 Output 4 - On
56 Input Seq. A - Input 4 Output 1 - On
57 Input Seq. A - Input 4 Output 2 - On
58 Input Seq. A - Input 4 Output 3 - On
59 Input Seq. A - Input 4 Output 4 - On
60 Input Seq. B - Input 5 Output 5 - On
61 Input Seq. B - Input 5 Output 6 - On
62 Input Seq. B - Input 5 Output 7 - On
63 Input Seq. B - Input 5 Output 8 - On
64 Input Seq. B - Input 6 Output 5 - On
65 Input Seq. B - Input 6 Output 6 - On
66 Input Seq. B - Input 6 Output 7 - On
67 Input Seq. B - Input 6 Output 8 - On
68 Input Seq. B - Input 7 Output 5- On
69 Input Seq. B - Input 7 Output 6 - On
70 Input Seq. B - Input 7 Output 7 - On
71 Input Seq. B - Input 7 Output 8 - On
72 Input Seq. B - Input 8 Output 5 - On
73 Input Seq. B - Input 8 Output 6 - On
74 Input Seq. B - Input 8 Output 7 - on
75 Input Seq. B - Input 8 Output 8 - On
76 Blue EAT Console Link Lamp - on
77 White EAT Console Link Lamp - On
78 Light Programmer - On

Figure 4.23.
Pepsi Pavilion programming schedule and organizational chart, 1970.
E.A.T./GRI Box 44, Folder 29.

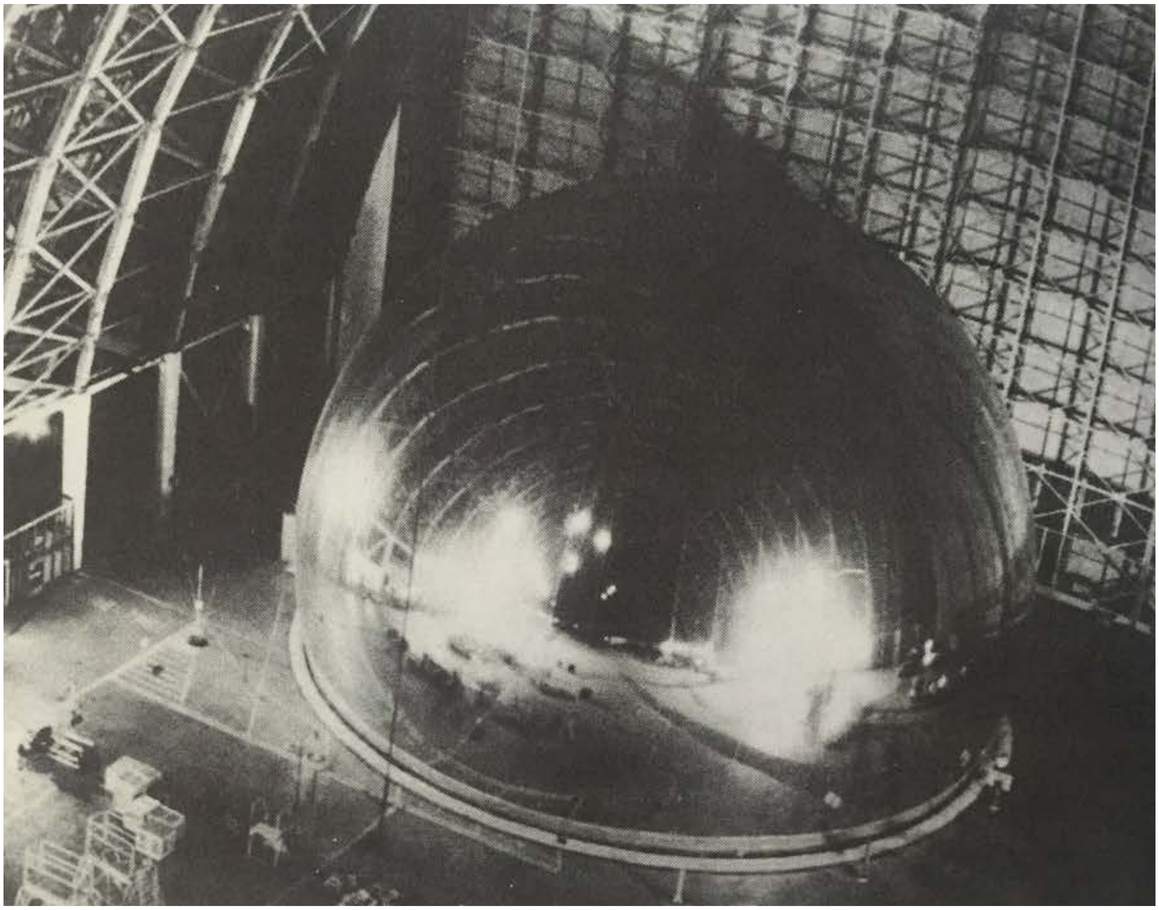


Figure 4.24.
Full-scale model of mirror dome, installed at Marine Air Corps Station, Santa Ana, California, September 1969. Photo: David MacDermott. E.A.T./GRI Box 193.

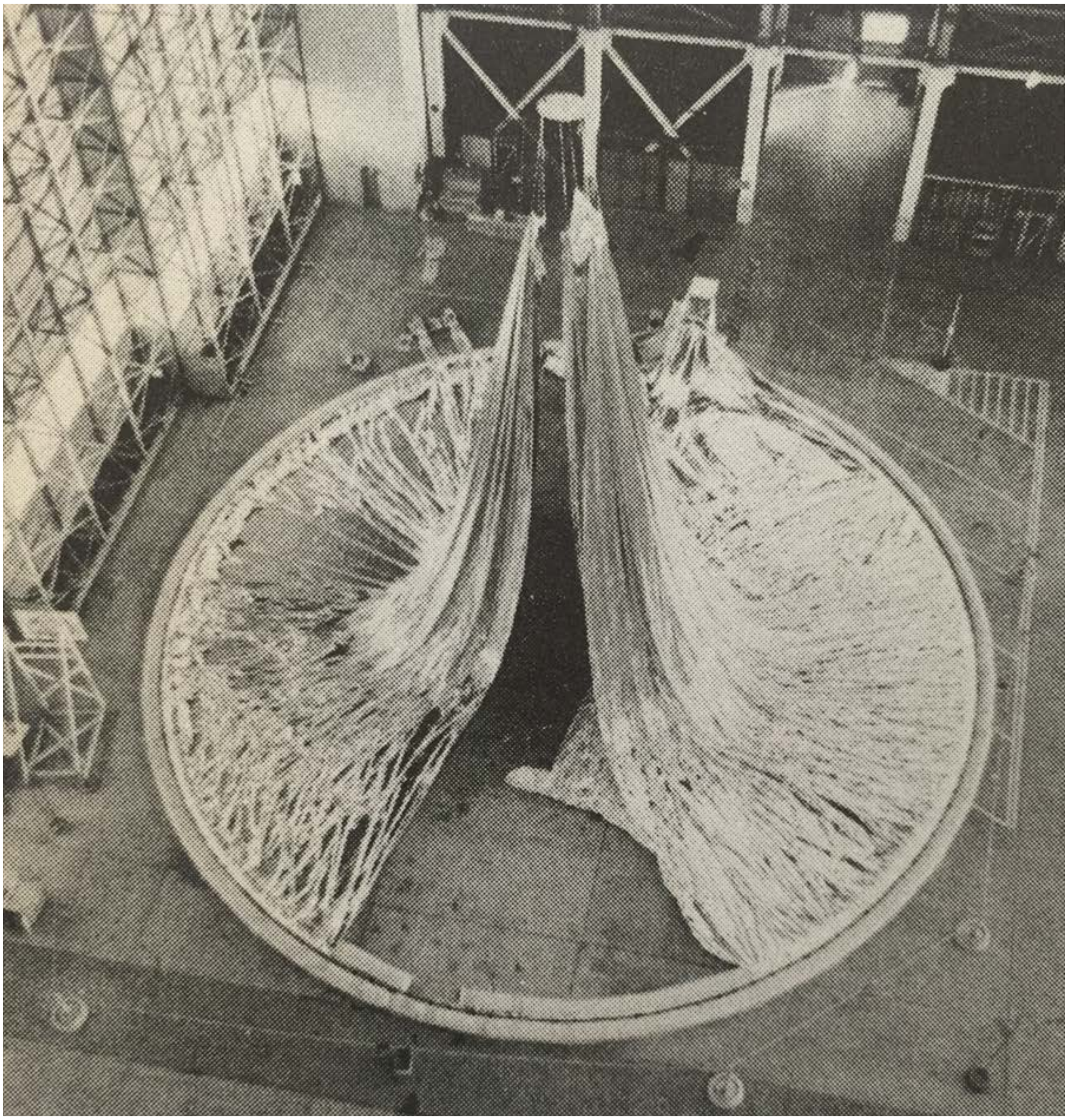


Figure 4.25.
Full-scale model of mirror dome, after initial tear in structure, installed at Marine Air Corps Station, Santa Ana, California, September 1969. Photo: David MacDermott. E.A.T./GRI Box 193.

Figure 4.26.
ECHO 1 satellite, test inflation in dirigible hangar before launch on August 12, 1960.
Photo: NASA.

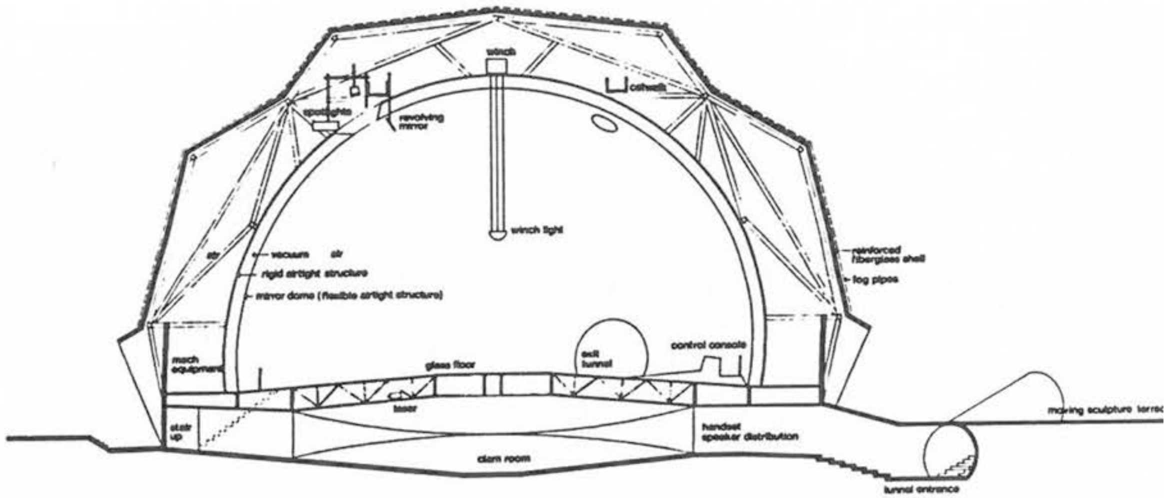


Figure 4.27.
E.A.T., Pepsi Pavilion, dome cross section, rendering by John Pearce, 1970.
E.A.T./GRI Oversize Folder 4.

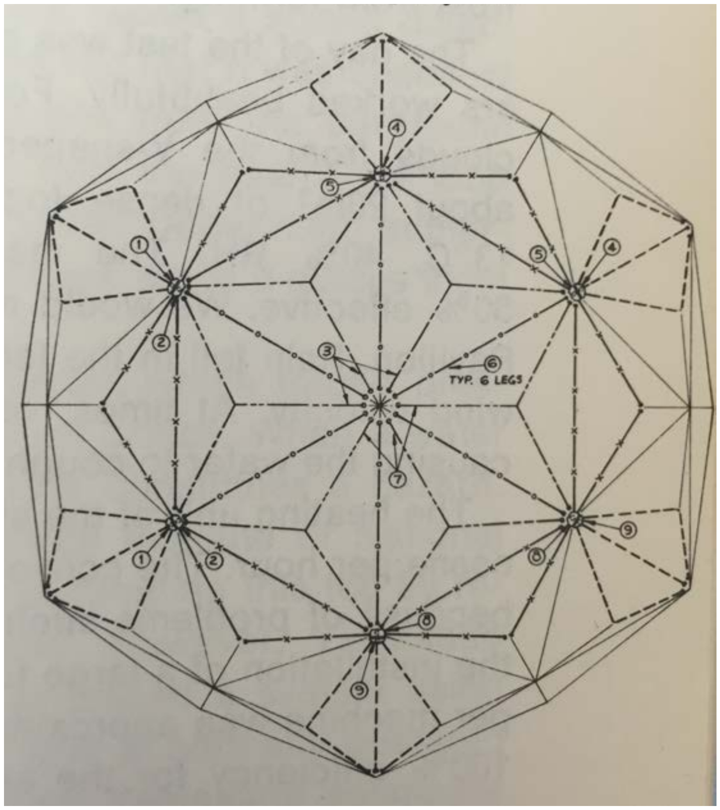


Figure 4.28.
Fog piping layout, Pepsi Pavilion, 1970. E.A.T./GRI Flat file folder 7.

Figure 4.29.
Wind tunnel test at Kyoto University, September 1969.
Reprinted from E.A.T., *Pavilion* (New York: E.P. Dutton, 1972).

Figure 4.30.
Installation of fog piping, Pepsi Pavilion, 1970. Reprinted from E.A.T., *Pavilion* (New York: E.P. Dutton, 1972).

Figure 4.31.
Pump installation for fog system, Pepsi Pavilion, 1970; Fujiko Nakaya and Billy Klüver.
Reprinted from E.A.T., *Pavilion* (New York: E.P. Dutton, 1972).

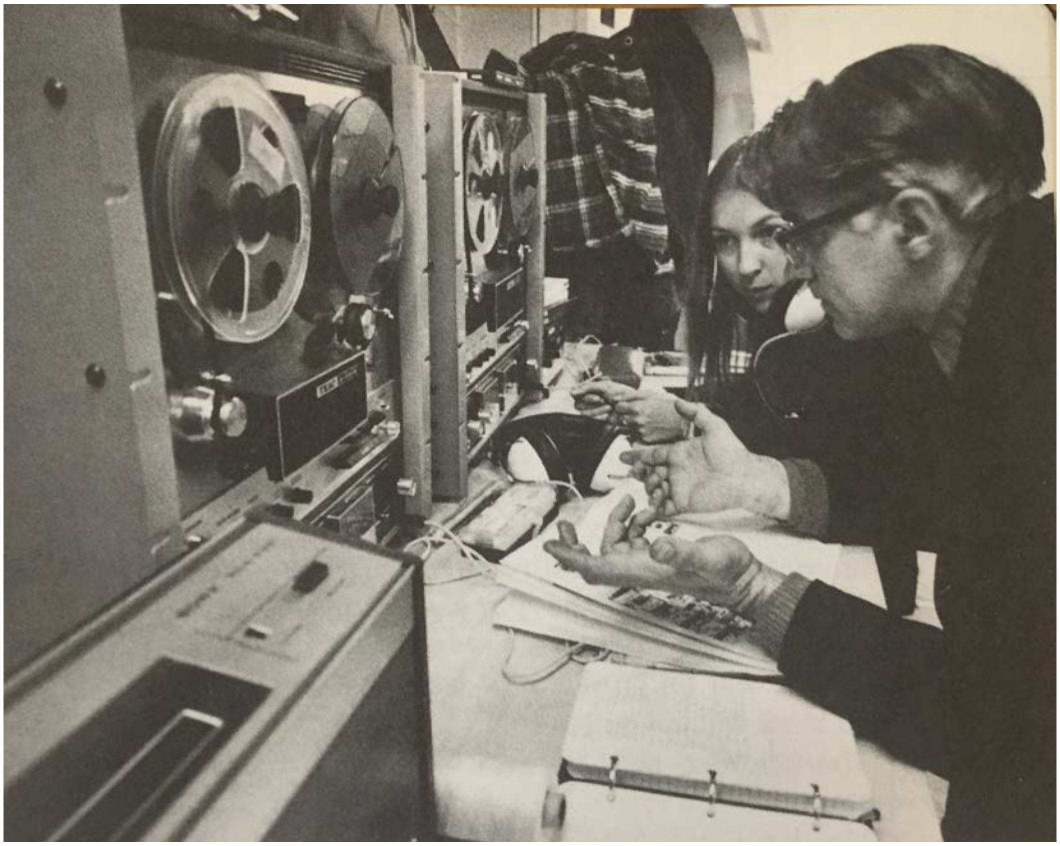


Figure 4.32.
David Tudor and Ritty Burchfield preparing program tapes, Pepsi Pavilion, 1970. Photo: Shunk-Kender. E.A.T./GRI Box 197.

Figure 4.33.
Girl with flag and her “real image,” inverted, near center of mirror dome, Pepsi Pavilion, Expo 70, Osaka, March 1970. Photo: Shunk-Kender. E.A.T./GRI Box 199.

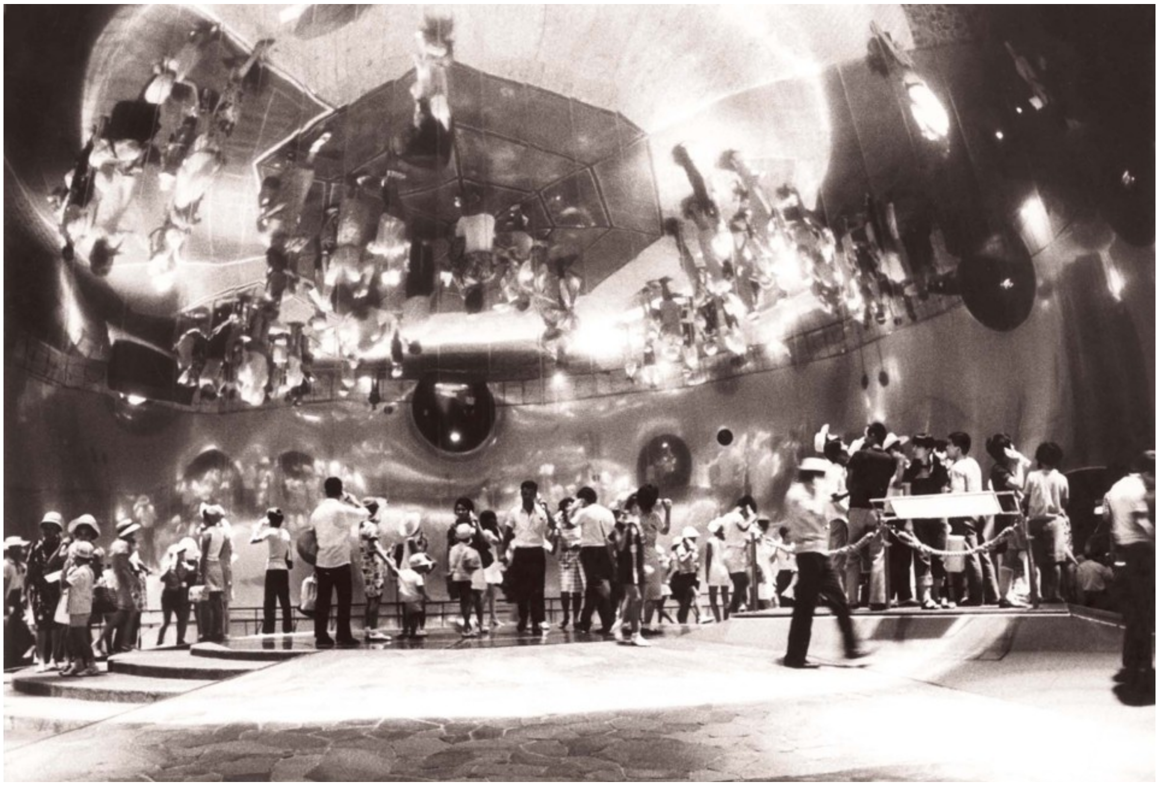
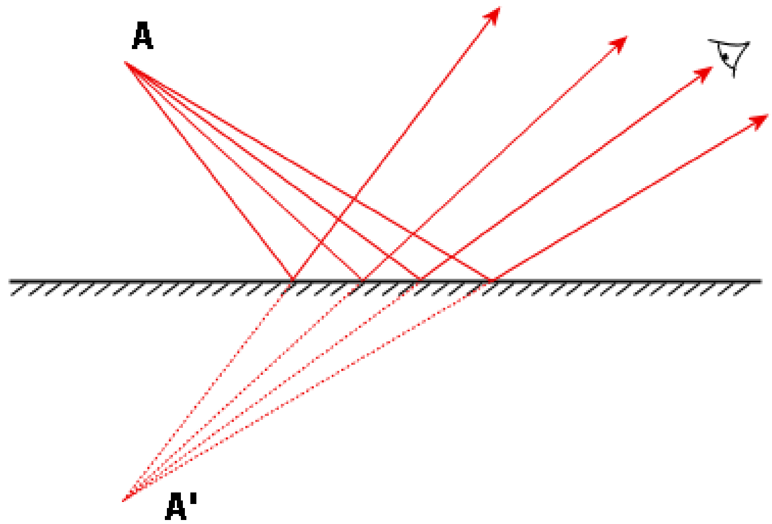
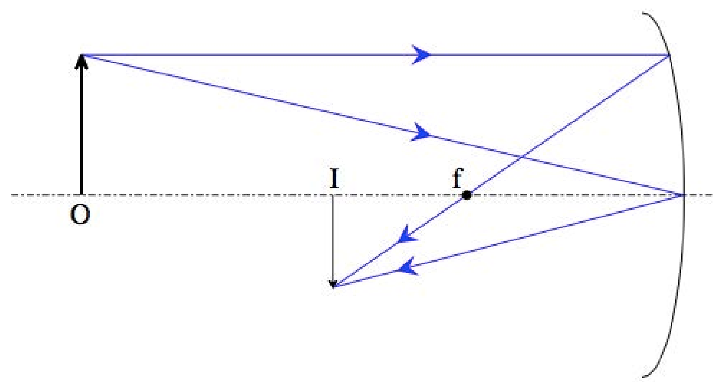


Figure 4.34.
Visitors inside mirror dome, Pepsi Pavilion, Expo 70, Osaka, 1970. Photo: Fujiko Nakaya. E.A.T./GRI Box 199.





Figures 4.35-4.36.

Top: Diagram of virtual image. Wikimedia Commons.

Bottom: Diagram of real image. Wikimedia Commons.

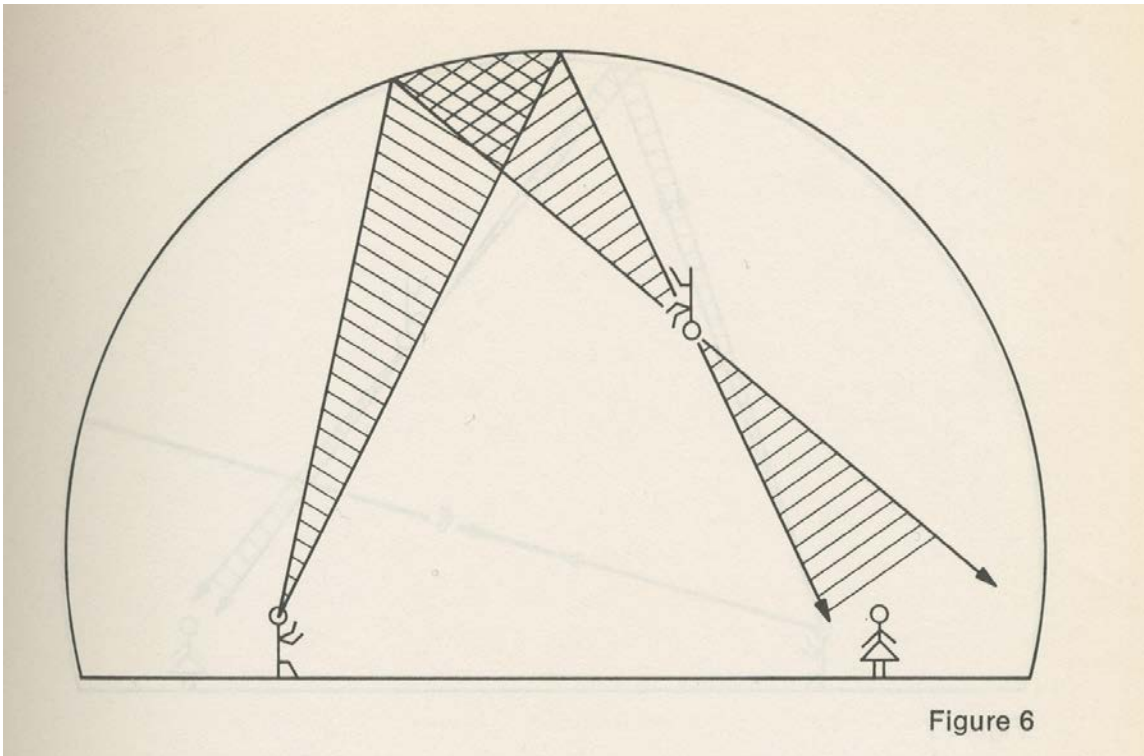


Figure 4.37.
Diagram of real image (inverted male figure) inside Pepsi Pavilion mirror dome.
Reprinted from E.A.T., *Pavilion* (New York: E.P. Dutton, 1972).

Figure 4.38.
Mirror dome interior with real image of pink-draped balloon; and virtual image of red balloons and hanging lantern. Pepsi Pavilion, Expo 70, Osaka, March 1970. Photo: Shunk-Kender. E.A.T./GRI Box 197.

Figure 4.39.
Mirror dome interior with performance of Remy Charlip's *Homage to Loie Fuller*. Pepsi Pavilion, Expo 70, Osaka, March 1970. Photo: Shunk-Kender. E.A.T./GRI Box 197.

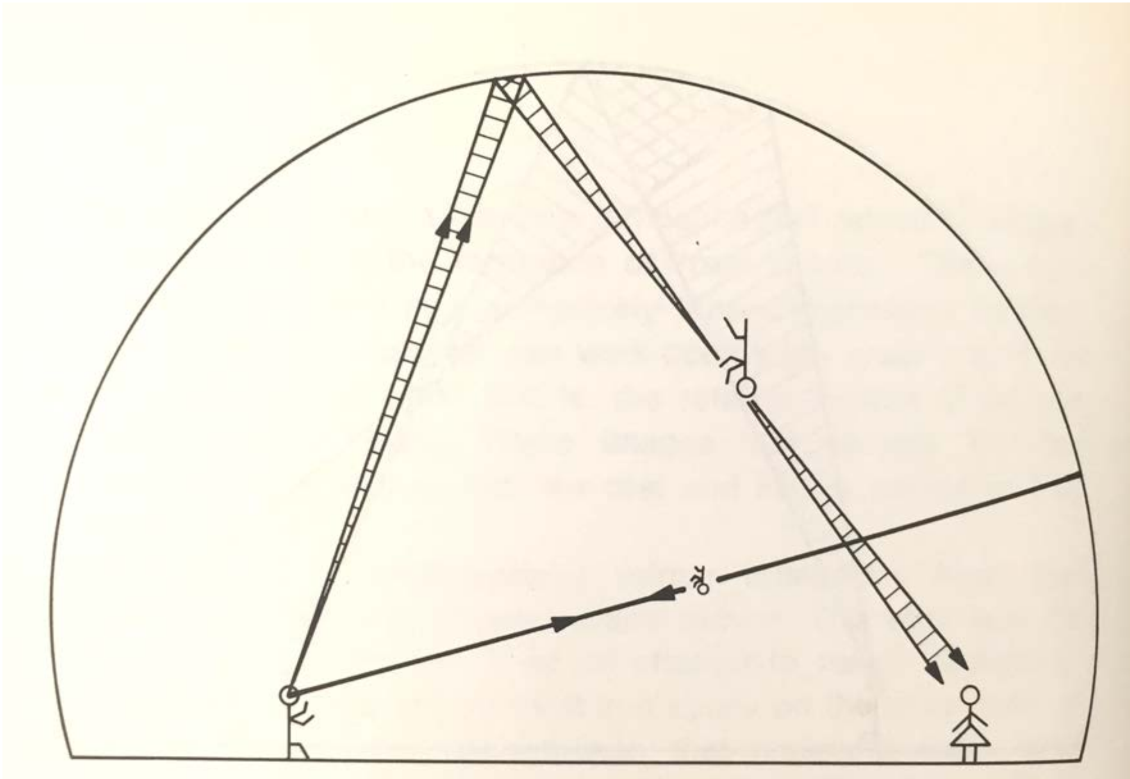


Figure 4.40.
Elsa Garmire, illustration of spherical aberration: "the illuminated man sees his own image smaller and lower down in space than the image of him that the woman sees." Reprinted from E.A.T., *Pavilion* (New York: E.P. Dutton, 1970), 197.

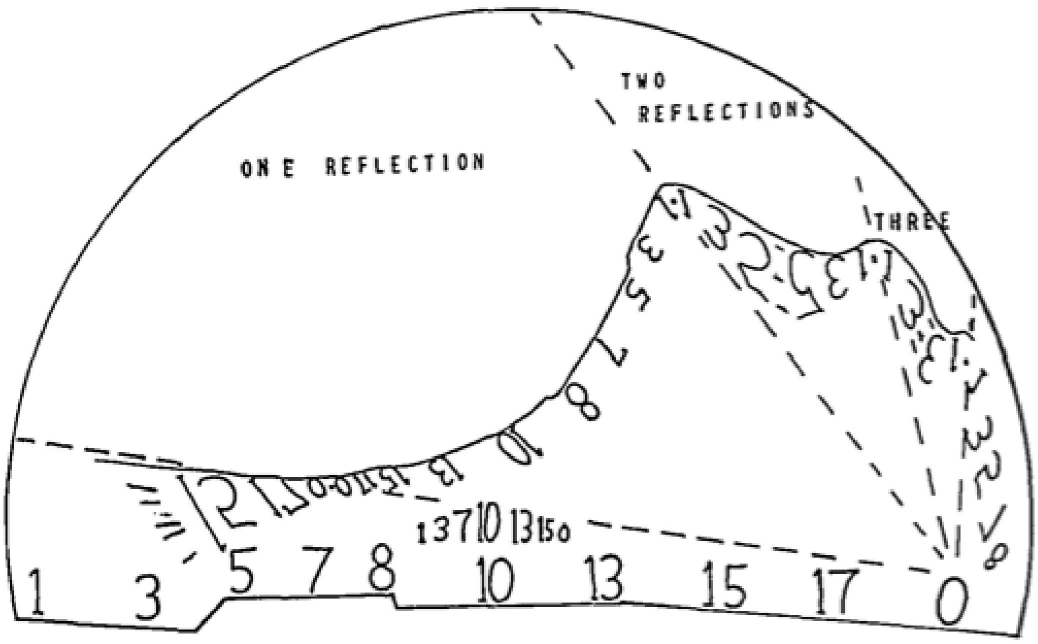


Figure 4.41.
First-order, second-order, third-order, etc. images, as seen from the position of '0' in lower right. Reprinted from Elsa Garmire, "Calculation of the Optical Effects of a 27.5-m Spherical Mirror," *Applied Optics* 10, no. 12 (December 1971): 2760-2762; 2760.

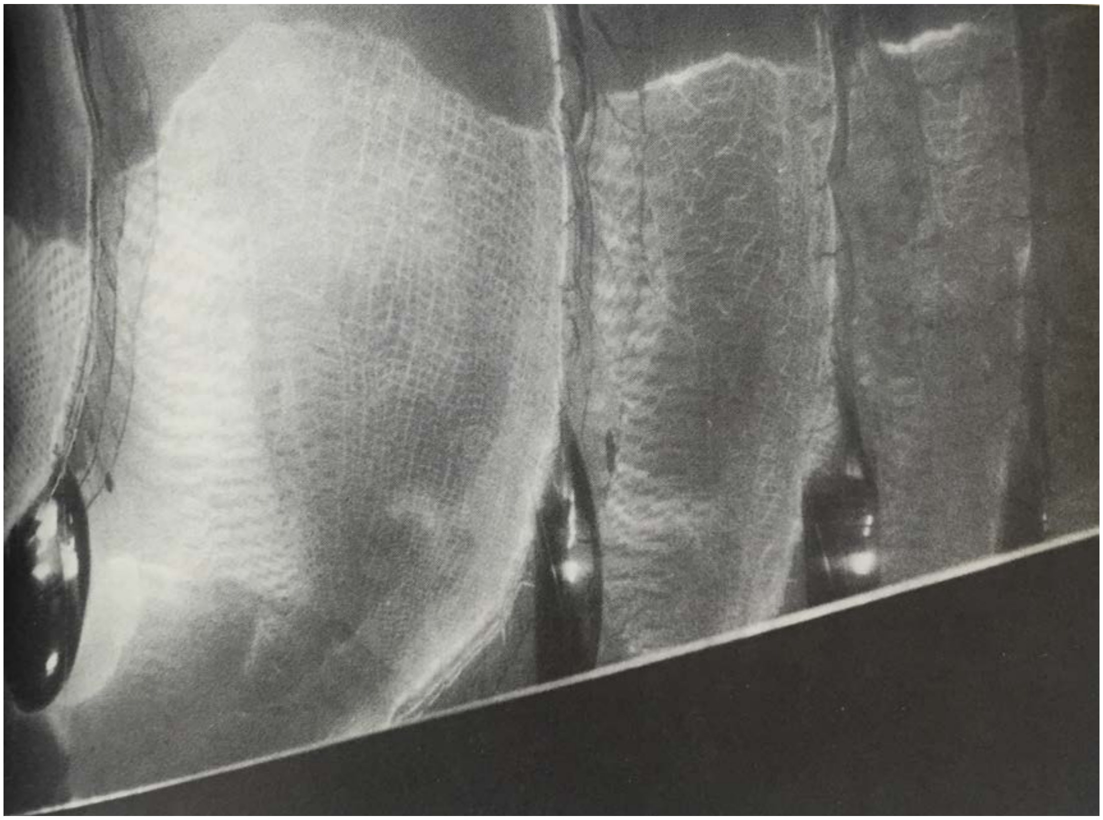


Figure 4.42.
"Successive rings of higher-order real images in mirror dome. The first-order real image ring can be seen on the far left, and four more rings are seen on the right." Pepsi Pavilion, Expo 70, Osaka, 1970. Photo: Fujiko Nakaya. E.A.T./GRI Box 199. Reprinted in Billy Klüver, "Photographic Recording of Some Optical Effects in a 27.5-m Spherical Mirror," *Applied Optics* 10, no. 12 (December 1971): 2754-2759; 2758.

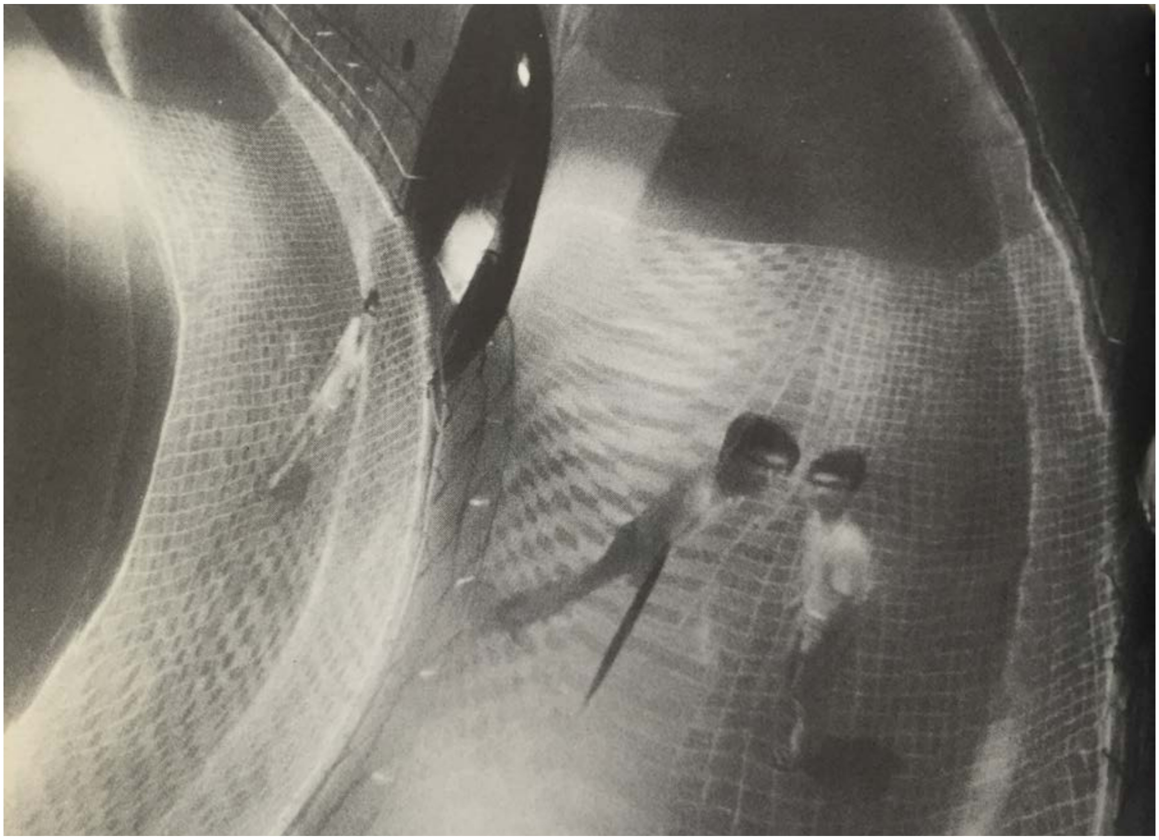
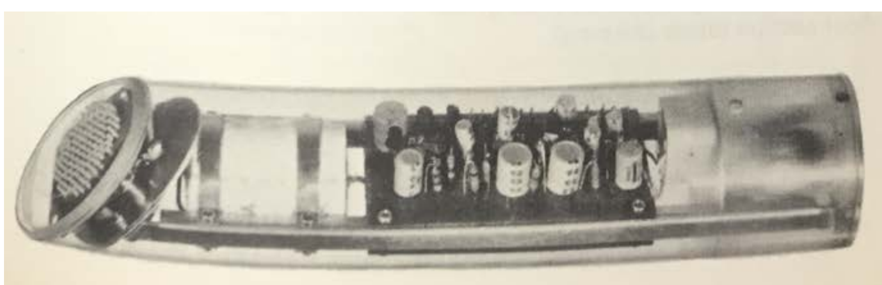


Figure 4.43.
"The effects when viewer stands close to the edge of the floor, next to the mirror, with his back to the mirror, and looks up to the left or right. Higher-order real images appear as rings. On the left, one sees a first-order real image of a person standing on a tiled section of the floor. The second-order real-image ring to the right appears roughly symmetrical: two images of the same person appear facing each other. The two reflections are produced by a virtual-real image sequence." Pepsi Pavilion, Expo 70, Osaka, 1970. Photo: Fujiko Nakaya. E.A.T./GRI Box 199. Reprinted in Billy Klüver, "Photographic Recording of Some Optical Effects in a 27.5-m Spherical Mirror," *Applied Optics* 10, no. 12 (December 1971): 2754-2759; 2758.

Figure 4.44.
Photograph taken with "camera pointing beyond the center of the mirror dome floor facing the far opposite side of the mirror. The images of the subjects are not inverted upside-down, left to right, or back to front. [They merely appear higher in space, upright.] This type of second-order real image results from two successive *real*-image reflections, i.e., the subject produces a real image which in turn produces another real image." Pepsi Pavilion, Expo 70, Osaka, 1970. Photo: Fujiko Nakaya. Reprinted from Billy Klüver, "Photographic Recording of Some Optical Effects in a 27.5-m Spherical Mirror," *Applied Optics* 10, no. 12 (December 1971): 2754-2759; 2759.

Figure 4.45.
Virtual image of pink-draped balloon in center of pavilion creates “bloom” effect, flooding dome with its image. Pepsi Pavilion, Expo 70, Osaka, 1970. Photo: Shunk-Kender. E.A.T./GRI Box 197.



Figures 4.46-4.47.

Top: Girl with handset. Pepsi Pavilion, Expo 70,
Osaka, 1970. Photo: Shunk-Kender. E.A.T./GRI Box 198.

Below: Handset, Pepsi Pavilion, Expo 70, Osaka, 1970.
Reprinted from E.A.T., *Pavilion* (New York: E.P. Dutton, 1972).

Figure 4.48.
Mirror dome interior with performance of Homage to Loie Fuller. Pepsi Pavilion, Expo 70, Osaka, March 1970. Photo: Shunk-Kender. E.A.T./GRI Box 197.

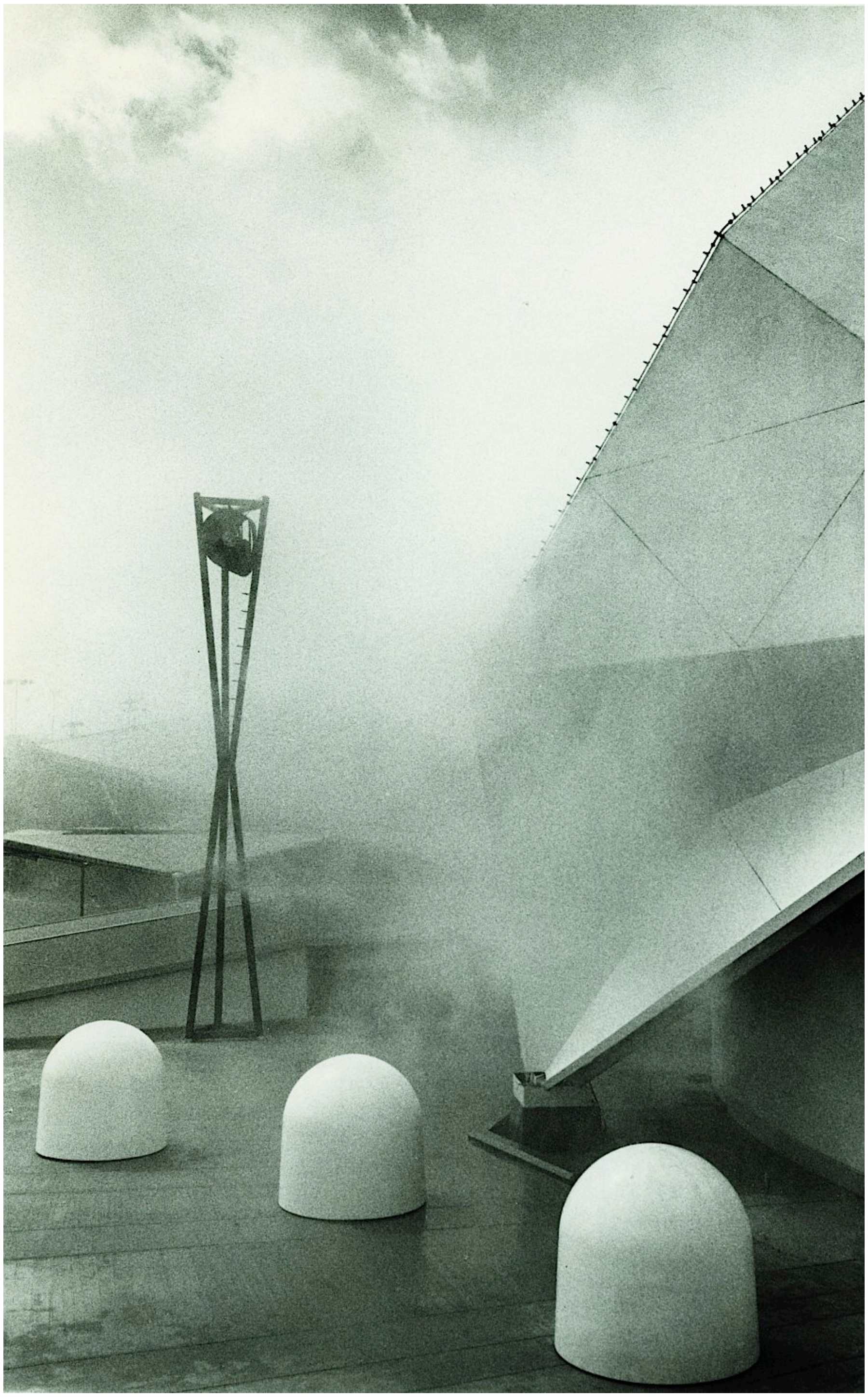


Figure 4.49.
E.A.T., Pepsi Pavilion, Expo 70, Osaka, 1970. Exterior with fog, *Floats*, and *Suntrak*.
Photo: Shunk-Kender. E.A.T./GRI Box 200.

Figure 4.50.
E.A.T., Pepsi Pavilion, Expo 70, Osaka, 1970. Exterior with fog, *Floats*, and *Suntrak*.

Figure 4.51.
E.A.T., Pepsi Pavilion, Expo 70, Osaka, 1970.
Photo: Shunk-Kender. E.A.T./GRI Box 200.

Figure 4.52.
Robert Breer and E.A.T., *Floats*, 1970, installed in front of the Pepsi Pavilion, Expo 70, Osaka. Photo: Shunk-Kender. E.A.T./GRI Box 198.

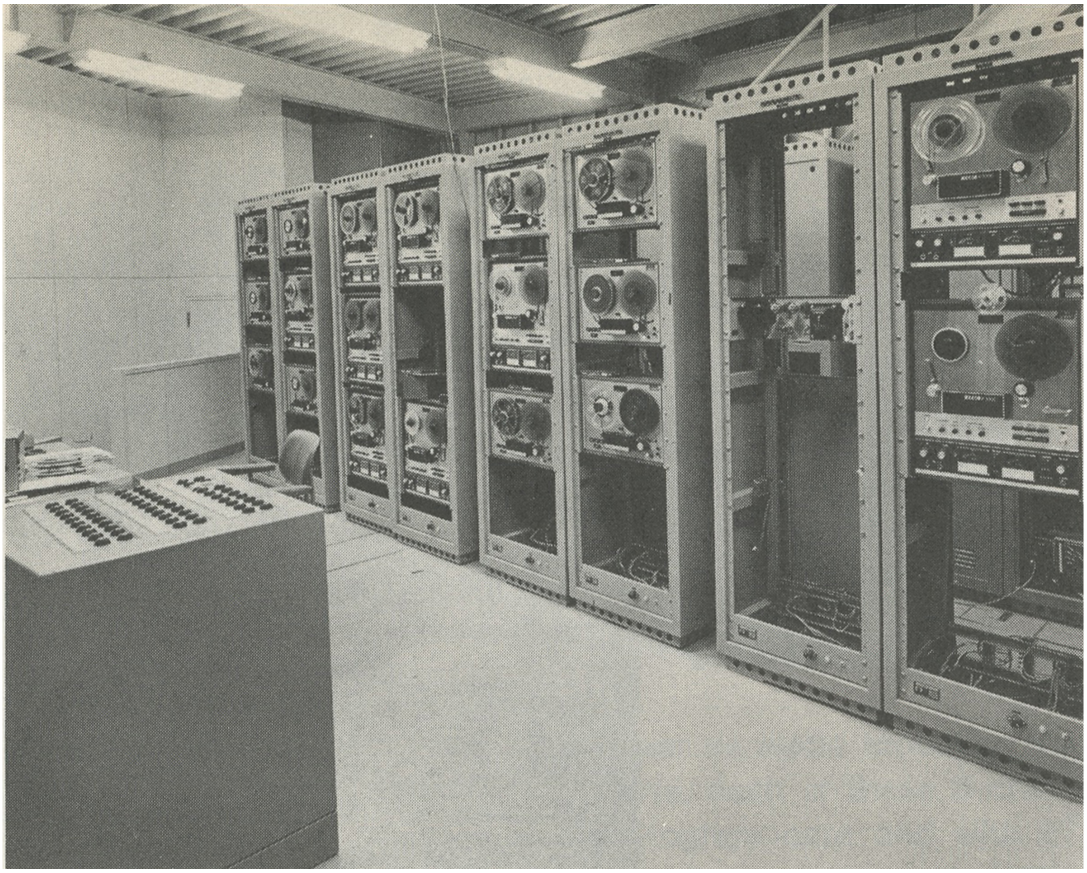


Figure 4.53.
Racks of tape recorders in control room, Pepsi Pavilion, Expo 70, Osaka, 1970.

Figures 4.54-4.55.

Top: Eero Saarinen, Bell Telephone Laboratories, Holmdel, New Jersey, 1967. Photo: Cervin Robinson. Eero Saarinen Collection, Yale University Library.

Bottom: Eero Saarinen, Bell Telephone Laboratories, Holmdel, New Jersey, circa 1967. Photo: Alcatel-Lucent. Eero Saarinen Collection, Yale University Library.

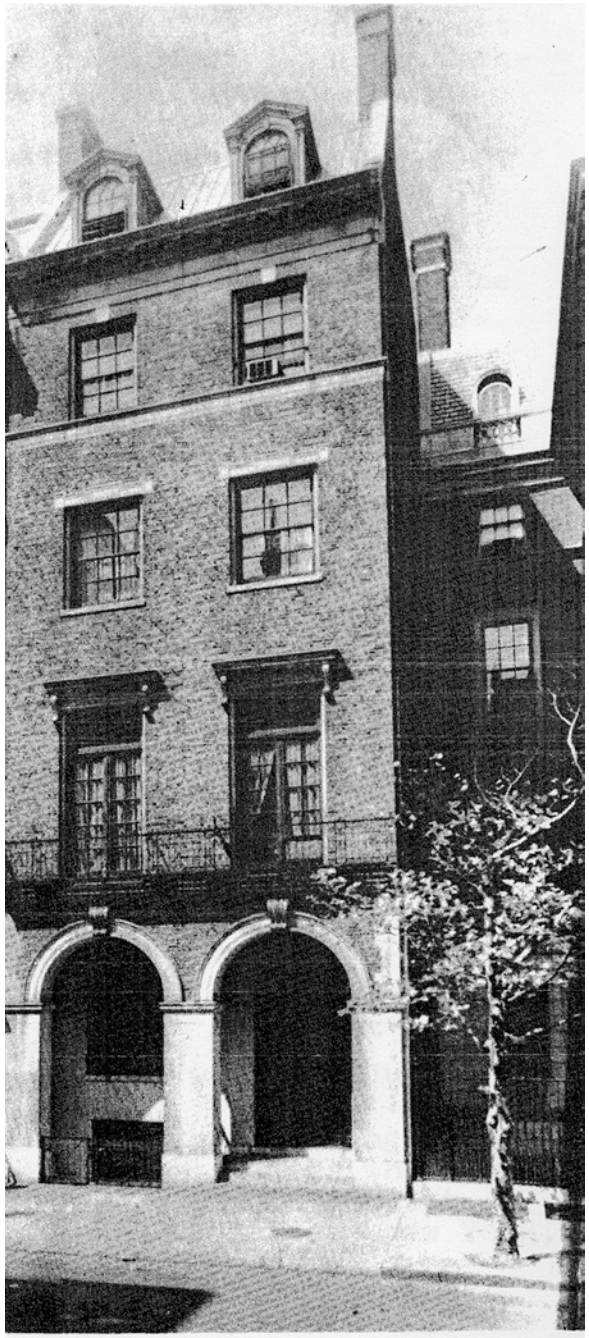


Figure 5.1.
Façade of Automation House,
49 East 68th Street, New York, 1967.
Photo: *E.A.T. News* 1, no. 3 (November 1, 1967).

Figure 5.2.
Gordon Matta-Clark, still from *Automation House*, 1971.
16mm transferred to video, black and white, 32 min.,
produced by Carlota Schoolman.

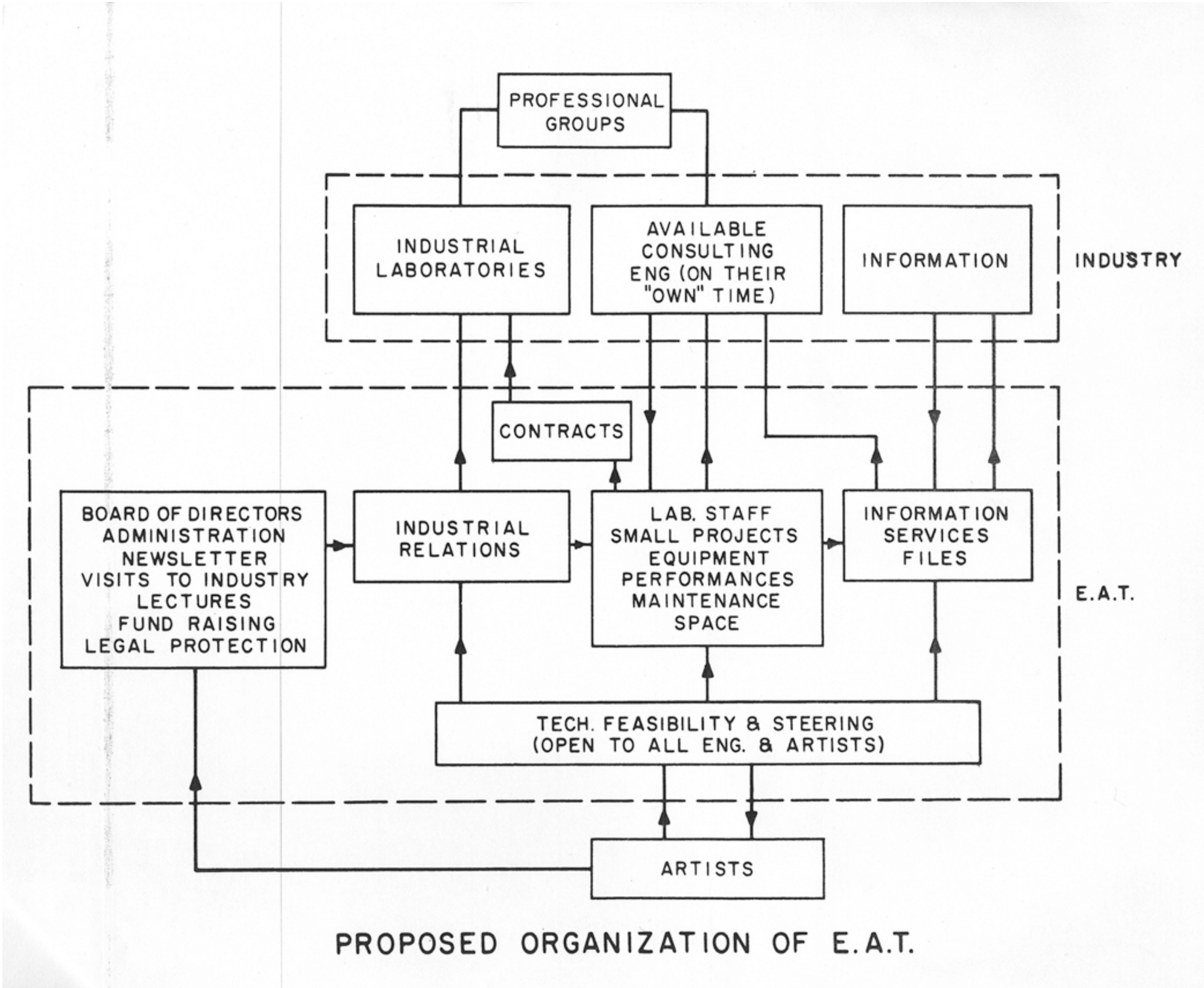


Figure 5.3.
Experiments in Art and Technology, organizational chart, 1967.
First published in *E.A.T. News* 1, no. 1 (January 15, 1967).

Figure 5.4.
Theodore Kheel at E.A.T. press conference, New York, October 1967.

E.A.T. NEWS

Volume 1, No. 3 November 1, 1967

Experiments in Art and Technology 9 East 16th Street, N.Y., N.Y. 10003

Julie Martin, Editor

The five months since the last E.A.T. News have been full of activity. There have been many developments that have clarified the organization of E.A.T., expanded its scope and crystallized its aims.

The Board of Directors has been selected. We have formed a Council of Agents to facilitate personal contacts between E.A.T. and the industrial, political, artistic and technical communities. The Agents will be prominent individuals sympathetic to the aims of E.A.T. who will act in their areas on behalf of E.A.T.

Our approach to the industrial community has resulted in formal support from a number of companies, labor unions and individuals. The most notable ones being American Telephone & Telegraph Company and the AFL-CIO. Other organizations have informally indicated their support, and are in the process of making this formal.

E.A.T. has entered into an agreement with the American Foundation on Automation and Employment and its president, Theodore Kheel and will make its executive headquarters in the American Foundation's new building, Automation House, 49 East 68th Street. Member engineers of E.A.T. are consulting on the technical facilities of Automation House. When complete, Automation House will provide facilities for seminars, meetings, bullsessions, performances, demonstrations and presentations of works of art resulting from the collaboration between artists and engineers.

Figure 5.5.
E.A.T. News 1, no. 3 (November 1, 1967), 1.

Figure 5.6.
Billy Klüver, Edward Swayduck, Theodore Kheel, Robert Rauschenberg, and others at Amalgamated Lithographers of America headquarters, New York, 1968.
E.A.T./GRI Box 187.

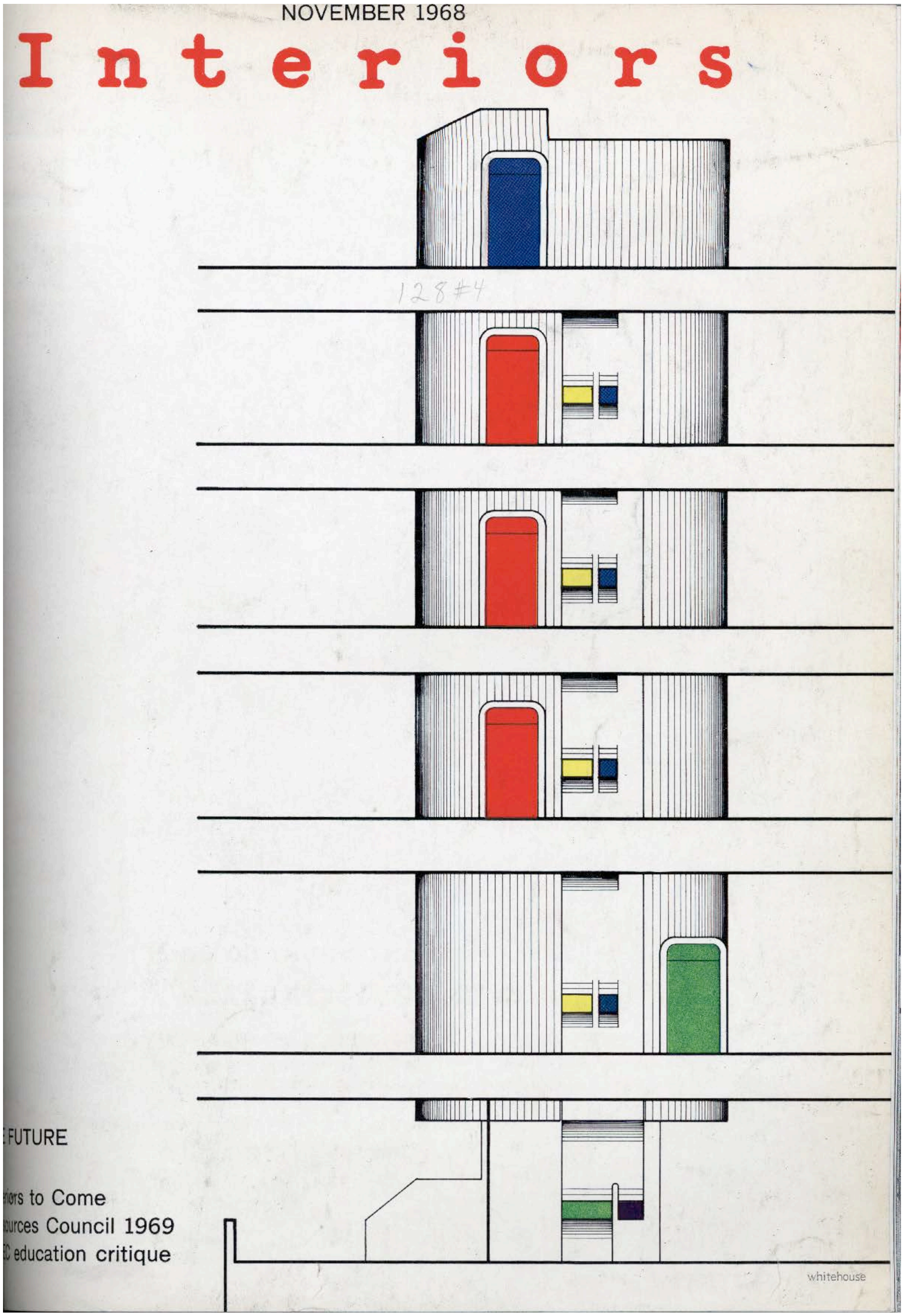


Figure 5.7.
Cover of *Interiors* 128, no. 4 (November 1968).
Illustration: Roger Whitehouse.

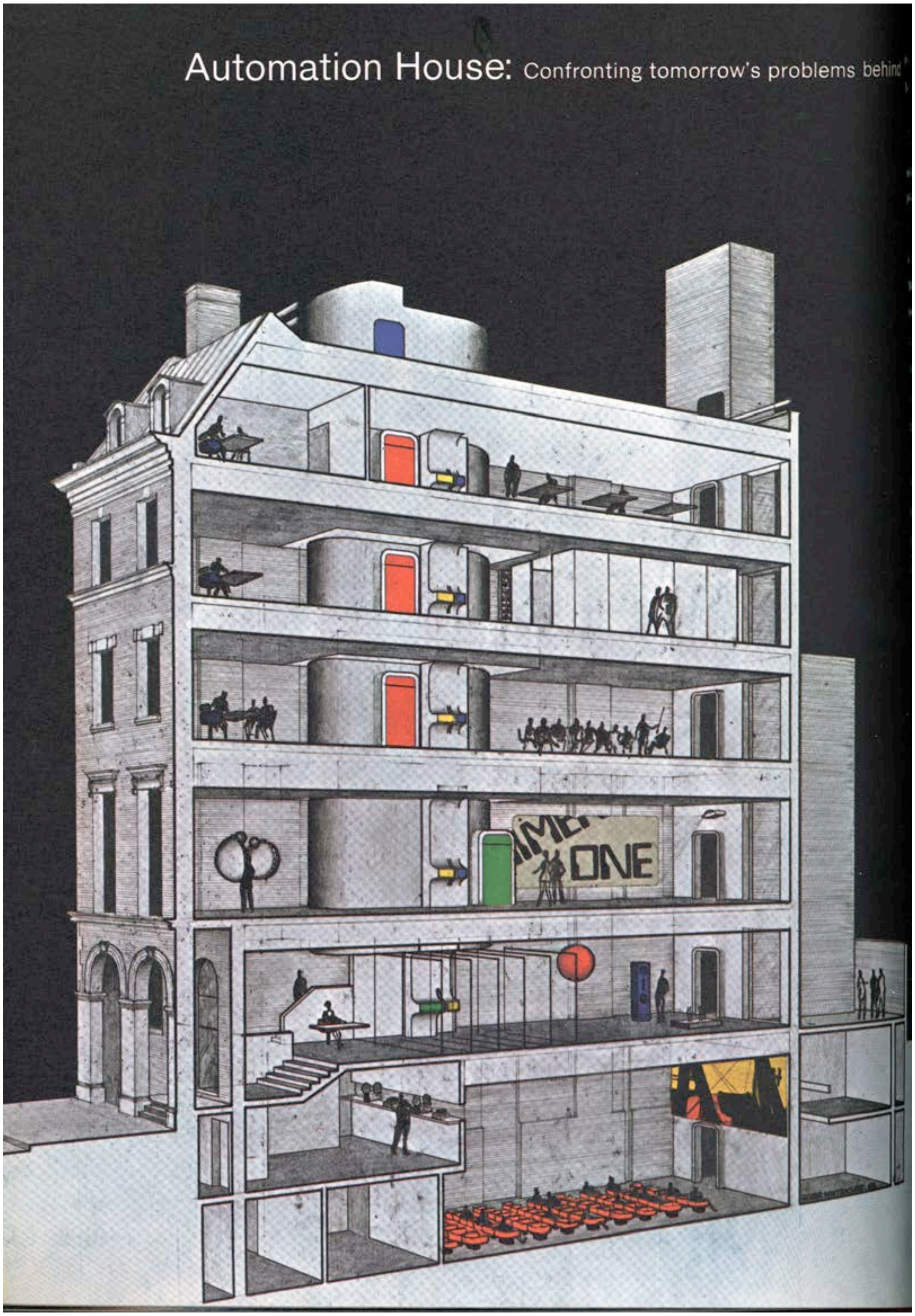


Figure 5.8.
Automation House rendering,
Interiors 128, no. 4 (November 1968), 113.
Illustration: Roger Whitehouse.

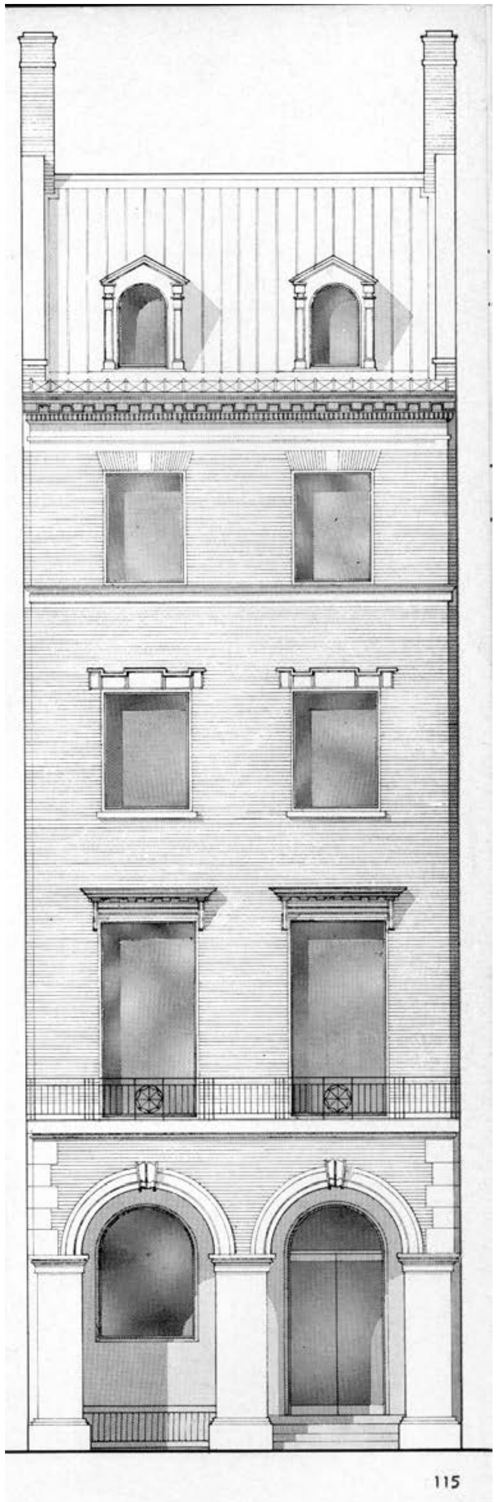


Figure 5.9.
Automation House rendering,
Interiors 128, no. 4 (November 1968), 115.
Illustration: Roger Whitehouse.

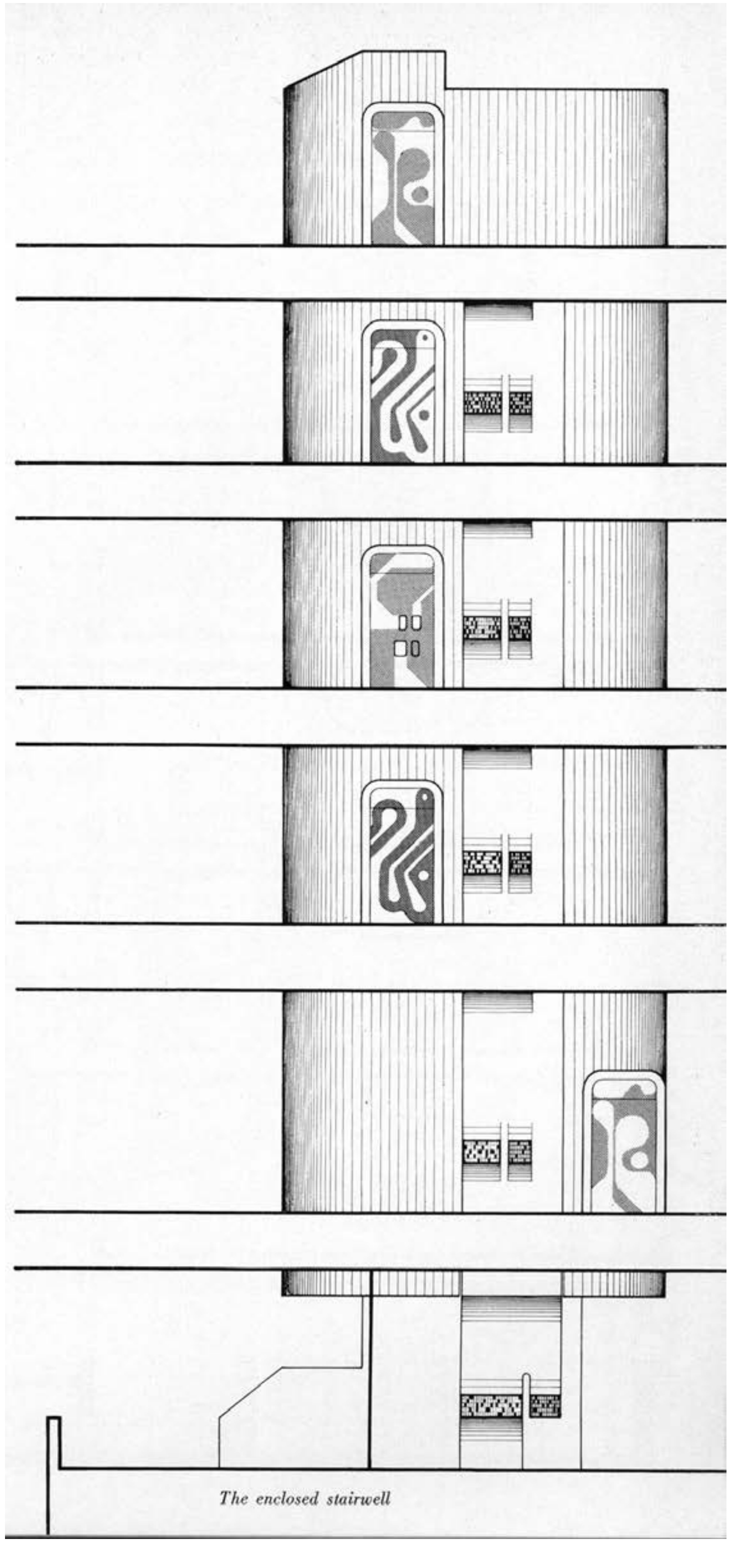


Figure 5.10.
Automation House rendering,
Interiors 128, no. 4 (November 1968), 116.
Illustration: Roger Whitehouse.

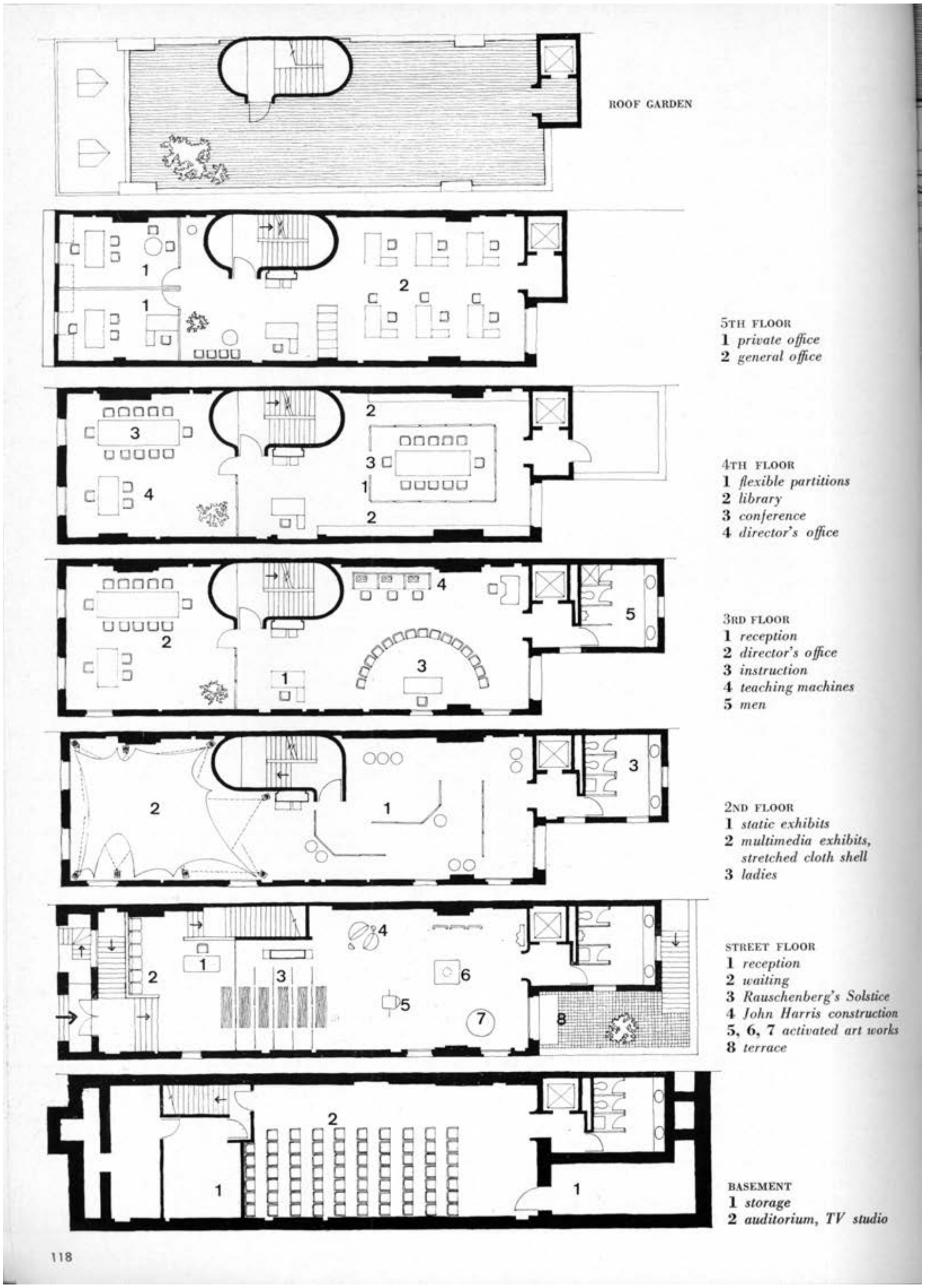
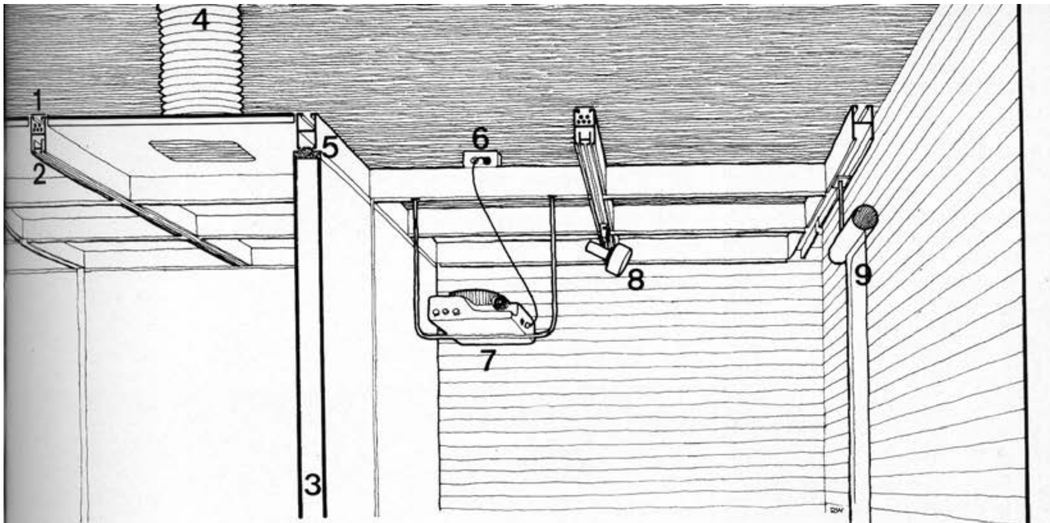
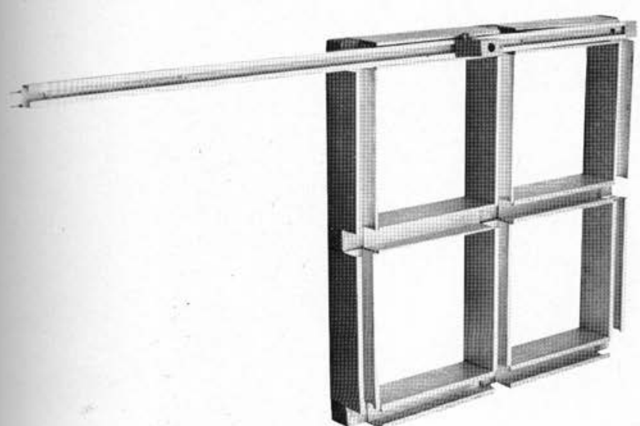


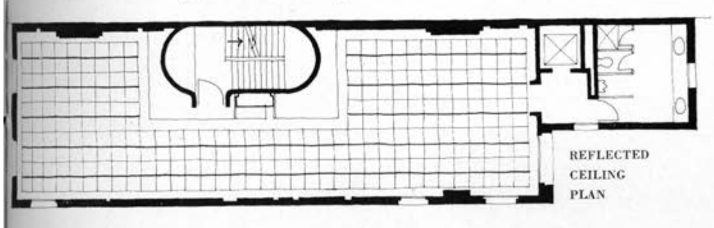
Figure 5.11.
Automation House rendering,
Interiors 128, no. 4 (November 1968), 118.
Plan illustration: Lehrecke and Tonnetti.



1 *electric raceway*
2 *Lightolier Lytespan conduit supplying standard and exhibition lighting, dimmer controlled*
3 *special removable exhibition partition panel by La Cour Associates*
4 *flexible HVAC duct connector supply*
5 *Alumastrut*
6 *independent 120-volt outlets to supply special equipment (projectors, etc.) hung from grid*
7 *Carousel projector*
8 *Lightolier Lytespan clip-on lamp*
9 *projection screen*



2′ Alumastrut ceiling grid element holds partitions, power lines, etc.



The inside will add to the interior's exhibition capacity, holding not only paintings and sculpture but all conceivable motorized, lit, cycled, and projected multi-media applications. The architects are interested in Bob Wiegand's kinetic murals—in which both the mural surface and the projected source are in continuous motion, as rotating carousel projectors throw images on moving louver-type baffles.

Outer panels of the doors will carry super-graphics or brilliant coats of paint. Our cover shows one idea, page 117 another. Smaller color areas are doors of instrument/switch panels—the architects having decided to make a design asset of the need for complicated controls for the highly automated interiors.

The prodigious flexibility demanded by Kheel will be achieved by means of a ceiling-grid system consisting of 2′ Alumastrut modules carrying both high and regular voltage wiring, and receiving movable paritions, Lightolier Lytespan fixtures, projection screens, and frames for hanging automated slide projectors, television sets, and heavier works of art or other exhibits, flat or three-dimensional.

Key personalities at Automation House include Joseph Krevitsky, executive director of the Center for Information on Job Training and Development, and Dr. Matthew Kelly of Cornell University's New York State School of Industrial and Labor Relations, who will be involved with the Institute of Collective Bargaining and Group Relations. Last but not least are physicist Dr. J. William (Billy) Klüver and artist Robert Rauschenberg, respectively president and vice president of the non-profit E.A.T. (Experiments in Art and

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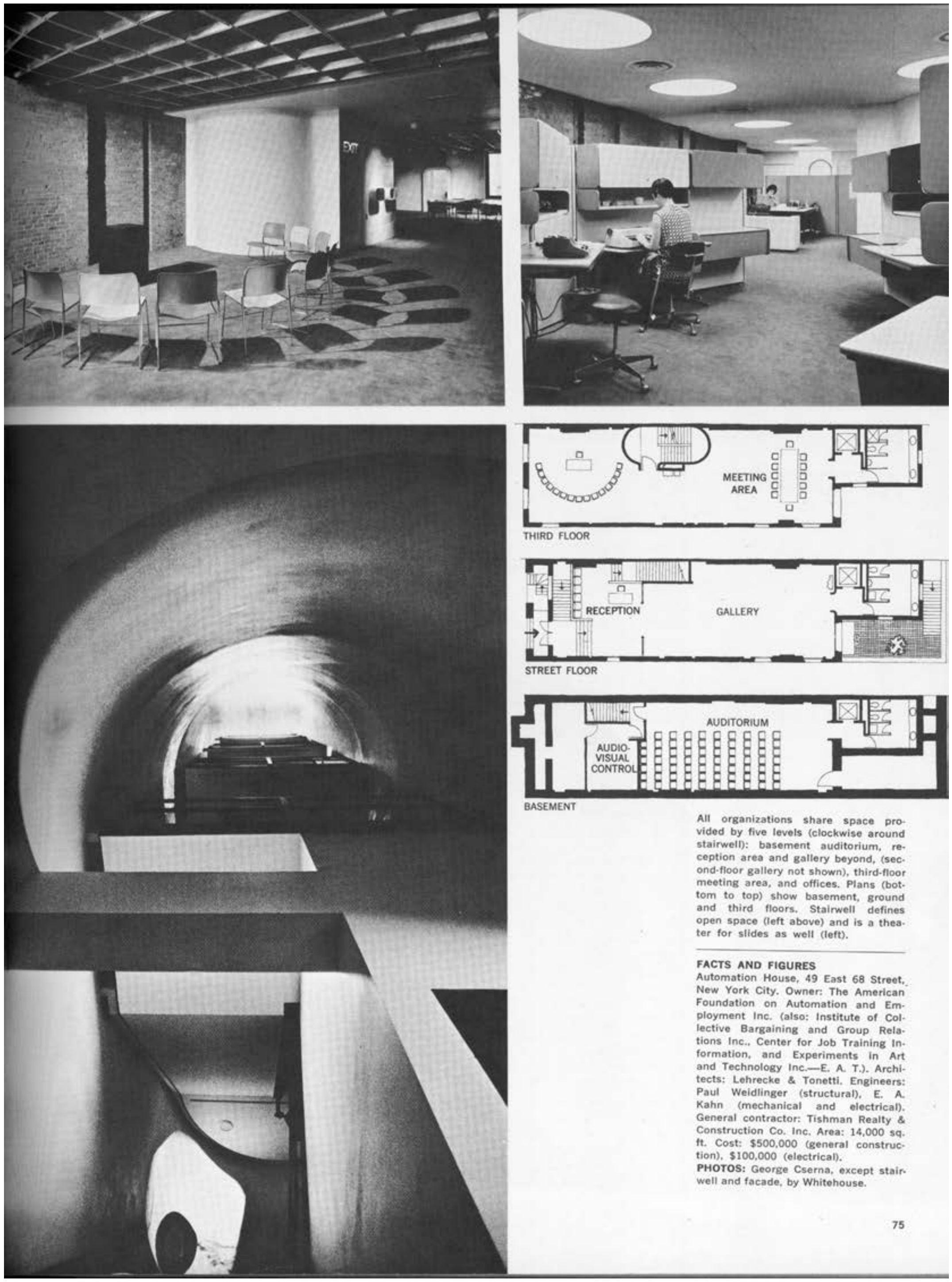
Figure 5.12.
Automation House rendering,
Interiors 128, no. 4 (November 1968), 119.
Plan illustration: Lehrecke and Tonnetti.



All organizations share space provided by five levels (clockwise around stairwell): basement auditorium, reception area and gallery beyond, (second-floor gallery not shown), third-floor meeting area, and offices. Plans (bottom to top) show basement, ground and third floors. Stairwell defines open space (left above) and is a theater for slides as well (left).

FACTS AND FIGURES

Automation House, 49 East 68 Street, New York City. Owner: The American Foundation on Automation and Employment Inc. (also: Institute of Collective Bargaining and Group Relations Inc., Center for Job Training Information, and Experiments in Art and Technology Inc.—E. A. T.). Architects: Lehrecke & Tonetti. Engineers: Paul Weidlinger (structural), E. A. Kahn (mechanical and electrical). General contractor: Tishman Realty & Construction Co. Inc. Area: 14,000 sq. ft. Cost: $500,000 (general construction), $100,000 (electrical).

PHOTOS: George Cserna, except stairwell and facade, by Whitehouse.

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Figure 5.13.
Automation House rendering,
Architectural Forum 133, no. 1 (July-August 1970): 75.

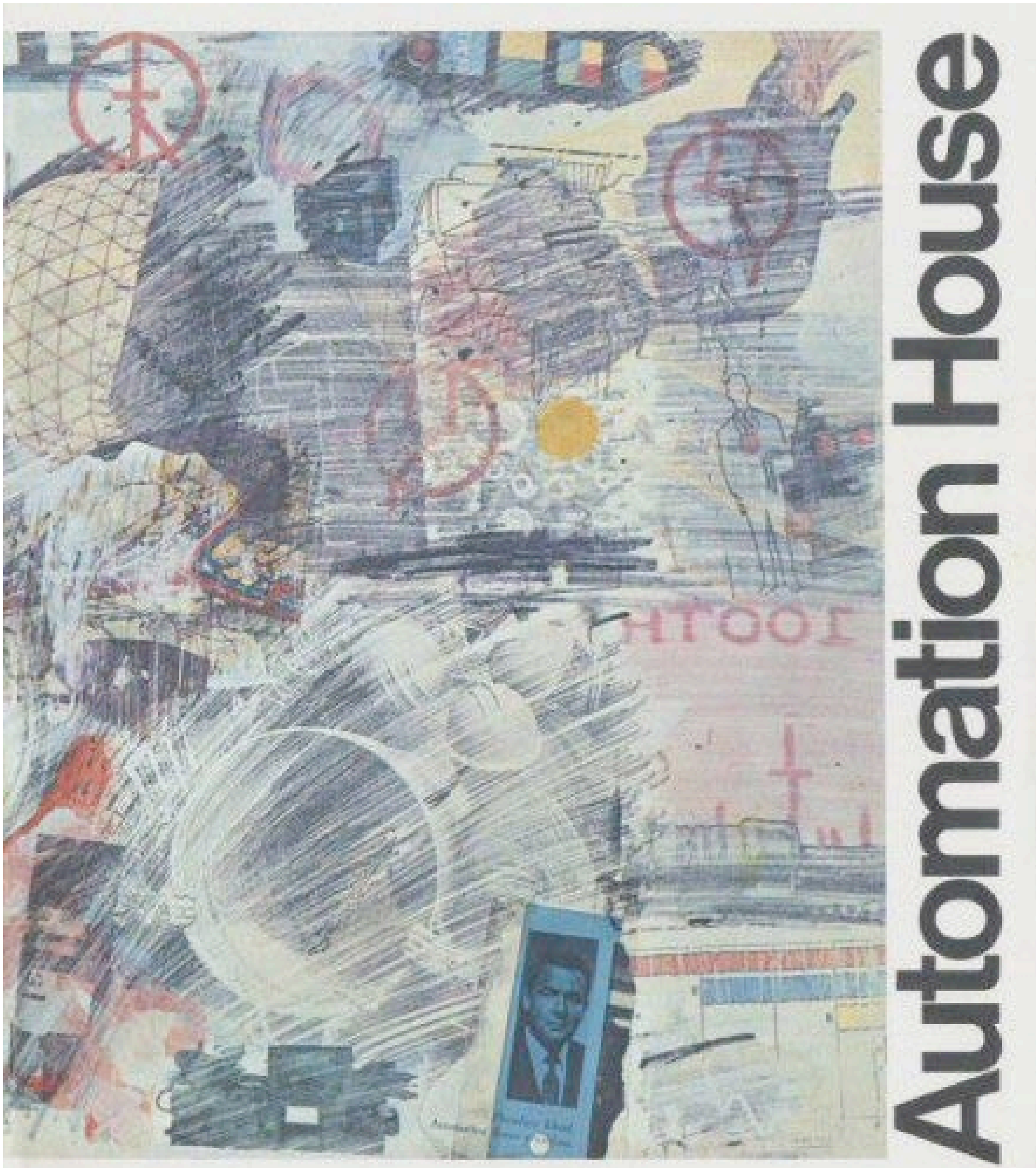


Figure 5.14.
"Automation House: A Philosophy for Living in a World of Change," advertising supplement, *The New York Times*, February 1, 1970.

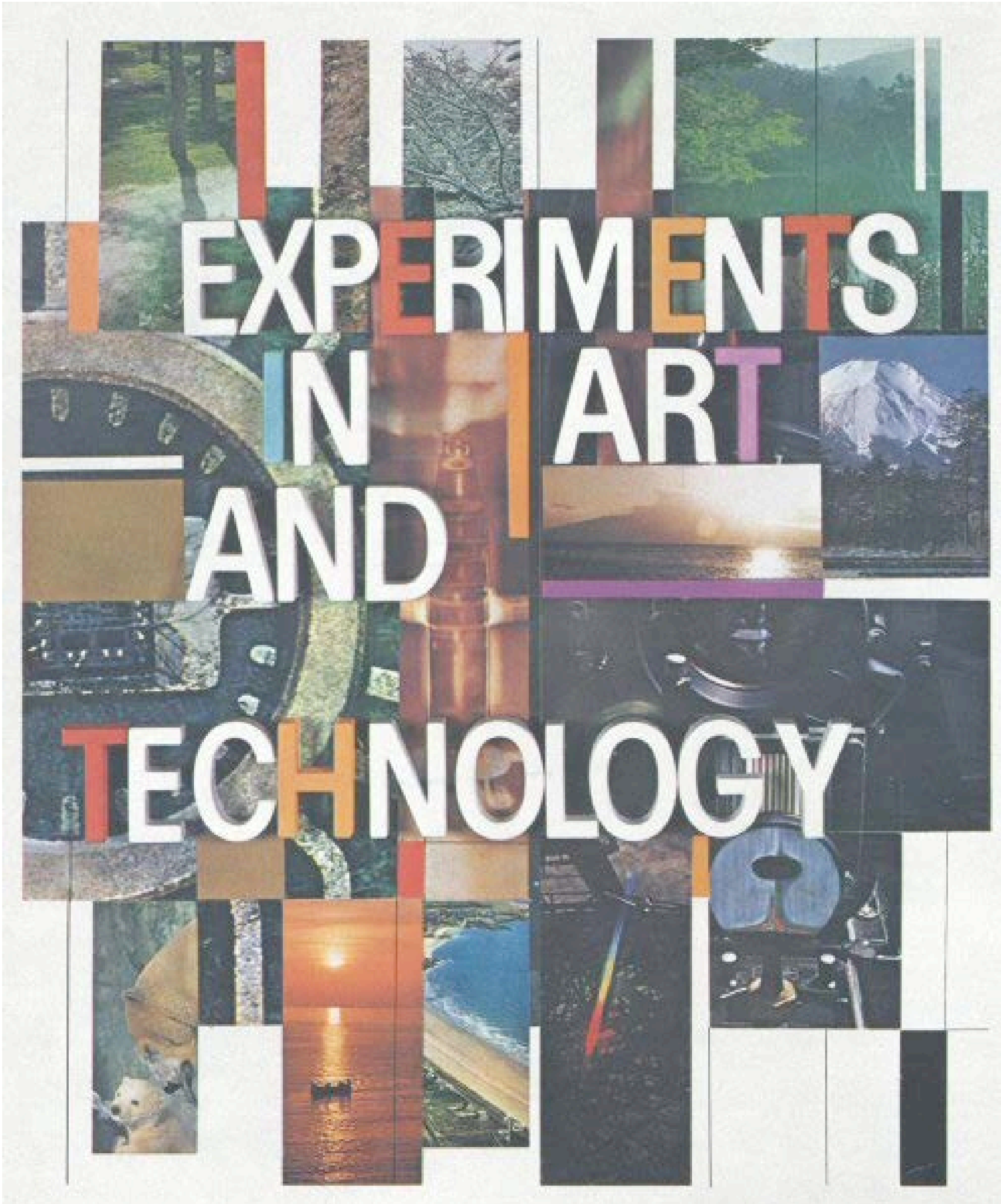


Figure 5.15.
"Automation House: A Philosophy for Living in a World of Change," advertising supplement, *The New York Times*, February 1, 1970.

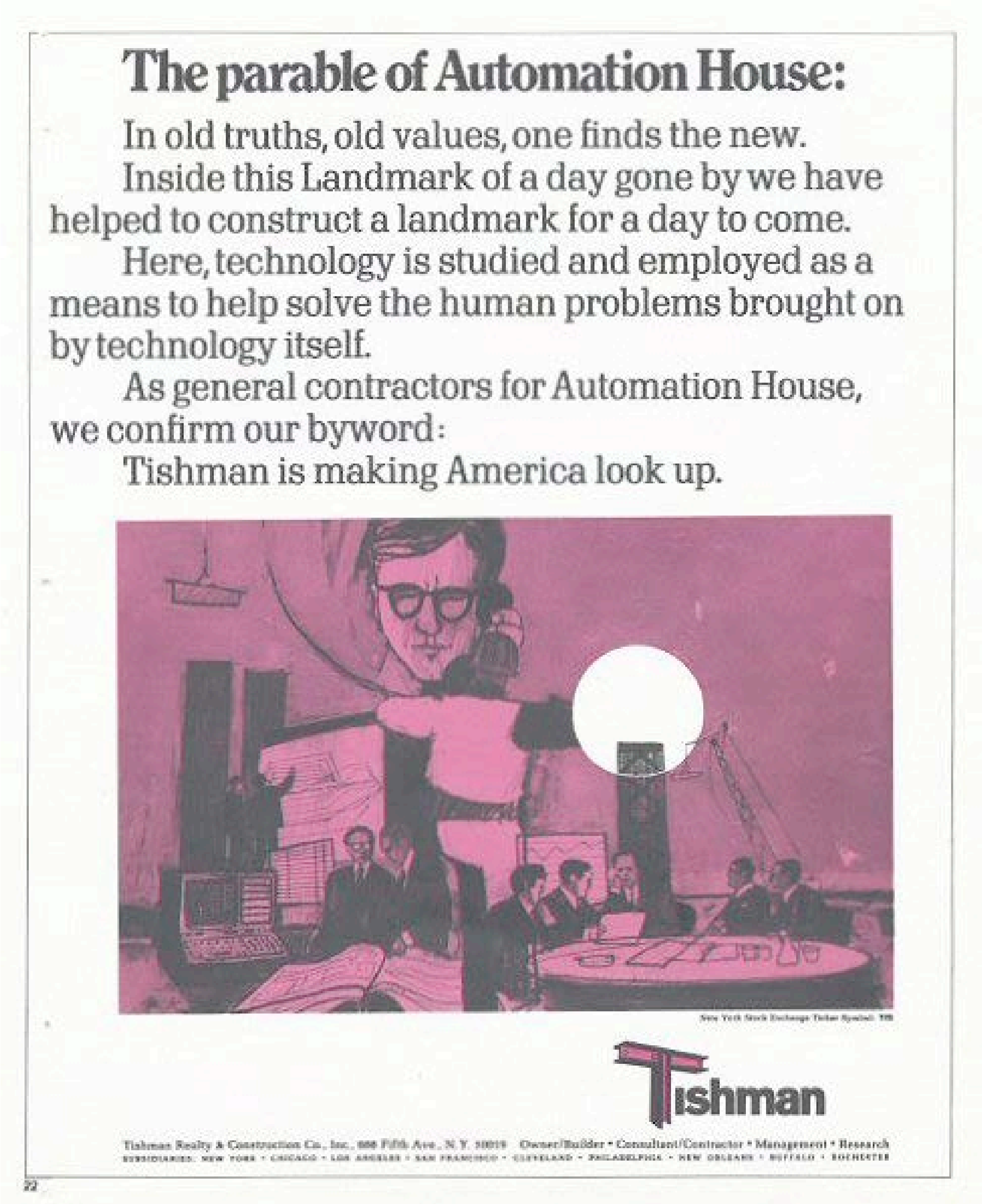


Figure 5.16.
Advertising supplement, *The New York Times*, February 1, 1970.

Figure 5.17.
Boyd Mefferd, *Strobe-Lighted Room*, 1968.
Strobe lights, Lucite floor panels.
Photo: *The New York Times*.

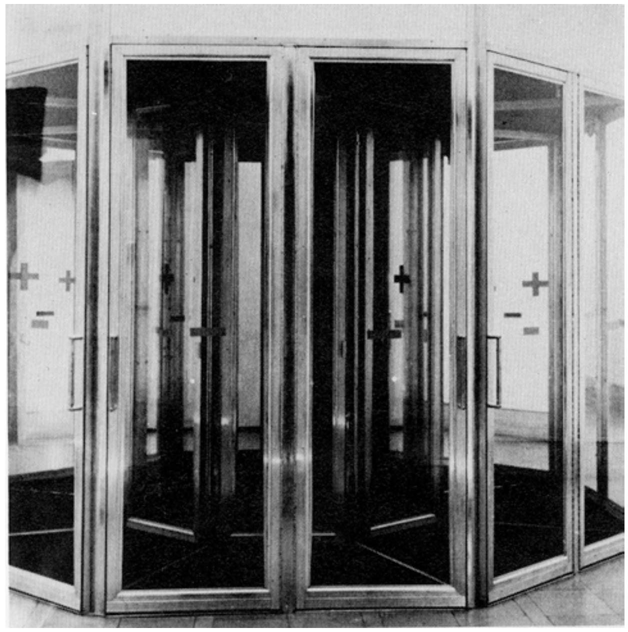


Figure 5.18.
Terry Riley, *Time-Lag Accumulator*, 1968.
Glass, aluminum, mylar, tape recorder delay system, speakers.

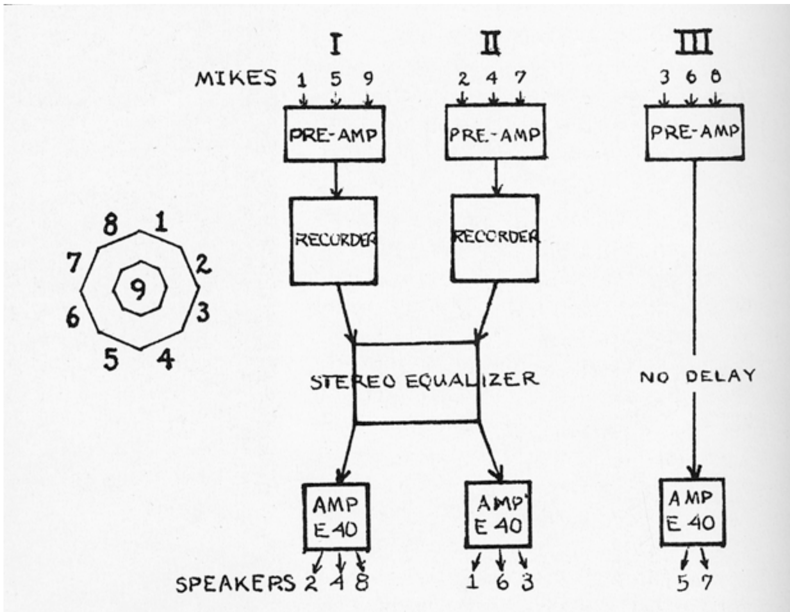


Figure 5.19.
Terry Riley, block diagram for *Time-Lag Accumulator*, 1968.

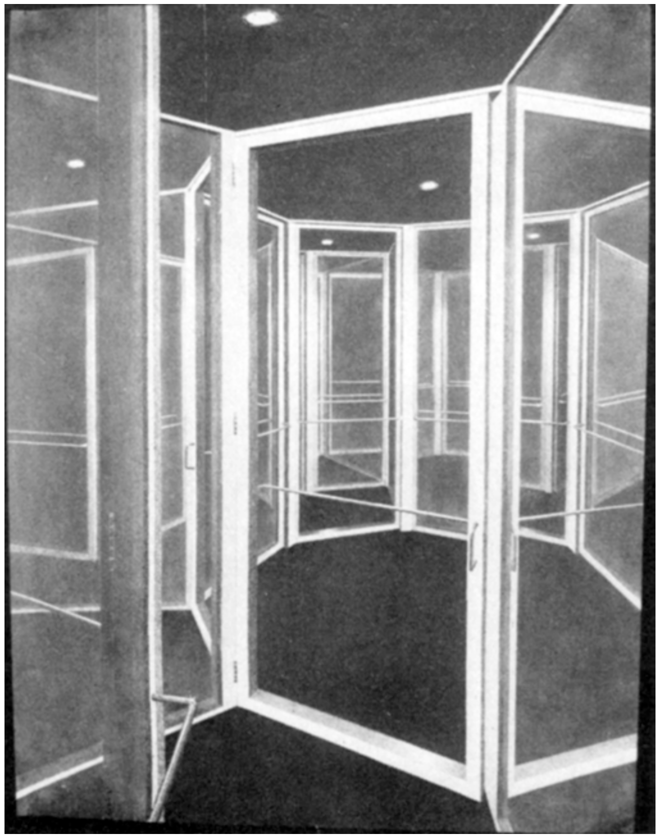


Figure 5.20.
Terry Riley, sketch for *Time-Lag Accumulator*, 1968.

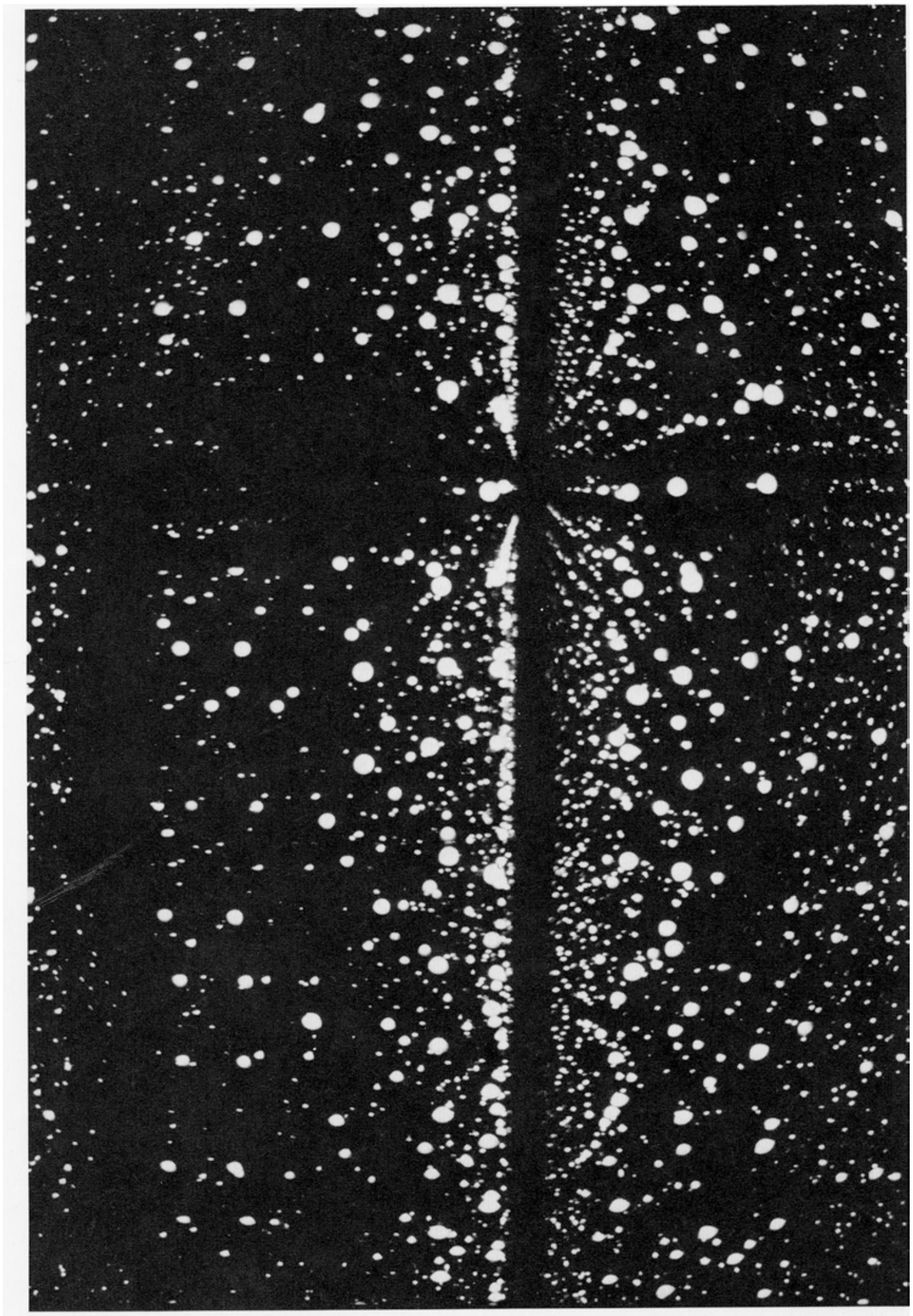


Figure 5.21.
Stanley Landsman, *Infinity Chamber*, 1968. 6,000 lights and mirrors.
Photo: Warner Studio.

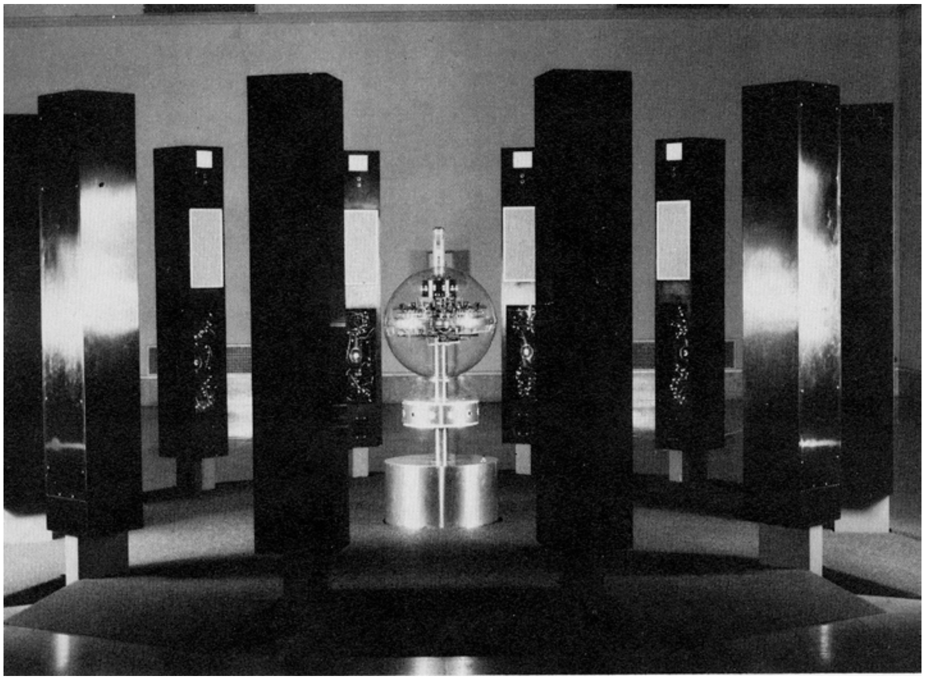


Figure 5.22.
James Seawright, *Electronic Peristyle*, 1968.
Digitally controlled motion sensors, synthesizer
(devised by Robert Moog), neon bulbs, metal.

Figure 5.23.
Robert Rauschenberg, *Currents*, 1970.
Black and white screenprint, 43 x 34 in.

Figure 5.24.
Anthony Braxton (saxophone), Leroy Jenkins (violin),
Gordon Mumma (horn), Automation House, New York, November 1970.
Photo: Gordon Mumma.

INFORMATION SHEET FOR E.A.T. ARTISTS' TV PROGRAMMING PROJECT

NAME ED RUSCHA TELEPHONE HO3-7057

ADDRESS 1024 3/4 N. WESTERN AVE. HOLLYWOOD, CALIF. 90029

COULD YOU MAKE: 1 one-hour program? ✓ 2 one-hour programs?___

1/2 hr

SHORT DESCRIPTION OF PROGRAM(S) YOU WOULD LIKE TO MAKE. (If you have any questions about FCC regulations on content, please contact us.)

Movie set in car. Girl picks up hitchiker and talks non-stop on subjects as politics, earthquakes pollution.. factual funny too.

HOW WOULD YOU MAKE IT?

✓ In studio. AND OUTSIDE

✓ 16mm film.

___Super 8mm film.

___½" or 1" video tape. (Particular broadcast station regulations may limit what you can do technically.)

___Other, please specify:

ESTIMATED TIME IT WOULD TAKE: Studio___ Non-studio___

APPROXIMATE COSTS: (Do not include use of studio.)

$1000.00 Your salary OR WHAT ?

$1000.00 Other people working with you OR ?

500.00 Travel & expenses

500.00 Other direct costs (props, special effects, etc.)

$1500.00 Costs of making a film (stock, camera rental, editing, etc.)

Estimates can be as approximate as you like: they are not binding.

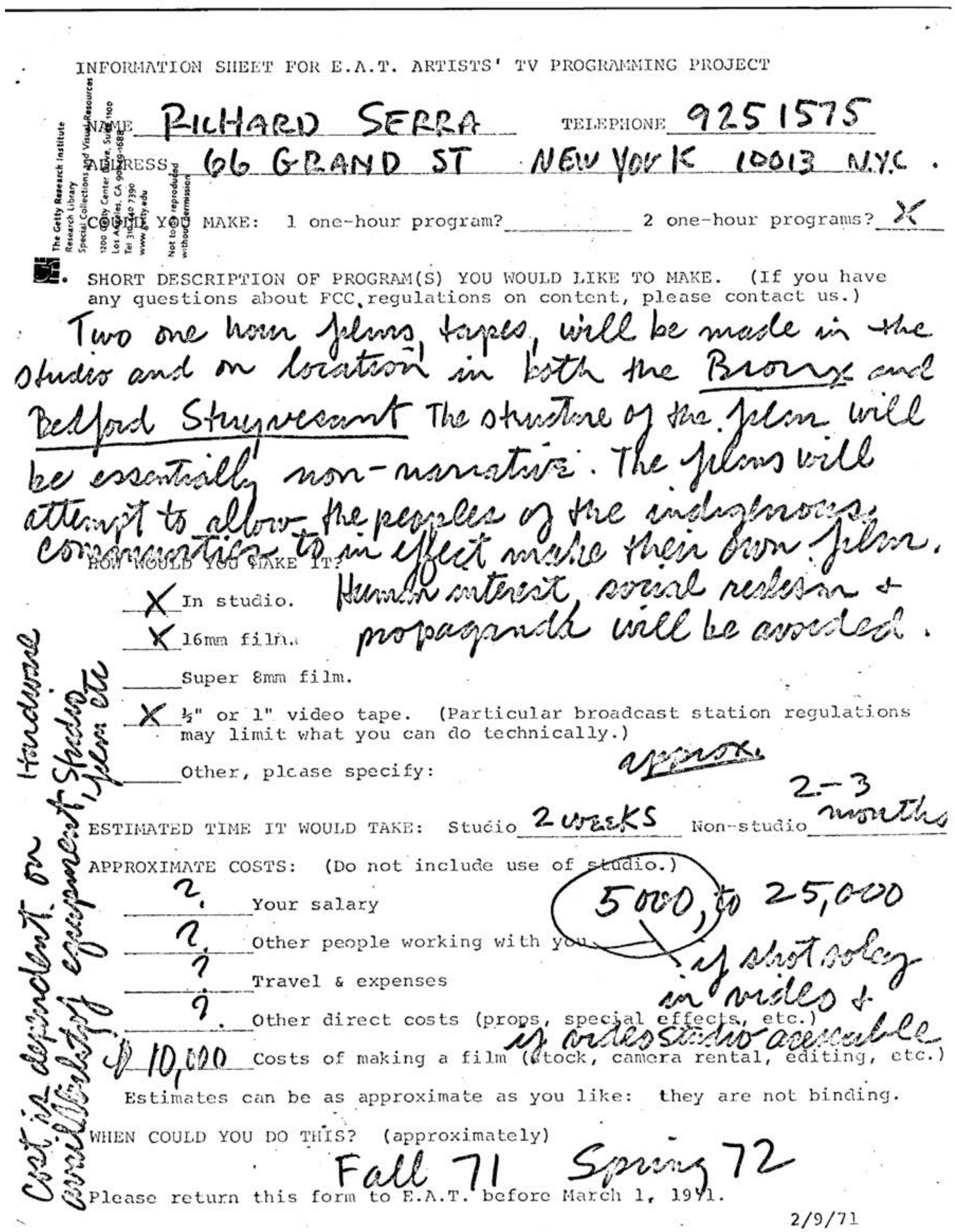
WHEN COULD YOU DO THIS? (approximately)

SUMMER - FALL 1971

Please return this form to E.A.T. before March 1, 1971.

2/9/71

Figure 5.25.
Ed Ruscha, "Information Sheet for
E.A.T. Artists' TV Programming Project," 1971.
Collection Getty Research Institute, Los Angeles.



INFORMATION SHEET FOR E.A.T. ARTISTS' TV PROGRAMMING PROJECT

NAME RICHARD SERRA TELEPHONE 925 1575

ADDRESS 66 GRAND ST NEW YORK 10013 N.Y.C.

COULD YOU MAKE: 1 one-hour program?_____ 2 one-hour programs? X

SHORT DESCRIPTION OF PROGRAM(S) YOU WOULD LIKE TO MAKE. (If you have any questions about FCC regulations on content, please contact us.)

Two one hour films, tapes, will be made in the studio and on location in both the Bronx and Bedford Stuyvesant The structure of the film will be essentially non-narrative. The films will attempt to allow the peoples of the indigenous communities to in effect make their own film. Human interest, social realism & propaganda will be avoided.

HOW WOULD YOU MAKE IT?

X In studio.

X 16mm film.

_____ Super 8mm film.

X ½" or 1" video tape. (Particular broadcast station regulations may limit what you can do technically.)

_____ Other, please specify:

ESTIMATED TIME IT WOULD TAKE: Studio 2 WEEKS Non-studio approx. 2–3 months

APPROXIMATE COSTS: (Do not include use of studio.)

?. Your salary

?. Other people working with you

? Travel & expenses

?. Other direct costs (props, special effects, etc.)

$10,000 Costs of making a film (stock, camera rental, editing, etc.)

5000, to 25,000 if shot soley in video & if video studio accessible

Cost is dependent on Hardware availability equipment Studio, film etc

Estimates can be as approximate as you like: they are not binding.

WHEN COULD YOU DO THIS? (approximately)

Fall 71 Spring 72

Please return this form to E.A.T. before March 1, 1971.

2/9/71

Figure 5.26.
Richard Serra, "Information Sheet for
E.A.T. Artists' TV Programming Project," 1971.
Collection Getty Research Institute, Los Angeles.

INFORMATION SHEET FOR E.A.T. ARTISTS' TV PROGRAMMING PROJECT

NAME Videofreex, Inc. TELEPHONE (212) 925-7286

ADDRESS 98 Prince Street, New York, New York 10012

COULD YOU MAKE: 1 one-hour program? ______ 2 one-hour programs? X

SHORT DESCRIPTION OF PROGRAM(S) YOU WOULD LIKE TO MAKE. (If you have any questions about FCC regulations on content, please contact us.)

We would like to make a "Videofreex mix" program - a collage of tapes covering the areas in which we remain constantly interested (informational, educational, political, experimental, and erotic tapes, and tapes covering music, theatre, events, "people at home," and alternate culture groups). (See Tapeography.) These would be presented in a "disc-jockey" type format, mixed with live in the studio and all recorded into a complete program.

We usually work with 1/2" portable equipment, editing on 1" - but we would like to use this opportunity to explore the technological advantages of 2" portable equipment without losing our particular style and versatility.

(If you would like to see an example of this kind of work on 1/2" equipment, we have shows every Friday night at 9:00.)

HOW WOULD YOU MAKE IT?

X In studio.

___ 16mm film.

___ Super 8mm film.

___ ½" or 1" video tape. (Particular broadcast station regulations may limit what you can do technically.)

X Other, please specify: 2" portable equipment: mini-cam

ESTIMATED TIME IT WOULD TAKE: Studio 1 day Non-studio 5 days

APPROXIMATE COSTS: (Do not include use of studio.)

$10,000. Your salarys

______ Other people working with you

$2,000. Travel & expenses

$1,500. Other direct costs (props, special effects, etc.) for computer graphics special effects device

$10,000. Costs of making a film (stock, camera rental, editing, etc.)

Estimates can be as approximate as you like: they are not binding.

WHEN COULD YOU DO THIS? (approximately)

Any time, within a month's notice.

Please return this form to E.A.T. before March 1, 1971.

2/9/71

Figure 5.27.
Videofreex, Information Sheet for
E.A.T. Artists' TV Programming Project," 1971.
Collection Getty Research Institute, Los Angeles

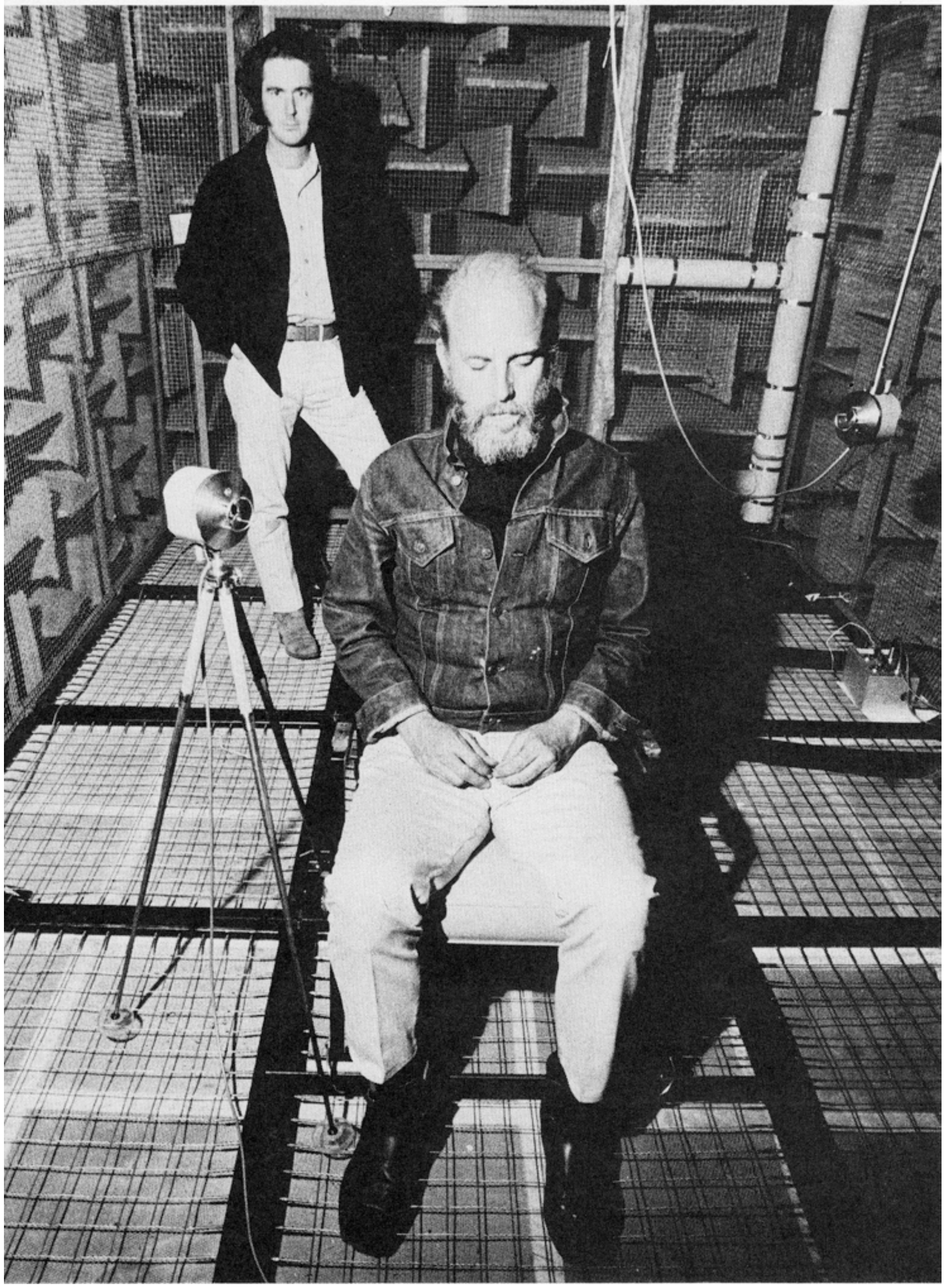


Figure 5.28.
Robert Irwin and James Turrell in anechoic chamber,
University of California Los Angeles, 1968.
Photo: Malcolm Lubliner.

Name	No. Progrs	In Studio	16mm	8mm	S8	½ or 1" tape	other	time studio	non-st.	Costs Sarlary,	Others	Travel	other,	film costs	when
Claes Olden Burg	2	x	x	x		x		3m0	3mo	fee royalty, ownership residuals				50,000 ½hr film	late 1971
Ann Halprin Wkshp	2	x	x			x	still	6m0		0	1,000	200	3,000	10,000(1hr)	w/in 6 mos
Ed Ruscha	1	x	x							1000	1000	500	500	1500	Sumn-Fall 71
R. Breer	1		x	x				2ds	2-3wks	2000		200		500	
Richard Serra Bob Creeley	2	x	x			x		2wks	2-3mos	?	?	?	?	5-25,~~000~~ tape 10,000 film	fall 71-sp 72
Jean Dupuy	2			8		x									
Pauline Oliveros	2	x													
Kieth Sonnier	1	x				x(1")		2-3dys		1000	1000	500	300	1000	Sp. 71 or Summer
Remy Charlip	2		x												may and july
Michael Snow	1.	x				x		4hrs		1000	100	200	1000		
Robert Irwin	2		x						6mos				40,000	for 2 programs	july 71
Video Freex	2	x					2"portable	1dy	5dys	10,000		2000	1500	10,000	anytime
Ann Douglas	2					½"		½hrup	varies	250/day	negotiat		1500	= ?	immed.
George Kuchar	1		x						6mos	1000	1000	500		1500	anytime
Robert Israel	1	x				x									Dec71, J72
Gene Davis	1		x			x			2mos				5,000-7,000		Sp or Su 71
~~Charles Patton~~	2		x	x		x	mix		1 yr	500/wk	trav60/dy			100,000	3/15/71
Larry Poons	1		x											will keep receipts	now
Red Grooms															
Trisha Brown															
Shunk-Kender Paik	1		x			x									

Figure 5.29.
E.A.T., programming chart for Artists and Television, 1971.
Collection of the Getty Research Institute, Los Angeles.

B96F.8

This is the schedule for the first series of works by artists to be presented on television over the Public Access cable channels.

Tues., November 2
9:00 - 10:00 p.m.
Sterling C

Wed., November 3
9:00 - 10:00 p.m.
Teleprompter C

MICHAEL SNOW: A 16mm film

Tues., November 9
9:00 - 10:00 p.m.
Sterling C

Wed., November 10
9:00 - 10:00 p.m.
Teleprompter C

NANCY GRAVES: 200 Stills sound and color 8 minutes 16mm

Goulimine, 1970 sound and color 8 minutes 16mm

Izy Boukar sound and color 20 minutes 16mm

LUCAS SAMARAS: Self written and directed by Lucas Samaras. Photographed and edited by Kim Levin. sound and color 22 minutes 16mm

Tues., November 16
9:00 - 10:00 p.m.
Sterling C

Wed., November 17
9:00 - 10:00 p.m.
Teleprompter C

LES LEVINE: John and Mimi's Book of Love 1/2" videotape

Tues., November 23
9:00 - 10:00 p.m.
Sterling C

Wed., November 24
9:00 - 10:00 p.m.
Teleprompter C

ANDY WARHOL: One Hour of Tape Produced by Andy Warhol. Artist-Engineer Mike Netter. 1/2" videotape

Tues., November 30
9:00 - 10:00 p.m.
Sterling C

Wed., December 1
9:00 - 10:00 p.m.
Teleprompter C

KEITH SONNIER: 1/2" videotape

The Tuesday night shows may be viewed on television monitors at E.A.T., 49 East 68 and at Max's Terre Haute, First Avenue at 73rd, New York City.

This series was made possible by the following galleries: Bykert, Castelli, Pace, Reese-Paley; and was organized by Experiments in Art and Technology.

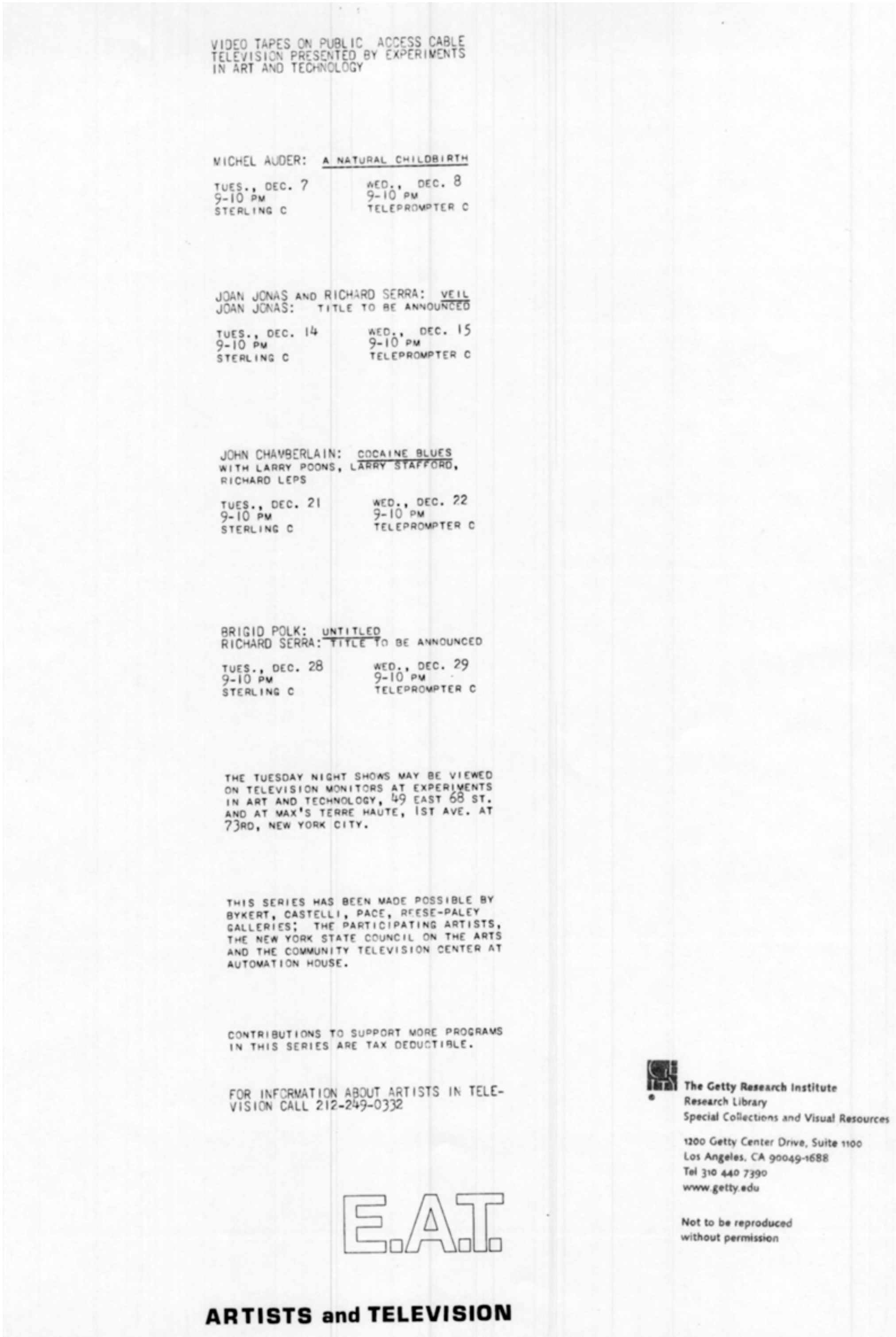
Future weekly programs will include works by Michel Auder, John Chamberlain, Gene Davis, Ralph Hocking, Joan Jonas, Brigid Polk, Larry Rivers, Richard Serra, Tony Shfrazi.

For information call Carlota Corday, 212-249-0332 or 925-3409.

E.A.T.

ARTISTS and TELEVISION

Figure 5.30.
E.A.T., Artists and Television broadcasting schedule, 1971.
Collection of the Getty Research Institute, B96F.8.



VIDEO TAPES ON PUBLIC ACCESS CABLE TELEVISION PRESENTED BY EXPERIMENTS IN ART AND TECHNOLOGY

MICHEL AUDER: A NATURAL CHILDBIRTH

TUES., DEC. 7
9-10 PM
STERLING C

WED., DEC. 8
9-10 PM
TELEPROMPTER C

JOAN JONAS AND RICHARD SERRA: VEIL
JOAN JONAS: TITLE TO BE ANNOUNCED

TUES., DEC. 14
9-10 PM
STERLING C

WED., DEC. 15
9-10 PM
TELEPROMPTER C

JOHN CHAMBERLAIN: COCAINE BLUES
WITH LARRY POONS, LARRY STAFFORD, RICHARD LEPS

TUES., DEC. 21
9-10 PM
STERLING C

WED., DEC. 22
9-10 PM
TELEPROMPTER C

BRIGID POLK: UNTITLED
RICHARD SERRA: TITLE TO BE ANNOUNCED

TUES., DEC. 28
9-10 PM
STERLING C

WED., DEC. 29
9-10 PM
TELEPROMPTER C

THE TUESDAY NIGHT SHOWS MAY BE VIEWED ON TELEVISION MONITORS AT EXPERIMENTS IN ART AND TECHNOLOGY, 49 EAST 68 ST. AND AT MAX'S TERRE HAUTE, 1ST AVE. AT 73RD, NEW YORK CITY.

THIS SERIES HAS BEEN MADE POSSIBLE BY BYKERT, CASTELLI, PACE, REESE-PALEY GALLERIES; THE PARTICIPATING ARTISTS, THE NEW YORK STATE COUNCIL ON THE ARTS AND THE COMMUNITY TELEVISION CENTER AT AUTOMATION HOUSE.

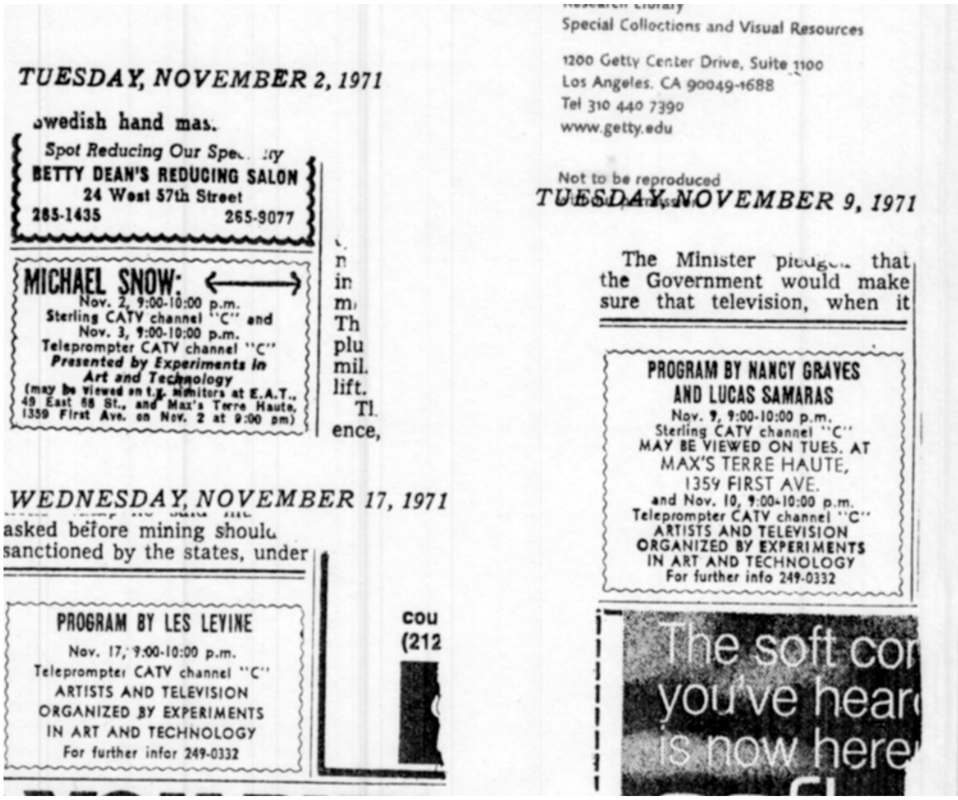
CONTRIBUTIONS TO SUPPORT MORE PROGRAMS IN THIS SERIES ARE TAX DEDUCTIBLE.

FOR INFORMATION ABOUT ARTISTS IN TELEVISION CALL 212-249-0332

E.A.T.

ARTISTS and TELEVISION

Figure 5.31.
E.A.T., Artists and Television broadcasting schedule, 1971.
E.A.T./GRI, Box 96, Folder 8.



TUESDAY, NOVEMBER 2, 1971

wedish hand mas.
Spot Reducing Our Spe... ...y
BETTY DEAN'S REDUCING SALON
24 West 57th Street
265-1435 265-9077

MICHAEL SNOW: ←→
Nov. 2, 9:00-10:00 p.m.
Sterling CATV channel "C" and
Nov. 3, 9:00-10:00 p.m.
Teleprompter CATV channel "C"
Presented by Experiments in
Art and Technology
(may be viewed on t.v. monitors at E.A.T.,
49 East 68 St., and Max's Terre Haute,
1359 First Ave. on Nov. 2 at 9:00 pm)

TUESDAY, NOVEMBER 9, 1971

The Minister pledge... that
the Government would make
sure that television, when it

PROGRAM BY NANCY GRAVES
AND LUCAS SAMARAS
Nov. 9, 9:00-10:00 p.m.
Sterling CATV channel "C"
MAY BE VIEWED ON TUES. AT
MAX'S TERRE HAUTE,
1359 FIRST AVE.
and Nov. 10, 9:00-10:00 p.m.
Teleprompter CATV channel "C"
ARTISTS AND TELEVISION
ORGANIZED BY EXPERIMENTS
IN ART AND TECHNOLOGY
For further info 249-0332

WEDNESDAY, NOVEMBER 17, 1971

asked before mining should
sanctioned by the states, under

PROGRAM BY LES LEVINE
Nov. 17, 9:00-10:00 p.m.
Teleprompter CATV channel "C"
ARTISTS AND TELEVISION
ORGANIZED BY EXPERIMENTS
IN ART AND TECHNOLOGY
For further infor 249-0332

The soft co
you've hear
is now here

Figure 5.32.
Advertisements for Artists and Television,
New York Times, November 2, 9, and 17, 1971.

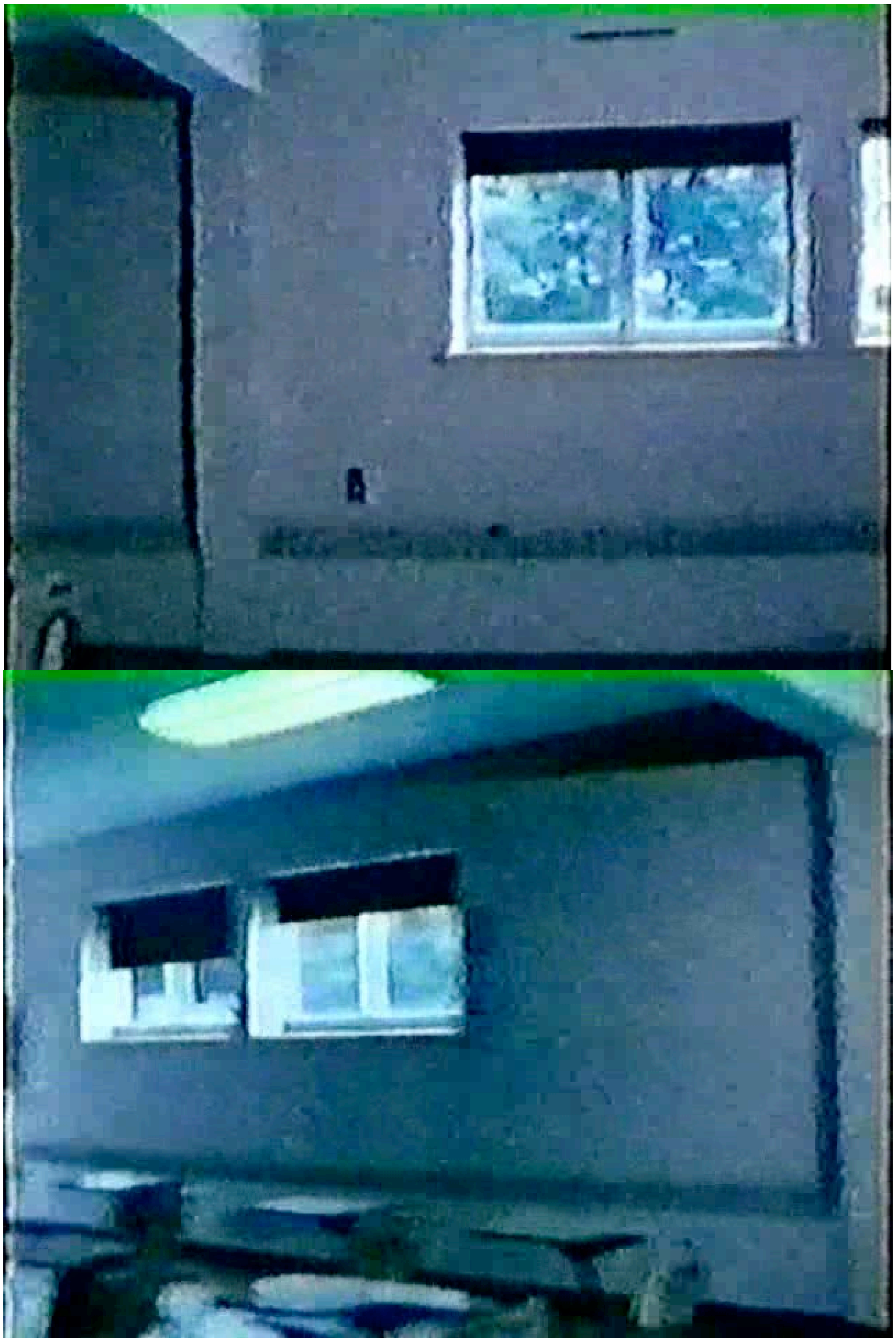


Figure 5.33.
Stills from Michael Snow, *Back and Forth* [□], 1968-69,
16mm transferred to video, 50 minutes, color, sound.

Figure 5.34.
Stills from Richard Serra, *Color Aid*, 1970-71,
16mm transferred to video, sound, 36 min.
Collection Film Library, Museum of Modern Art, New York,

Figure 5.35.
Stills from Richard Serra, *Anxious Automation*, 1971,
video, b&w, sound, 5 minutes. On screen: Joan Jonas.

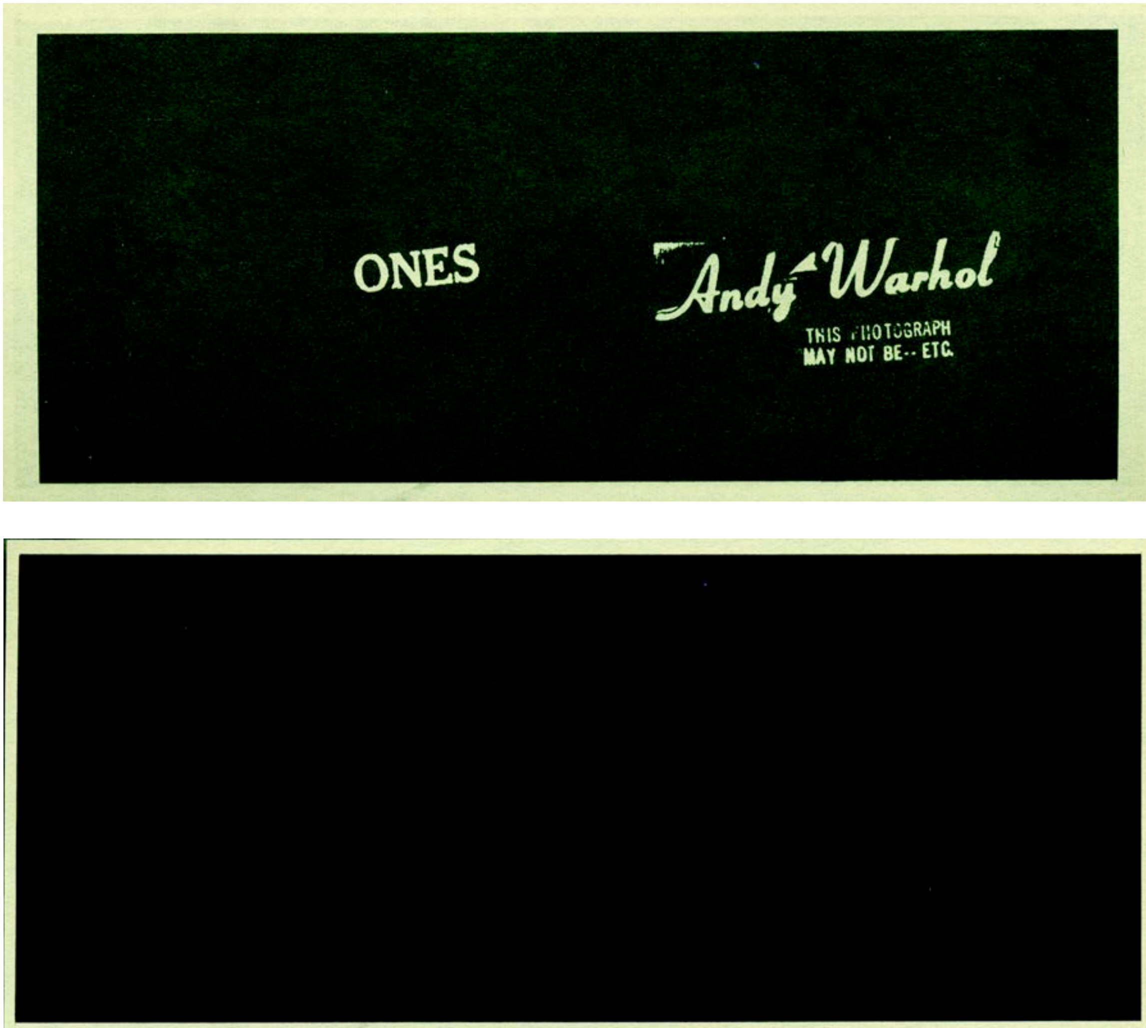


Figure 5.36.
Andy Warhol, recto and verso of $1 bill for “Artcash,”
offset lithograph on wove paper, edition of 75, 1971.
Collection of Julie Martin, Berkeley Heights, NJ.

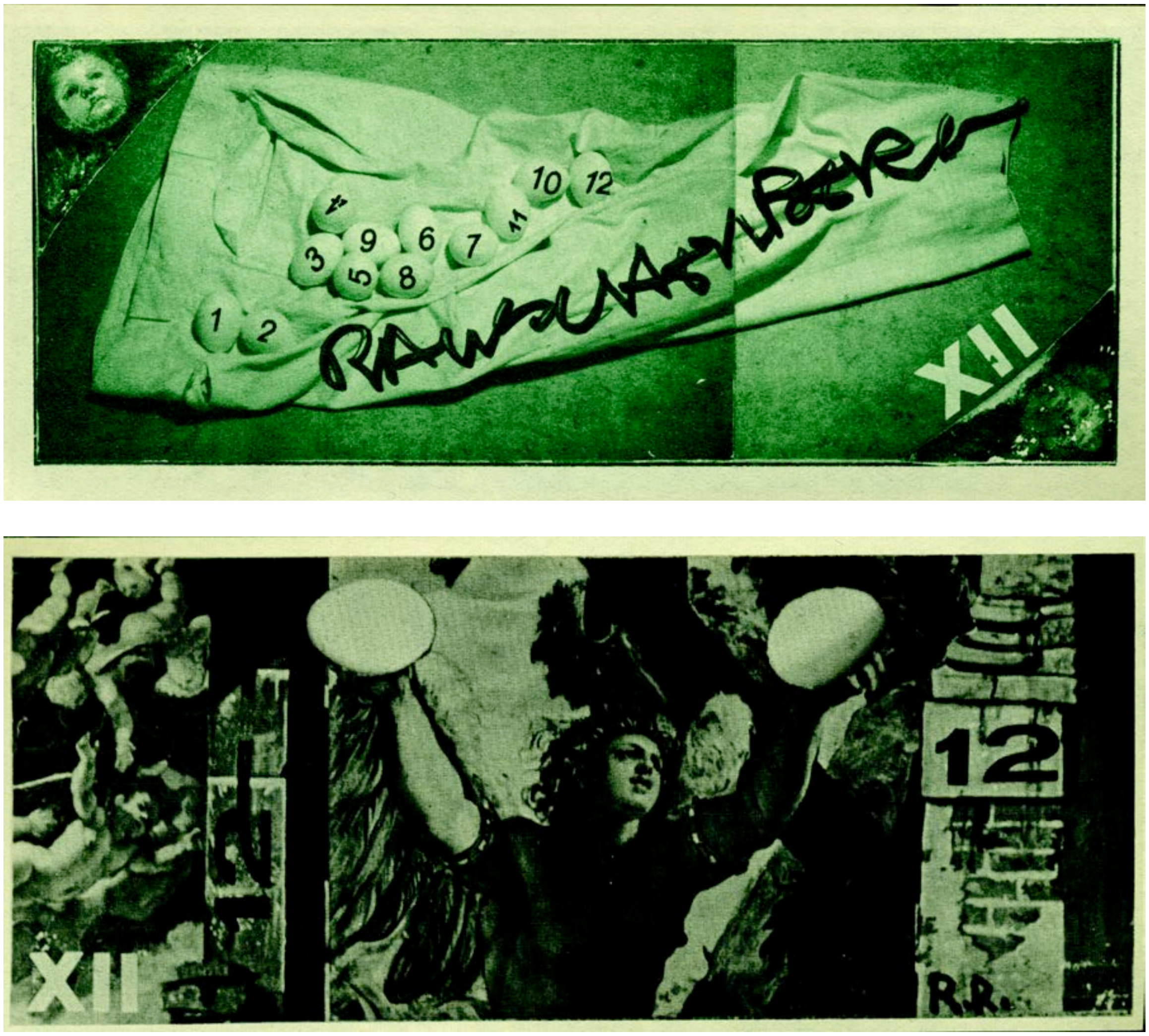


Figure 5.37.
Robert Rauschenberg, recto and verso of $12 bill for "Artcash,"
offset lithograph on wove paper, edition of 75, 1971.
Collection of Julie Martin, Berkeley Heights, NJ.

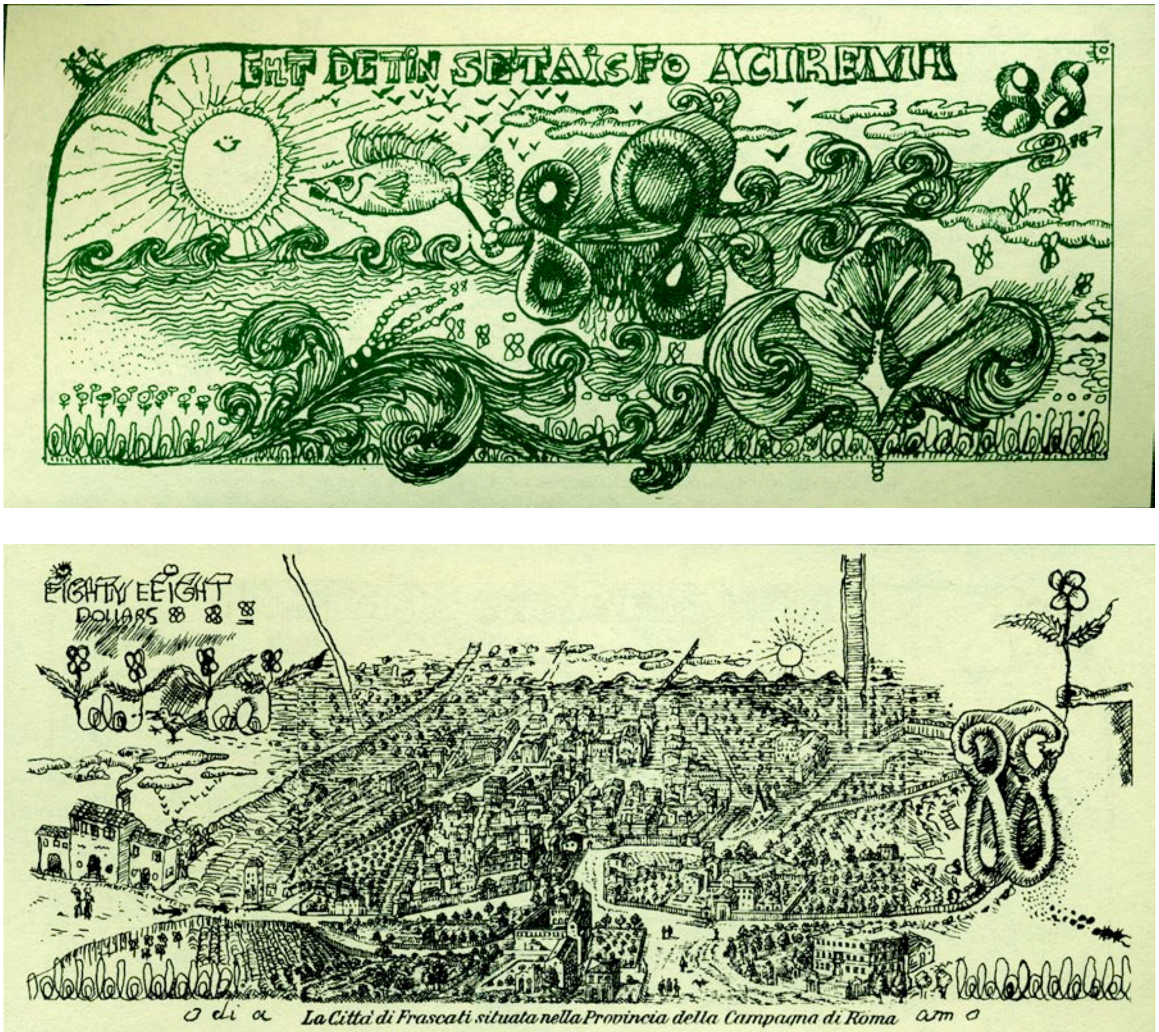


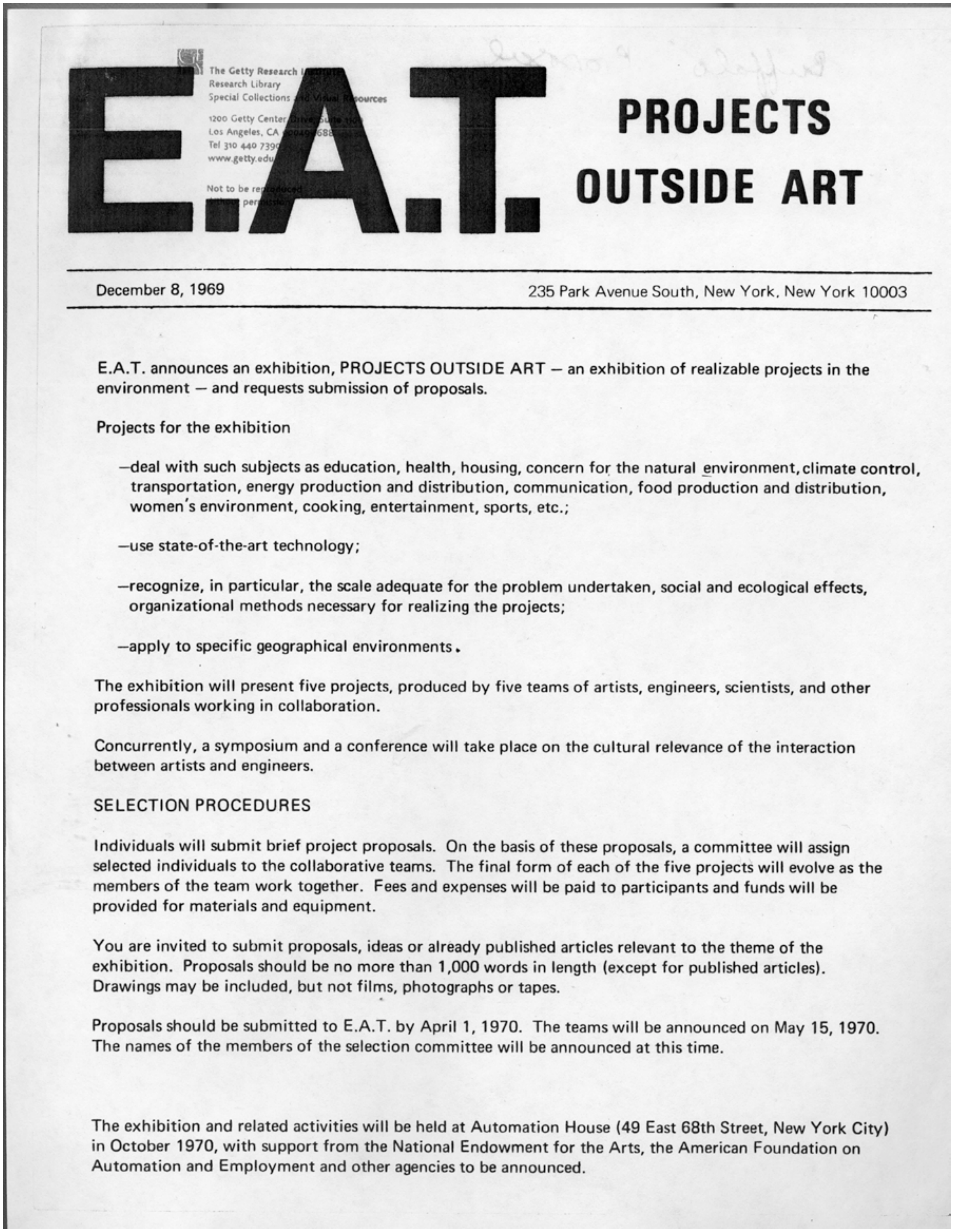
Figure 5.38.
Marisol, recto and verso of $88 bill for “Artcash,”
offset lithograph on wove paper, edition of 75, 1971.
Collection of Julie Martin, Berkeley Heights, NJ.

Figure 5.39.
Still from Gordon Matta-Clark, *Automation House*, 1971, 16mm transferred to video, black and white, 32 min., produced by Carlota Schoolman.

Figure 5.40.
Still from Gordon Matta-Clark, *Automation House*, 1971,
16mm transferred to video, black and white, 32 min.,
produced by Carlota Schoolman.

Figure 5.41.
Still from Gordon Matta-Clark, *Automation House*, 1971,
16mm transferred to video, black and white, 32 min.,
produced by Carlota Schoolman.

Figure 5.42.
Still from Gordon Matta-Clark, *Automation House*, 1971,
16mm transferred to video, black and white, 32 min.,
produced by Carlota Schoolman.



E.A.T.

PROJECTS
OUTSIDE ART

December 8, 1969 — 235 Park Avenue South, New York, New York 10003

E.A.T. announces an exhibition, PROJECTS OUTSIDE ART – an exhibition of realizable projects in the environment – and requests submission of proposals.

Projects for the exhibition

—deal with such subjects as education, health, housing, concern for the natural environment, climate control, transportation, energy production and distribution, communication, food production and distribution, women's environment, cooking, entertainment, sports, etc.;

—use state-of-the-art technology;

—recognize, in particular, the scale adequate for the problem undertaken, social and ecological effects, organizational methods necessary for realizing the projects;

—apply to specific geographical environments.

The exhibition will present five projects, produced by five teams of artists, engineers, scientists, and other professionals working in collaboration.

Concurrently, a symposium and a conference will take place on the cultural relevance of the interaction between artists and engineers.

SELECTION PROCEDURES

Individuals will submit brief project proposals. On the basis of these proposals, a committee will assign selected individuals to the collaborative teams. The final form of each of the five projects will evolve as the members of the team work together. Fees and expenses will be paid to participants and funds will be provided for materials and equipment.

You are invited to submit proposals, ideas or already published articles relevant to the theme of the exhibition. Proposals should be no more than 1,000 words in length (except for published articles). Drawings may be included, but not films, photographs or tapes.

Proposals should be submitted to E.A.T. by April 1, 1970. The teams will be announced on May 15, 1970. The names of the members of the selection committee will be announced at this time.

The exhibition and related activities will be held at Automation House (49 East 68th Street, New York City) in October 1970, with support from the National Endowment for the Arts, the American Foundation on Automation and Employment and other agencies to be announced.

Figure 5.43.
E.A.T., Projects Outside Art announcement, December 8, 1969.

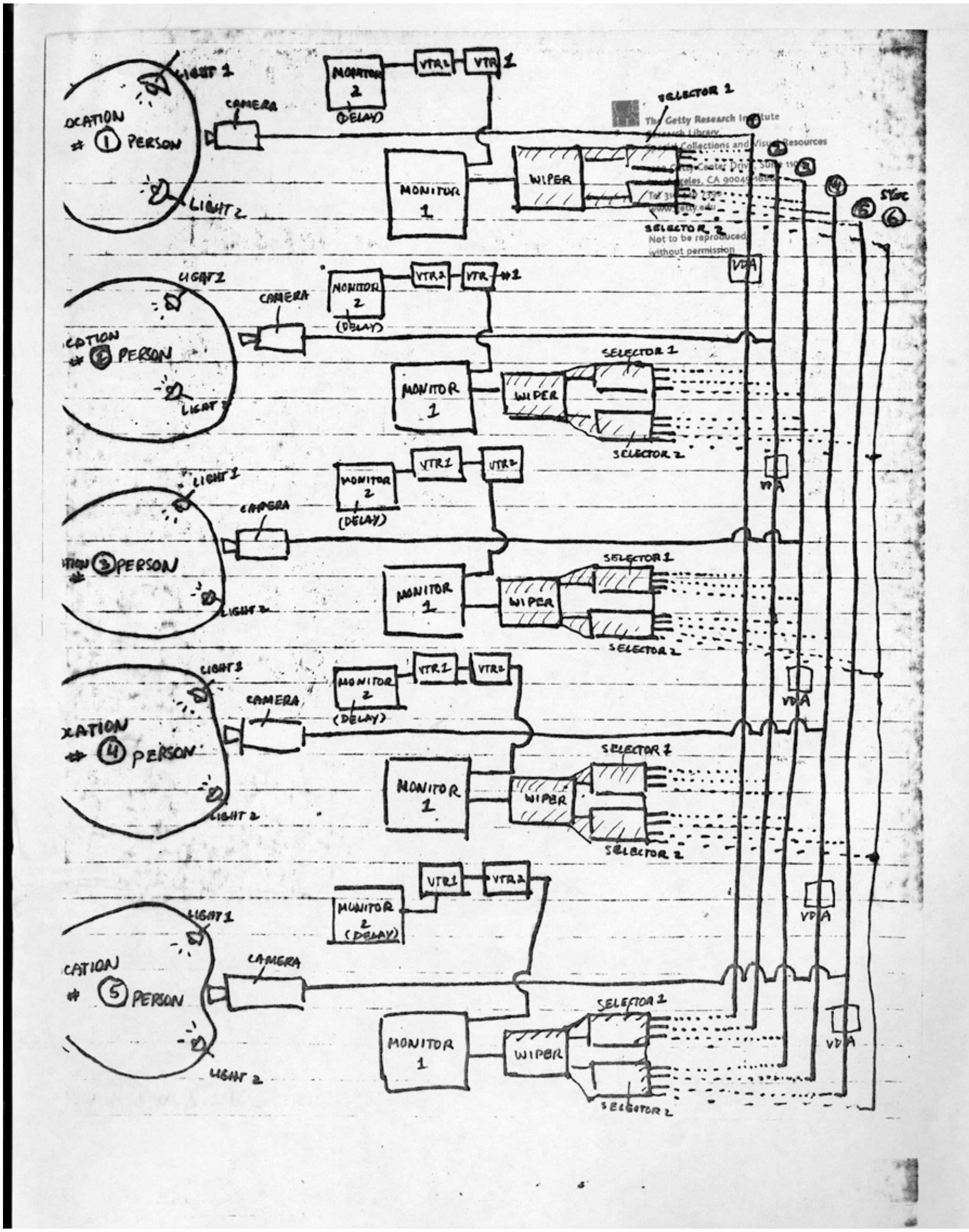


Figure 5.44.
Allan Kaprow, diagram for *Sales Pitch*, 1970.

Figure 5.45.
E.A.T., *Children and Communication*, New York, 1974.
Photo: Robert Whitman.

Bibliography

Archives consulted:

Andy Warhol Museum Archives, Pittsburgh, PA.

Archives of American Art. Smithsonian Institution, Washington, D.C.

Foundation for Contemporary Performance Arts Archive, New York, NY.

The Getty Research Institute, Los Angeles, CA. Experiments in Art and Technology Records, 1966–1997. Accession number 940003.

The Museum of Modern Art Archives, New York, NY. Experiments in Art and Technology/Billy Klüver Files.

Los Angeles County Museum of Art Archives, Los Angeles, CA.

The Daniel Langlois Foundation for Art, Science and Technology, Montreal. Collection of Documents Published by E.A.T.; 9 Evenings: Theatre and Engineering fonds; Steina and Woody Vasulka fonds.

Musée National d'Art Moderne, Centre Georges Pompidou, Curatorial Files, Paris.

Museum Ludwig Archives, Cologne.

National Gallery of Art Archives and Conservation Files, Washington, D.C.

Robert Rauschenberg Foundation, New York, NY.

Works cited:

Abramson, Albert. *The History of Television 1942 to 2000*. Jefferson, NC: McFarland, 2003.

Adler, Renata. "Automation House." *The New Yorker*, March 14, 1970.

Adorno, Theodor W. "Culture and Administration." In *The Culture Industry: Selected Essays on Mass Culture*. Translated by Wes Blomster. London and New York: Routledge, 2002.

______. *Currents of Music: Elements of a Radio Theory*. Translated by Robert Hullot-Kentor. Frankfurt: Suhrkamp Verlag, 2006.

Agamben, Giorgio. “What Is an Apparatus?” In *What Is an Apparatus? And Other Essays*. Translated by David Kishik and Stefan Pedatella, 1–25. Stanford: Stanford University Press: 2009.

Alberro, Alexander. *Conceptual Art and the Politics of Publicity*. Cambridge, MA: MIT Press, 2003.

Alexander, Christopher. *Notes on the Synthesis of Form*. Cambridge: Harvard University Press, 1964.

Alloway, Lawrence. “Network: The Art World Described as a System.” *Artforum International*, September 1972.

American Foundation on Automation and Employment. “Automation House: A Philosophy for Living in a World of Change.” Advertising supplement. *The New York Times*, February 1, 1970.

“The Anand Project: A Television Experiment in Rural India.” *TECHNE* 1, no. 2 (November 6, 1970).

Anderson, Simon. “Living in Multiple Dimensions: George Brecht and Robert Watts, 1953–1963.” In *Off Limits: Rutgers University and the Avant-Garde, 1957–1963*, edited by Joan Marter, 100–117. Newark and New Brunswick, New Jersey: The Newark Museum and Rutgers University Press, 1999.

Anon., “A Community Antenna or Cable Television system (CATV) consists of…” *Radical Software* 1, no. 1 (Spring 1970).

Anon., “A Good Janitor Becomes as Important as a Curator.” *Life*, August 12, 1966.

“Arbitration Opinion.” Local 100, Transport Workers Union of America vs. the New York City Transit Authority, 1963. Theodore Woodrow Kheel Arbitration Awards, #5024. Kheel Center for Labor-Management Documentation and Archives, Cornell University Library.

“Art Experiments in Mixed Media Will Be Traced.” *The New York Times*, October 13, 1970.

Ashley, Robert. *Music with Roots in the Aether: Interviews with and Essays About Seven American Composers*. Köln: MusikTexte, 2000.

Aspen 4. Spring 1967.

Attali, Jacques. *Noise: A Political Economy of Music*. Minneapolis: University of Minnesota Press, 1985.

Bachelard, Gaston. *Le nouvel esprit scientifique*. Paris: Librairie Félix Alcan, 1934.

Bagrit, Sir Leon. *The Age of Automation: The BBC Reith Lecture Series 1964*. New York: Mentor Books, 1965.

Bamford, James. *The Puzzle Palace.* New York: Penguin, 1983.

Banham, Reyner. "A Home Is Not a House." *Art in America*, April 1965.

______. "People's Palaces." *New Statesman* 68 (August 1964): 191–192.

______. *The Architecture of the Well-Tempered Environment*. Chicago: University of Chicago Press, 1969.

Bardiot, Clarisse. "The Diagrams of *9 Evenings*." In *9 Evenings Reconsidered: Art, Theatre, and Engineering, 1966*, edited by Catherine Morris, translated by Claire Grace, 45–51. Cambridge, MA: MIT List Visual Arts Center, 2006. Exhibition catalogue.

Bardiot, Clarisse and Catherine Morris. "Interview with Herb Schneider." In *9 Evenings Reconsidered: Art, Theatre, and Engineering, 1966*, edited by Catherine Morris, 55–64. Cambridge, MA: MIT List Visual Arts Center, 2006. Exhibition catalogue.

Barnes, Clive. "Happening: Ineffable Night at the Armory." *The New York Times,* Oct. 17, 1966.

Bateson, Gregory. "Restructuring the Ecology of a Great City." *Radical Software* 1, no. 3 (Spring 1971): 2–3.

Battcock, Gregory, ed. *New Artists Video: A Critical Anthology*. New York: E. P. Dutton, 1978.

Baudrillard, Jean. "The Precession of Simulacra." In *Art after Modernism: Essays on Rethinking Representation*, edited by Brian Wallis. New York: New Museum of Contemporary Art, 1984.

______. "Simulacra and Simulacrum." In *Selected Writings*, edited by Mark Poster. Stanford: Stanford University Press, 1988.

Bauman, Zygmunt. *Liquid Modernity*. Cambridge: Polity, 2000.

Beck, Ulrich. *Ecological Politics in an Age of Risk*. Translated by Amos Weisz. Cambridge: Polity Press, 1995.

______. *Power in the Global Age: A New Global Political Economy*. Cambridge: Polity Press, 2005.

______. “The Reinvention of Politics: Toward a Theory of Reflexive Modernization.” In Beck, Giddens, and Lash, eds., *Reflexive Modernization: Politics, Tradition and Aesthetics in the Modern Social Order*.

______. *Risk Society: Towards a New Modernity*. Translated by Mark Ritter. London: Sage Publications, 1992.

______. “Self-Dissolution and Self-Endangerment of Industrial Society: What Does This Mean?” In *Reflexive Modernization: Politics, Tradition and Aesthetics in the Modern Social Order*.

Beck, Ulrich and Elizabeth Beck-Gernsheim. *Individualization*. London: Sage Publications, 2002.

Beck, Urich, Anthony Giddens, and Scott Lash, eds. *Reflexive Modernization: Politics, Tradition and Aesthetics in the Modern Social Order*. Cambridge: Polity Press, 1994.

Behrman, David. Interview in *John Cage: Variations VII*. New York: ARTPIX and Experiments in Art and Technology, 2008. DVD.

______. Interview with Julie Martin. Barishnykov Arts Center, New York, March 15, 2010.

Bell, Daniel. *The Coming of Post-Industrial Society*. New York: Basic Books, 1973.

Bell, Daniel. Preface to *The Age of Automation: The BBC Reith Lecture Series 1964*, by Sir Leon Bagrit, xi–xii. New York: Mentor Books, 1965.

Bello, Francis. “The World’s Greatest Industrial Laboratory.” *Fortune* 58, no. 5 (November 1958): 148–157.

Beniger, James R. *The Control Revolution: Technological and Economic Origins of the Information Society*. Cambridge, MA: Harvard University Press, 1986.

Benjamin, Walter. “On Some Motifs in Baudelaire.” In *Illuminations*, edited by Hannah Arendt. New York: Schocken Books, 1969.

Bennett, Stuart. *A History of Control Engineering, 1930–1955*. London: Peter Peregrinus, 1993.

Berg, Gretchen. "Nothing to Lose." *Cahiers du Cinéma in English* 10 (May 1967): 43.

Berman, Marshall. *All That Is Solid Melts into Air: The Experience of Modernity*. London and New York: Verso, 1983.

Bernstein, Jeremy. *Three Degrees Above Zero: Bell Laboratories in the Information Age*. London: Cambridge University Press, 1987.

Bernstein, Roberta. *Jasper Johns' Paintings and Sculptures 1954-1974: "The Changing Focus of the Eye."* Ann Arbor and London: UMI Research Press, Studies in the Fine Arts: The Avant-Garde, 1975.

"The Biggest Mirror Ever." *Architectural Forum* 126, no. 3 (April 1967): 33–41.

Bishop, Claire. "Rate of Return: Artists Placement Group." *Artforum International*, October 2010.

Bijker, Wiebe E, Thomas P. Hughes, and Trevor Pinch, eds. *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*. Cambridge, MA: MIT Press, 2012.

Blake, Peter. *Form Follows Fiasco: Why Modern Architecture Hasn't Worked*. New York: Little, Brown, 1977.

Bochner, Mel. Interview with Hans-Ulrich Obrist and Sandra Antelo-Suarez. Accessed January 21, 2017. http://projects.e-flux.com/do_it/notes/interview/i003.html.

Bochner, Mel. "Media Study." *Artforum International*, September 2012.

______. *The Singer Notes*. 1968.

Bode, Hendrik W. "Feedback: The History of an Idea." In *Selected Papers on Mathematical Trends in Control Theory*, edited by Richard Bellman. New York: Dover, 1964.

______. *Synergy: Technical Integration and Technological Innovation in the Bell System*. Murray Hill, NJ: Bell Laboratories, 1971.

Boehmer, Konrad. "Chance as Ideology." Translated by Ian Pepper. *October* 82 (Fall 1997): 62–76.

Bogue, Ronald. *Deleuze on Music, Painting, and the Arts*. London: Routledge, 2003.

Bois, Yve-Alain. "Liquid Words." In *Formless: A User's Guide*. New York: Zone Books, 1997: 124–129.

______. "The Use-Value of 'Formless.'" In *Formless: A User's Guide*. New York: Zone Books, 1997: 13–40.

______. "Matisse and 'Arche-Drawing.'" In *Painting as Model*, 3–64. Cambridge, MA: MIT Press, 1993.

______. "The Measurement Pieces: From Index to Implex." In *Mel Bochner: Thought Made Visible, 1966–1973*, edited by Richard Field. New Haven, CT: Yale University Press, 1995.

______. "Thermometers Last Forever." In *Edward Ruscha: Romance with Liquids*. New York: Gagosian Gallery, 1993.

Bosh, Clemen. "The Talk of the Town: Westbeth." *The New Yorker*, June 8, 1968.

Bourdieu, Pierre. *On Television*. Translated by Priscilla Parkhurst Ferguson. New York: The New Press, 1998.

______. *Science of Science and Reflexivity*. Translated by Richard Nice. Chicago: University of Chicago Press, 2004.

Bourdon, David. *Warhol*. New York: H. N. Abrams, 1989.

Brand, Stewart. *The Last Whole Earth Catalog*. January 1, 1971.

Braun, Ernest and Stuart MacDonald. *Revolution in Miniature: The History and Impact of Semiconductor Electronics*, 2nd edition. Cambridge: Cambridge University Press, 1982.

Braverman, Harry. *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century*. New York and London: Monthly Review Press, 1974.

Brecht, George. *Chance Imagery*. New York: Something Else Press, 1966.

______. "Paragraphs, Quotations, and Lists." In *An Anthology of Chance Operations*, edited by George Brecht, La Monte Young, et al. New York: George Maciunas and Jackson MacLow, 1962.

Breitwieser, Sabine, ed. *Experiments in Art and Technology*. Cologne: Walther König and Museum of Modern Art Salzburg, 2015. Exhibition catalogue.

Brouwer, Maureen, ed. *Dan Graham: Works, 1965–2000*. Düsseldorf: Richter Verlag, 2001.

Brown, Paul, Charlie Gere, Nicholas Lambert, and Catherine Mason, eds. *White Heat Cold Logic: British Computer Art 1960–1980*. Cambridge, MA: MIT Press, 2009.

Buchloh, Benjamin H. D. "The Book of the Future: Alison Knowles' *The House of Dust*." 2007. www.jamesfuentes.com/exhibits_pages/programming%20chance/BBuchloh_text_HouseofDust.pdf.

______. "Drawing Blanks: Notes on Andy Warhol's Late Works." *October* 127 (Winter 2009): 3–24.

______. "Fluxus." In *Art Since 1900: Modernism, Antimodernism, Postmodernism*. London: Thames and Hudson, 2004.

______. *Neo-Avantgarde and Culture Industry: Essays on European and American Art from 1955 to 1975*. Cambridge, MA: MIT Press, 2001.

______. "Ready-Made, Objet Trouvé, Idée Reçue." In *Dissent: The Issue of Modern Art in Boston*, 106–122. Boston: Institute of Contemporary Art, 1986.

______. "Conceptual Art 1962–1969: From the Aesthetic of Administration to the Critique of Institutions." *October* 55 (Winter 1990): 105–143.

Burnham, Jack. "Art and Technology: The Panacea That Failed." In *The Myths of Information: Technology and Postindustrial Culture*, edited by Kathleen N. Woodward. Madison, WI: Coda Press, 1980.

______. "Steps in the Formulation of Real-Time Political Art." In *Framing and Being Framed: 7 Works 1970–75*, by Hans Haacke. Edited by Kasper König. Halifax: Nova Scotia College of Art and Design Press, 1975.

______. "Systems Esthetics." *Artforum International*, September 1968.

Burns, R. W. *Television: An International History of the Formative Years*. London: IEEE History of Technology Series, 1998.

Bush, Vannevar. "As We May Think." *The Atlantic Monthly*, July 1945.

______. US Office of Scientific Research and Development. *Science, the Endless Frontier: A Report to the President*. Washington, D.C.: US Government Printing Office, 1945.

Bylinsky, Gene. "THE NEW LOOK AT AMERICA'S TOP LAB: How has Bell Labs weathered the breakup of AT&T? Surprisingly well. Basic research still thrives, but there's a new emphasis on applying it to products." *Fortune*, February 1, 1988. Accessed August 1, 2016.

http://archive.fortune.com/magazines/fortune/fortune_archive/1988/02/01/70146/index.htm.

Cage, John. "Art and Technology 1969." *TECHNE* 1, no. 1 (April 14, 1969): 11.

______. "Composition as Process: Indeterminacy." In Cage, *Silence*, 35–40.

______. "Diary: How to Improve the World (You Will Only Make Matters Worse) 1965." In *A Year From Monday: New Lectures and Writings*. Middletown, CT: Wesleyan University Press, 1967.

______. "Experimental Music." In Cage, *Silence*, 7–12.

______. "Interview with Richard Kostelanetz." In *Conversing with Cage*, edited by Richard Kostelanetz. New York: Limelight Editions, 1988.

______. Cited in "Radio Happenings: Recorded at WBAI, NYC 7/9/66–1/16/67." *Exact Change Yearbook No. 1*, edited by Peter Gizzi, 251–70. Boston: Exact Change.

______. *Silence: Lectures and Writings*. Middletown, CT: Wesleyan University Press, 1961

______. "To Describe the Process of Composition Used in Music of Changes and Imaginary Landscape No. 4." In Cage, *Silence*, 57–59.

______. *Notations*. New York: Something Else Press, 1969.

______. "On Robert Rauschenberg, Artist, and His Work." In Cage, *Silence*, 98–108.

Callon, Michel. "Society in the Making: The Study of Technology as a Tool for Sociological Analysis." In Bijker, Hughes, and Pinch, eds., *The Social Construction of Technological Systems*.

Camille, Michael. "Simulacrum." In *Critical Terms for Art History*, 2nd ed., edited by Richard Shiff and Robert S. Nelson. Chicago: University of Chicago Press, 2003.

Canaday, John. "Esthetics of Expo: Big and Noisy." *The New York Times*, March 16, 1970.

______. "Rauschenberg Art: Chance to Catch Up." *The New York Times*, July 10, 1970.

______. "What's in a Name, Like Warhol or Vanderbilt?" *The New York Times*, April 9, 1966.

Castelli, Leo. "Andy Warhol: Quelques grands témoins: Sidney Janis, Leo Castelli, Robert Rosenblum, Clement Greenberg." Interview by Ann Hindry. *Artstudio* 8 (1988): 114–129.

______. Interview by David Bailey. In *Andy Warhol: Transcript of David Bailey's ATV Documentary*, n.p. London: Bailey Litchfield/Mathews Miller Dunbar, 1972.

______. Oral history interview by Paul Cummings. May 14, 1969. Tape 1. Archives of American Art, Smithsonian Institution.

Chandler Jr., Alfred D. *Scale and Scope: The Dynamics of Industrial Capitalism*. Cambridge, MA: Harvard University Press, 1990.

______. *The Visible Hand: The Managerial Revolution in American Business*. Cambridge, MA: Harvard University Press, 1977.

Cherry, E. Colin. "A History of the Theory of Information." *Proceedings of the Institution of Electrical Engineers* 98 (September 1951): 383–393.

Clark, T. J. "Modernism, Postmodernism, and Steam." *October* 100 (Spring 2002): 154–174.

Coe, Ralph T., ed. *The Magic Theater*. Kansas City: The Circle Press, 1970.

Cohen, Martin. "The Electronic Soapbox." *Lithopinion* 7, no. 3 (Fall 1972): 31–36.

Control 1–3 (1965–1967).

Cooper, Harry. "Speak, Painting: Word and Device in Early Johns." *October* 127 (Winter 2009): 65–76.

Crary, Jonathan. "Eclipse of the Spectacle." In *Art After Modernism: Rethinking Representation*, edited by Brian Wallis, 283–294. New York: The New Museum of Contemporary Art, 1984.

______. *Suspensions of Perception: Attention, Spectacle, and Modern Culture*. Cambridge, MA: MIT Press, 1999.

Creeley, Robert. "Feedback: 'Contemporary Voices in the Arts.'" *Arts Magazine* 41, no. 8 (Summer 1967): 18-20.

Cross, Lowell. Interview in *John Cage: Variations VII*. New York: ARTPIX and Experiments in Art and Technology, 2008. DVD.

Crowley, Michael F. et al, eds. *Science and Engineering Employment 1970–80: Special Report*. Washington, D.C.: U.S. Government Printing Office, 1981.

Damisch, Hubert. *A Theory of /Cloud/: Toward a History of Painting*. Translated by Janet Lloyd. Stanford: Stanford University Press, 2002.

Daniell, Thomas. "Bug Eyes and Blockhead." *Log: Observations on Architecture and the Contemporary City* 36 (Winter 2016): 34–47.

Davis, Douglas. *Art and the Future*. New York: Praeger, 1973.

______. "Art & Technology—The New Combine." *Art in America*, January/February 1968.

______. "Improbable Marriage." *Newsweek*, April 20, 1970.

De Bruyn, Eric. "Topological Pathways of Post-Minimalism." *Grey Room* 25 (Fall 2006): 32–63.

Debord, Guy. *Society of the Spectacle*. Translated by Donald Nicholson-Smith. New York: Zone, 1994.

Deleuze, Gilles. *Negotiations, 1972–1990*. Translated by Martin Joughin. New York: Columbia University Press, 1995.

______. "Postscript on the Societies of Control." *October* 59 (Winter 1992): 3–7.

Deleuze, Gilles and Félix Guattari. "Becoming-Music." In *A Thousand Plateaus: Capitalism and Schizophrenia*, translated by Brian Massumi. London: Continuum, 2003.

______. *Milles Plateaux*. Paris: Éditions Minuit, 1980.

Denes, Agnes. "Matrix of Knowledge." In *The Human Argument: The Writings of Agnes Denes*, edited by Klaus Ottman, 104–106. Putnam, CT: Spring Publications, 2008.

Derber, Milton. "Collective Bargaining: The American Approach to Industrial Democracy." *Annals of the American Academy of Political and Social Science* 431 (May 1977): 83–94.

The DEW Line Story. New York: Western Electric Company, 1958. Informational brochure.

Diaz, Eva. *The Experimenters: Chance and Design at Black Mountain College*. Chicago: University of Chicago Press, 2015.

Diebold, John. *Automation: The Advent of the Automatic Factory*. New York: Van Nostrand, 1952.

______. *Beyond Automation: Managerial Problems of an Exploding Technology*. New York: McGraw Hill, 1964.

"Dimensions of Major Work Stoppages, 1947–1959." *Bureau of Labor Statistics Bulletin* 1298. Washington, D.C.: U.S. Government Printing Office, 1961.

Doane, Mary Ann. *The Emergence of Cinematic Time*. Cambridge: Harvard University Press, 2002.

______. "Information, Crisis, Catastrophe." In *Logics of Television: Essays in Cultural Criticism*, edited by Patricia Mellencamp, 222–239. Bloomington: Indiana University Press, 1990.

Duchamp, Marcel. "The Creative Act." In *The Essential Writings of Marcel Duchamp*, edited by Michel Sanouillet and Elmer Peterson, 138–140. London: Thames & Hudson, 1975.

Dunlop, John T., ed. *Automation and Technological Change*. New York: American Assembly, Columbia University, 1962.

"Experiments in Art and Technology: A Summary." *E.A.T. Proceedings*, no. 9 (May 19, 1969): 1.

E.A.T. Information. March 18, 1970.

E.A.T. Information. September 19, 1969.

"E.A.T. Events." *E.A.T./LA Survey* 6 (October 1970): 8.

"E.A.T. Report 1970: Los Angeles." September 18, 1970.

"E.A.T./LA Report." *TECHNE* 1, no. 2 (November 6, 1970).

E.A.T. LA newsletter. *Survey* 6 (October 1970).

E.A.T. News 1, no. 1 (January 15, 1967).

E.A.T. News 1, no. 2 (June 1, 1967).

E.A.T. News 1, no. 3 (November 1, 1967).

E.A.T. News 1, no. 4 (December 20, 1967).

E.A.T. News 2, no. 1 (March 18, 1968).

E.A.T. Operations and Information, no. 1 (November 1, 1968).

E.A.T. Operations and Information, no. 2 (April 24, 1969).

E.A.T. President's Report, October 1, 1969.

E.A.T. Proceedings, no. 9 (May 19, 1969).

E.A.T. "Artists' Television Programming at Automation House, Project Proposal." March 22, 1971, n.p.

______. "Major Local Groups and their leaders." July 31, 1968.

______. "Projects Outside Art." *Techne: A Projects and Process Paper* 1, no. 2 (November 6, 1970): 6.

______. "Report on the Artists and Television program on public access cable television channels in Manhattan." December 20, 1971 (revised March 5, 1972), n.p.

______. *President's Report*. October 1, 1969, 3.

Eaton, Manfred. *Bio-Music: Biological Feedback Experiential Music System*s. Millerton, NY: Something Else Press, 1974.

Eco, Umberto. *The Open Work*. Translated by Anna Cancogni. Cambridge: Harvard University Press, 1989.

Edwards, Paul N. *The Closed World: Computers and the Politics of Discourse in America*. Cambridge: MIT Press, 1996.

Ehrlich, George. "'The Magic Theatre' Exhibition: An Appraisal." *Art Journal* 29, no. 1 (Autumn 1969): 40–44.

Ehrlich, Paul R. *The Population Bomb*. New York: Ballantine, 1968.

Enzensberger, Hans Magnus. "Constituents of a Theory of the Media." *New Left Review* 1, no. 64 (November/December 1970): 13–36.

Epstein, Gerald A. and Juliet B. Schor. "The Rise and Fall of the Golden Age." In *The Golden Age of Capitalism: Reinterpreting the Postwar Experience*, edited by Stephen A. Marglin and Juliet B. Schor, 39–125. Oxford: Oxford University Press, 1991.

Ericson, Raymond. "Study of Noise Takes Art Form." *The New York Times*, November 22, 1970, 80.

Ewald, François. "Insurance and Risk." In *The Foucault Effect: Studies in Governmental Rationality*, edited by Graham Burchell, Colin Gordon, and Peter Miller, 197–210. Chicago: University of Chicago Press, 1991.

Fahlström, Öyvind. "Take Care of the World." In *Manifestos*, 11. New York: Something Else Press, 1966.

Farber, Manny. "Film." *Artforum International*, January 1970.

Feyerabend, Paul. *Against Method*. New York: Verso, 1978.

Fisk, James B. "The Bell Telephone Laboratories." In *The Organisation of Research Establishments*, edited by John Cockroft, 198–212. Cambridge: Cambridge University Press, 1965.

Foster, Hal. "Death in America." In *Andy Warhol*, edited by Annette Michelson, 69–90. October Files 2. Cambridge, MA: MIT Press, 2001.

______. *The Return of the Real*. Cambridge, MA: MIT Press, 1996.

Fraser, Andrea. "From the Critique of Institutions to an Institution of Critique." *Artforum International*, September 2005.

Frei, Georg and Neil Printz, eds. *The Andy Warhol Catalogue Raisonné*. Vol. 2, *Paintings and Sculptures 1964–1969*. London: Phaidon, 2002.

Funcke, Bettina. *Pop or Populus: Art Between High and Low*. Berlin: Sternberg Press, 2009.

Galison, Peter. "Image of Self." In *Things That Talk: Object Lessons from Art and Science*, edited by Lorraine Daston, 257–296. New York and Cambridge, MA: Zone Books and MIT Press, 2004.

______. "The Many Faces of Big Science." In *Big Science: The Growth of Large-Scale Research*, edited by Peter Galison and Bruce Hevly, 1–17. Stanford: Stanford University Press, 1992.

______. "The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision." *Critical Inquiry* 21, no. 1 (Autumn 1994): 228–266.

______. "Physics Between War and Peace." In *Science, Technology, and the Military*, edited by E. Mendelsohn, M. Roe Smith, and P. Weingart, 47–86. Dordrecht: Kluwer, 1988.

______. "War Against the Center." In *Architecture and the Sciences*, edited by Antoine Picon and Alessandra Ponte, 196–227. Princeton: Princeton Architectural Press, 2003.

Garber, Peter M. "The Collapse of the Bretton Woods Fixed Exchange Rate System." In *A Retrospective on the Bretton Woods System: Lessons for International Monetary Reform*, edited by Michael D. Bordo and Barry Eichengreen, 461–494. Chicago: University of Chicago Press, 1993.

Garmire, Elsa. "An Overview." In Klüver, Billy, Julie Martin, and Barbara Rose, eds. *Pavilion*, 173–206.

______. "Art and Technology—Ruminations of an Engineer." *E.A.T./LA Survey* 1 (January 1970): 5.

______. "Calculation of the Optical Effects of a 27.5-m Spherical Mirror." *Applied Optics* 10, no. 12 (December 1971): 2760–2762.

Gersten, Paul. "Sessions of the Art and Technology Course." *E.A.T./LA Survey*, no. 7 (January 1971): 12–13.

Gertner, Jon. *The Idea Factory: Bell Labs and the Great Age of American Innovation*. New York: Penguin, 2012.

Giddens, Anthony. *Modernity and Self-Identity: Self and Society in the Late Modern Age*. Cambridge: Polity Press, 1991.

______. "The Politics of Risk Society." In *Conversations with Anthony Giddens: Making Sense of Modernity*, edited by Anthony Giddens and Christopher Pierson, 204–217. Stanford: Stanford University Press, 1998.

Giddens, Anthony and Christopher Pierson, eds. *Conversations with Anthony Giddens: Making Sense of Modernity*. Stanford: Stanford University Press, 1998.

Gigerenzer, Gerd, et al. *The Empire of Chance: How Probability Changed Science and Everyday Life*. Cambridge: Cambridge University Press, 1990.

Glueck, Grace. "Art Notes: Disharmony at the Armory." *The New York Times*, October 30, 1966.

______. "Artists' Designs for Currency Include a $12 Bill." *The New York Times*, November 6, 1971.

______. "Electro-vangelist." *The New York Times*, October 4, 1970, 120.

______. "It's Les! It's Lucas! It's a Teletrip!" *The New York Times*, November 7, 1971.

______. "Scientist Brings Art to His Work." *The New York Times*, December 17, 1965.

Gnazzo, Anthony. Interview in *John Cage: Variations VII*. New York: ARTPIX and Experiments in Art and Technology, 2008. DVD.

Goehr, Lydia. *The Imaginary Museum of Musical Works: An Essay in the Philosophy of Music*. Oxford: Oxford University Press, 1992.

Goodman, Landon. *Man and Automation*. Harmondsworth, Middlesex: Penguin, 1957.

Goodyear, Anne Collins. "Gyorgy Kepes, Billy Klüver, and American Art of the 1960s: Defining Attitudes Toward Science and Technology." *Science in Context* 17, no. 4 (2004): 611–635.

Gots, Jason. "Why Top Innovators Make Time to Waste Time." Accessed August 7, 2016. http://bigthink.com/humanizing-technology/why-top-innovators-like-3m-make-time-to-waste-time.

Gough, Maria. *The Artist as Producer: Russian Constructivism in Revolution*. Berkeley: University of California Press, 2005.

Greenberg, Clement. "Modernist Painting." In *Modernism with a Vengeance, 1957–1969*. The Collected Essays and Criticism, edited by John O'Brian, vol. 4, 85–93. Chicago: The University of Chicago Press, 1993.

Gruen, John. "Nine Evenings: First a Bore." *World Journal Tribunal*, October 14, 1966.

______. "Spectator Participation." *New York*, November 11, 1968.

Gueft, Olga. "Automation House: Confronting Tomorrow's Problems Behind Yesterday's Façade." *Interiors*, November 1968.

Guillén, Mauro F. *Models of Management: Work, Authority, and Organization in a Comparative Perspective*. Chicago: University of Chicago Press, 1994.

Gustaitis, Rasa. "'Angry Arts' War Protest Opens in N.Y.: Unprecedented in Scope." *The Washington Post, Times Herald*, January 30, 1967.

Haacke, Hans. Statement. In *Hans Haacke*. New York: Howard Wise Gallery, 1968. Exhibition catalogue.

Habermas, Jürgen. "Individuation Through Socialization: On George Herbert Mead's Theory of Subjectivity." In *Postmetaphysical Thinking: Philosophical Essays*, translated by William Mark Hohengarten, 149–204. Cambridge, MA: MIT Press, 1994.

Hacking, Ian. “How Should We Do the History of Statistics?” In *The Foucault Effect: Studies in Governmental Rationality*, edited by Graham Burchell, Colin Gordon, and Peter Miller, 181–196. Chicago: University of Chicago Press, 1991.

______. *The Taming of Chance*. Cambridge: Cambridge University Press, 1990.

Haraway, Donna. “A Cyborg Manifesto.” In *Simians, Cyborgs, and Women: The Reinvention of Nature*, 149–181. New York: Routledge, 1991.

Harwood, John. *The Interface: IBM and the Transformation of Corporate Design 1945–1975*. Minneapolis: University of Minnesota Press, 2011.

Hawkins, Donald T. “Case Study: The AT&T Bell Laboratories Library Network.” In *Special Libraries: A Survival Guide*, edited by James M. Matarazzo and Toby Pearlstein, 7–16. Santa Barbara: ABC-CLIO, 2013.

Heidegger, Martin. *Parmenides*. Translated by André Schuwer and Richard Rocjewicz. Bloomington, IN: Indiana University Press, 1992.

Heijdra, Ben J. and Frederick van der Ploeg. “Trade Unions and the Labour Market.” In *The Foundations of Modern Macroeconomics*, 187–212. Oxford: Oxford University Press, 2002.

Heims, Steve Joshua. *The Cybernetics Group*. Cambridge: MIT Press, 1991.

Henahan, Donal. “Multimedia’s Mother of Them All.” *The New York Times*, April 13, 1969.

Herbert, Stephen. *A History of Early Television*. London: Routledge, 1997.

Hevly, Bruce. “Reflections on Big Science and Big History.” In *Big Science: The Growth of Large-Scale Research*, 355–363.

Hillman, Susanne. “Robert Rauschenberg, Robert Whitman and Billy Klüver: From 9 Evenings to Experiments in Art and Technology.” Ph.D. diss., Rutgers University, 2007.

Hoddeson, Lillian, Adrienne W. Kolb, and Catherine Westfall. *Fermilab: Physics, the Frontier, and Megascience*. Chicago: University of Chicago Press, 2009.

Holm, Wilton R. “Motion Pictures In An Evolving Culture—A Perspective.” *E.A.T./LA Survey* 6 (October 1970).

Hopps, Walter and Susan Davidson, eds. *Robert Rauschenberg: A Retrospective*. New York: Solomon R. Guggenheim Museum, 1997. Exhibition catalogue.

Horkheimer, Max and Theodor W. Adorno. *Dialectic of Enlightenment*. Translated by John Cumming. New York: Herder and Herder, 1972.

Hughes, Thomas P. "The Evolution of Large Technological Systems." In Bijker, Hughes, and Pinch, eds., *The Social Construction of Technological Systems*, 45–76.

______. *Networks of Power: Electrification in Western Society 1880–1930*. Baltimore: Johns Hopkins University Press, 1983.

Huhtamo, Erkki. "From Cybernation to Interaction: A Contribution to an Archaeology of Interactivity." In *The Digital Dialectic: New Essays on New Media*, edited by Peter Lunenfeld, 96–111. Cambridge: MIT Press, 1999.

"Humanizing Automation." *Architectural Forum*, July–August 1970.

Hultén, K. G. Pontus, ed. *Bewogen Beweging*. Amsterdam: Stedelijk Museum, 1961. Exhibition catalogue.

______. *The Machine as Seen at the End of the Mechanical Age*. New York: The Museum of Modern Art, 1968. Exhibition catalogue.

Husarik, Stephen. "John Cage and LeJaren Hiller: HPSCHD, 1969." *American Music* 1, no. 2 (Summer 1983): 1–21.

Ikegami, Hiroko. *The Great Migrator: Robert Rauschenberg and the Global Rise of American Art*. Cambridge, MA: MIT Press, 2010.

Ikegami, Hiroko. "World Without Boundaries? E.A.T. and the Pepsi Pavilion at Expo '70, Osaka." *Review of Japanese Culture and Society* 23 (December 2011): 174–190.

Irwin, Robert. "Correspondence with Ed Wortz." November 1968–January 1970. Robert Irwin Papers. Getty Research Institute. Accession no. 940081.

Jain, Anal K. *Fundamentals of Digital Image Processing*. Upper Saddle River, NJ: Prentice Hall, 1989.

Jameson, Fredric. "Periodizing the 60s." *Social Text*, no. 9/10 (Spring/Summer 1984): 178–209.

______. *Postmodernism, or, The Cultural Logic of Late Capitalism*. Durham, NC: Duke University Press, 1991.

______. “Transformations of the Image in Postmodernity.” In *The Cultural Turn: Selected Writings on the Postmodern, 1983–1998*, 93–135. London: Verso, 1998.

Jensen, Anne. “Nine Evenings of Nothing: Art as Tedium.” *Manhattan East*, October 20, 1966.

Jewett, Frank. *Modern Research Organizations and the American Patent System*. New York: Bell Telephone Laboratories Incorporated, 1932.

Johns, Jasper. Interview with Billy Klüver. March 1963. In *The Popular Image.* Washington, D.C.: Washington Gallery of Modern Art, 1963. Sound recording. 33 1/3 rpm.

Johnston, Jill. “Post-Mortem.” *The Village Voice*, December 15, 1966.

Jones, Caroline. *Machine in the Studio: Constructing the Postwar American Artist*. Chicago: University of Chicago Press, 1996.

Jones, Douglas W. “Punched Card Codes.” University of Iowa Computer Science Department. Accessed May 15, 2015. http://homepage.cs.uiowa.edu/~jones/cards/codes.html.

Joselit, David. *After Art*. Princeton and Oxford: Princeton University Press, 2012.

______. *Feedback: Television Against Democracy*. Cambridge, MA: MIT Press, 2007.

______. “Institutional Responsibility: The Short Life of Orchard.” *Grey Room*, no. 35 (Spring 2009): 108–115.

______. “Mirroring and Molds: The Johns Theory of the Readymade.” Lecture presented at “Jasper Johns: The First Decade.” Public symposium, National Gallery of Art, Washington D.C., April 28, 2007.

______. “No Exit: Video and the Readymade.” *October* 119 (Winter 2007): 37–45.

______. “Yippie Pop: Abbie Hoffman, Andy Warhol, and Sixties Media Politics.” *Grey Room* 8 (Summer 2002): 62–79.

Joseph, Branden W. *Beyond the Dream Syndicate: Tony Conrad and the Arts after Cage*. New York: Zone, 2008.

______. “Chance, Indeterminacy, Multiplicity.” In Robinson, ed., *The Anarchy of Silence: John Cage and Experimental Art*, 210–238.

______. “Passages: Engineering Marvel: On Billy Klüver.” *Artforum International*, March 2004.

______. “Plastic Empathy: The Ghost of Robert Whitman.” *Grey Room* 25 (Fall 2006): 64–91.

______. “The Play of Repetition: Andy Warhol’s *Sleep*.” *Grey Room* 19 (Spring 2005): 22–53.

______. *Random Order: Robert Rauschenberg and the Neo-Avant-Garde*. Cambridge: MIT Press, 2003.

______. “Rauschenberg’s Refusal.” In *Robert Rauschenberg: Combines*, edited by Paul Schimmel, 257–283. Los Angeles: Museum of Contemporary Art, 2005.

______. “Robert Morris and John Cage: Reconstructing a Dialogue.” *October* 81 (Summer 1997): 59–69.

______. “The Tower and the Line: Toward a Genealogy of Minimalism.” *Grey Room* 27 (Spring 2007): 58–81.

Kaizen, William. “Steps to an Ecology of Communication: Radical Software, Dan Graham, and the Legacy of Gregory Bateson.” *Art Journal* 67, no. 3 (Fall 2008): 86–108.

Kane, Caroline. “Digital Art and Experimental Color Systems at Bell Laboratories, 1965–1984: Restoring Interdisciplinary Innovations to Media History.” *Leonardo* 43, no. 1 (February 2010): 53–58.

Kaprow, Allan. *Assemblage, Environments and Happenings*. New York: H. N. Abrams, 1966.

Kargon, Robert, Stuart W. Leslie, and Erica Schoenberger. “Far Beyond Big Science: Science Regions and the Organization of Research and Development.” In *Big Science*, 334–354.

Keefe, Alexander. “Subcontinental Synth: David Tudor and the First Moog in India.” *East of Borneo*. Last modified April 30, 2013. http://www.eastofborneo.org/articles/subcontinental-synth-david-tudor-and-the-first-moog-in-india.

Keller, Sean. “Navigating Systems.” *Artforum International*, November 2008.

Kelly, Kevin. “One Dead Media.” Accessed May 10, 2015. http://kk.org/thetechnium/2008/06/one-dead-media/.

Kelly, Mervin J. “The Bell Telephone Laboratories—An Example of an Institute for Creative Technology.” *Proceedings of the Royal Society A* 203, no. 1074 (October 10, 1950): 287–301.

Kelsey, Robin. “Playing Hooky/Simulating Work: The Random Generation of John Baldessari.” *Critical Inquiry* 38, no. 4 (Summer 2012): 746–755.

______. *Photography and the Art of Chance*. Cambridge, MA: Harvard University Press, 2015.

Kepes, Gyorgy. “Toward Civic Art.” In *Explorations*. Washington, D.C.: Smithsonian Press, 1970. Exhibition catalogue.

Kheel, Theodore W., ed. *Automation and the Middle Manager: What Has Happened and What the Future Holds*. New York: American Foundation on Automation and Employment, 1965.

Kheel, Theodore W. *The Keys to Conflict Resolution*. New York: Basic Books, 1998.

Kingsland, Sharon E. *Modeling Nature: Episodes in the History of Population Ecology*. Chicago: University of Chicago Press, 1995.

Kirby, Michael. “Environmental Theater.” In *The Art of Time*. New York: E. P. Dutton, 1968.

Kittler, Friedrich. *Gramophone, Film, Typewriter*. Translated by Geoffrey Winthrop-Young and Michael Wutz. Stanford: Stanford University Press, 1999.

______. *Optische Medien*. Berlin: Merve, 2002.

Klein, S. “Technology Invades the Arts.” *Machine Design*, February 29, 1968.

Klüver, Billy. “The Artist and Industry.” Lecture presented at the Museum of Modern Art, New York, 1968. Sound Recording #68.26, Museum of Modern Art Archives, New York.

______. “Artists, Engineers, and Collaboration.” In *Culture on the Brink: Ideologies of Technology*, edited by Timothy Druckrey and Gretchen Bender, 207–219. Seattle: Bay Press, 1994.

______. “Artists, Engineers, and Technology.” In *Technological Change and Human Development: An International Conference, Jerusalem, April 14–18, 1969*, edited by Wayne L. Hodges and Matthew A. Kelly, 342–46. Ithaca, NY: New York State School of Industrial and Labor Relations and The American Foundation on Automation and Employment, 1970.

______. “Fragment on Man and the System.” *The Hasty Papers* 1, no. 1 (1960): 45.

______. “The Future of Art and Technology.” *E.A.T. Proceedings*, no. 12 (April 15, 1972): 1–4.

______. “The Garden Party.” In *The Machine, as Seen at the End of the Mechanical Age*, edited by K. G. Pontus Hultén, 169–171. New York: Museum of Modern Art, 1968.

______. “Jasper Johns.” In P. Miller. “The Engineer as Catalyst: Billy Klüver on Working with Artists,” 24.

______. “Oracle.” In *Robert Rauschenberg, Haywire: Major Technological Works of the 1960s*, edited by Cornelia Faist and Alfred Kren, 62–64. Ostfildern-Ruit: Hatje, 1997. Exhibition catalogue.

______. “Oral Presentation on Proposed CATV Rules.” March 26, 1971.

______. *On Record: 11 Artists 1963, Interviews with Billy Klüver*. New York: Experiments in Art and Technology, 1981.

______. “The Pavilion.” *Techne* 1, no. 2 (November 6, 1970): 1.

______. “Photographic Recording of Some Optical Effects in a 27.5-m Spherical Mirror.” *Applied Optics* 10, no. 12 (December 1971): 2754–2759.

______. “Teknologi för livet.” *Konstrevy* 42, no. 2 (1966): 56–61.

______. “Theater and Engineering—An Experiment: 2. Notes by an Engineer.” *Artforum International*, February 1967.

______. “What are you Working on Now?” In *Abstract Painting: 1960–69*, edited by Donald Droll, n.p. Long Island City, NY: P.S. 1 / Institute for Art and Urban Resources, 1983. Exhibition catalogue.

______. “Interface: Artist/Engineer.” *E.A.T. Proceedings*, no. 1 (April 21, 1967).

______. Interview with Douglas Davis. *Art in America*, January-February 1968.

______. “Interview with Billy Klüver.” In *Jasper Johns: Writings, Sketchbook Notes, Interviews*, edited by Kirk Varnedoe. New York: Museum of Modern Art, 1996.

Klüver, Billy with Julie Martin. “Four Difficult Pieces.” *Art in America*, July 1991.

______. “Working with Rauschenberg.” In Hopps and Davidson, *Robert Rauschenberg: A Retrospective*, 310–327.

Klüver, Billy, Julie Martin, and Barbara Rose, eds. *Pavilion by Experiments in Art and Technology*. New York: E. P. Dutton, 1972.

Knowles, Alison and James Tenney. *The House of Dust*. Cologne: König, 1969.

Knowles, Scott G. and Stuart W. Leslie. "'Industrial Versailles': Eero Saarinen's Corporate Campuses for GM, IBM, and AT&T." In *Science in the American Century*, edited by Sally Gregory Kohlstedt and David Kaiser, 235–268. Chicago: University of Chicago Press, 2013.

Kostelanetz, Richard. "Conversation with Robert Rauschenberg." In Kostelanetz, *The Theatre of Mixed-Means*. New York: The Dial Press, 1968.

Kostelanetz, Richard. "The Artist as Playwright and Engineer." *New York Times Magazine*, October 8, 1966.

Kotz, Liz. "Cagean Structures." In Robinson, ed., *The Anarchy of Silence: John Cage and Experimental Art*, 118–165.

______. "Post-Cagean Aesthetics and the 'Event Score.'" *October* 95 (Winter 2001): 55–89.

______. *Words to Be Looked At*. Cambridge, MA: MIT Press, 2007.

Kramer, Hilton. "Art: Landscapes of Button and Cohen." *The New York Times*, March 7, 1970.

Krauss, Rosalind E. "A View of Modernism." *Artforum International*, September 1972.

______. "Entropy." In *Formless: A User's Guide*, 73–78. New York: Zone Books, 1997.

______. *Passages in Modern Sculpture*. Cambridge, MA: MIT Press, 1977.

______. "Perpetual Inventory." In *Robert Rauschenberg*, edited by Branden W. Joseph, 93–131. October Files 4. Cambridge, MA: MIT Press, 2002.

______. "Video: The Aesthetics of Narcissism." *October* 1 (Spring 1976): 50–64.

Kretkowski, Paul D. "The 15 Percent Solution." *Wired*, January 1988.

Kuhn, Thomas. "The Essential Tension: Tradition and Innovation in Scientific Research." In *The Third University of Utah Research Conference on the Identification of Scientific Talent*, edited by C. Taylor, 162–174. Salt Lake City: University of Utah Press, 1959.

______. *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press, 1996.

Kumler, Aden. "The Patron-Function." In *Patronage: Power and Agency in Medieval Art*, edited by Colum Hourihane, 297–319. Princeton: Index of Christian Art, Princeton Univeristy and University Park, PA: Pennsylvania State University Press, 2013.

Kuo, Michelle. "'Inevitable fusing of specializations': Rauschenberg and Experiments in Art and Technology, 1966-70." In *Robert Rauschenberg*, edited by Leah Dickerman and Achim Borchardt-Hume, 260–71. New York and London: Museum of Modern Art and Tate Modern, 2016. Exhibition catalogue.

______. "Specters." In *Otto Piene*, edited by Joao Ribas, 58–77. Cambridge, MA: MIT List Visual Arts Center, 2011. Exhibition catalogue.

______. "*The Human Argument*." *Bookforum*, February/March 2009.

______. "The Uncertainty Principle: *Silver Clouds*." Lecture presented at "Art and Accident," panel organized by Robin Kelsey and Yukio Lippit, College Art Association Conference, April 2006.

______. "*9 Evenings* in Reverse." In *9 Evenings Reconsidered: Art, Theatre, and Engineering, 1966*, edited by Catherine Morris. Cambridge, MA: MIT List Visual Arts Center, 2006. Exhibition catalogue.

______. Review of *Beyond the Dream Syndicate: Tony Conrad and the Arts After Cage* by Branden W. Joseph. *The Art Bulletin* XCI, no. 4 (December 2009): 518–522.

Kuo, Michelle and Julian Rose. "Atmospheric Disturbance: Michelle Kuo and Julian Rose on Fujiko Nakaya at the Glass House." *Artforum International*, November 2014.

Lacerte, Sylvie. "9 Evenings." Accessed February 22, 2016. http://www.fondation-langlois.org/html/e/page.php?NumPage=1716.

"Labor, Industry Encourage Merger of Art, Technology." *AFL-CIO News*, October 21, 1967.

"Labor Peacemaker Theodore Woodrow Kheel." *The New York Times*. October 11, 1965.

Lambert-Beatty, Carrie. *Being Watched: Yvonne Rainer and the 1960s*. Cambridge: MIT Press, 2008.

______. "Moving Still: Mediating Yvonne Rainer's 'Trio A.'" *October* 89 (Summer 1999): 87–112.

Lange, Alexandra. "This Year's Model: Representing Modernism to the Post-war American Corporation." *Journal of Design History* 19, no. 3 (Autumn 2006): 233–248.

Lash, Scott. "Reflexive Modernization: The Aesthetic Dimension." In Beck, Giddens, and Lash, eds., *Reflexive Modernization: Politics, Tradition and Aesthetics in the Modern Social Order*.

Latour, Bruno. "The Berlin Key." In *Matter, Materiality and Modern Culture*, edited by Paul Graves-Brown, 10–21. London: Routledge, 2000.

______. "Networks, Societies, Spheres: Reflections of an Actor-Network Theorist." Last modified February 19, 2010. http://www.bruno-latour.fr/sites/default/files/121-CASTELLS-GB.pdf.

______. "On Technical Mediation—Philosophy, Sociology Genealogy." *Common Knowledge* 3, no. 2 (Fall 1994): 29–64.

______. "Powers of Association." In *Power, Action and Belief. A New Sociology of Knowledge?* edited by John Law, 261–277. London: Routledge and Kegan Paul, Sociological Review Monograph, 1986.

______. *Reassembling the Social: An Introduction to Actor-Network Theory*. Oxford: Oxford University Press, 2007.

______. *Science in Action: How to Follow Scientists and Engineers Through Society*. Cambridge, MA: Harvard University Press, 1987.

______. *We Have Never Been Modern*. Translated by Catherine Porter. Cambridge, MA: Harvard University Press, 1993.

Latour, Bruno and Steve Woolgar. *Laboratory Life*. Beverly Hills, CA: Sage, 1979.

Lee, Pamela M. *Chronophobia: On Time in the Art of the 1960s*. Cambridge, MA: MIT Press, 2004.

______. *Forgetting the Art World*. Cambridge, MA: MIT Press, 2012.

______. *New Games: Postmodernism after Contemporary Art*. New York and London: Routledge, 2013.

Leontief, Wassily and Faye Duchin. *The Impacts of Automation on Employment, 1963–2000: Final Report*. New York: Institute for Economic Analysis, New York University, 1984.

"Les Levine." *Radical Software* 1, no. 1 (Spring 1970).

Levin, Erica. "Dissent and the Aesthetics of Control: On Carolee Schneemann's *Snows*." *World Picture* 8 (Summer 2013). Accessed January 5, 2015. http://www.worldpicturejournal.com/WP_8/Levin.html.

Levin, Harvey J. "Organization and Control of Communications Satellites." *University of Pennsylvania Law Review* 113, no. 3 (January 1965): 315–357.

______. "Television's Second Change: A Retrospective Look at the Sloan Cable Commission." *The Bell Journal of Economics and Management Science* 4, no.1 (Spring 1973): 343–365.

Levine, Neil A. "Robert Rauschenberg." *Art News*, September 1965.

Levitt, Theodore. "Globalization of Markets." *Harvard Business Review* 61, no. 3 (May–June 1983): 92–102.

Levy, Walter J. "World Oil Cooperation or International Chaos." *Foreign Affairs* 52, no. 4 (July 1974): 690–713.

Lieberman, Henry R. "Art and Science Proclaim Alliance in Avant-Garde Loft." *New York Times*, October 11, 1967.

Lindgren, Nilo. "Into the Collaboration." In Klüver, Billy, Julie Martin, and Barbara Rose, eds., *Pavilion*, 3–59.

Lipman, Jean. "Money for Money's Sake." *Art in America*, January/February 1970.

Lippard, Lucy. "Total Theatre?" *Art International*, January 20, 1967.

Livingston, Jane. "Kansas City." *Artforum International*, September 1968.

Lobsinger, Mary Louise. "Cybernetic Theory and the Architecture of Performance: Cedric Price's Fun Palace." In *Anxious Modernisms*, edited by Sarah Williams Goldhagen and Réjean Legault, 119–140. Cambridge, MA: MIT Press, 2000.

Loewen, Norma. "Experiments in Art and Technology: A Descriptive History of the Organization." Ph.D. diss., New York University, 1975.

Lowry, W. K. "The Use of Computers in Information Systems." *Science* 175, no. 4024 (1972): 841–46.

Lubar, Steven. "'Do not fold, spindle or mutilate': A cultural history of the punch card." Accessed May 5, 2015. http://ccat.sas.upenn.edu/slubar/fsm.html.

Luhmann, Niklas. "Risky Behaviour of Organizations." In *Risk: A Sociological Theory*, translated by Rhodes Barrett, 199. Berlin: Walter de Gruyter, 1993.

______. *Art as a Social System*. Translated by Eva M. Knodt. Stanford: Stanford University Press, 2000.

______. *Legitimation durch Verfahren*. Neuweid: Luchterhand, 1969.

______. *Social Systems*. Translated by John Bednarz Jr. Stanford: Stanford University Press, 1995.

Lyotard, Jean-François. *The Postmodern Condition: A Report on Knowledge*. Translated by Geoff Bennington and Brian Massumi. Minneapolis: University of Minnesota Press, 1984.

Mabon, Prescott C. *Mission Communications: The Story of Bell Laboratories*. Murray Hill, NJ: Bell Telephone Laboratories, 1975.

"Manufacturing Biweekly Update, Industry Competitiveness and Regulatory Analysis." International Trade Administration, US Department of Commerce, February 2009. http://ita.doc.gov/td/industry/otea/ocea/mbu/index.html.

Marcuse, *One-Dimensional Man: Studies in the Ideology of Advanced Industrial Society*. New York: Beacon Press, 1964.

Martin, Julie. Interview. November 21, 2006. Berkeley Heights, New Jersey.

Martin, Reinhold. *The Organizational Complex*. Cambridge: MIT Press, 2004.

______. "The Physiognomy of the Office." In *The Organizational Complex*, 80-121. Cambridge: MIT Press, 2004.

Marx, Leo. "The Idea of 'Technology' and Postmodern Pessimism." In *Does Technology Drive History?: The Dilemma of Technological Determinism*, edited by Merrill Roe Smith and Leo Marx, 256–257. Cambridge: MIT Press, 1994.

Massumi, Brian, ed. *The Politics of Everyday Fear*. Minneapolis, MN: University of Minnesota Press, 1993.

Mathews, Max V. "Computer Composers: Comments and Case Histories." *TECHNE* 1, no. 2 (November 6, 1970): 10–11.

______. "The Digital Computer as a Musical Instrument." *Science*, November 1963.

Mathews, Max V., Joan E. Miller, F. R. Moore, John R. Pierce, and J. C. Risset. *The Technology of Computer Music*. Cambridge, MA: MIT Press, 1969.

Maxwell, James Hubert. *Theory of Servomechanisms*. MIT Radiation Laboratory Series 25. New York: McGraw, 1947.

McKee, Yates. "The Public Sensoriums of Pulsa: Cybernetic Abstraction and the Biopolitics of Urban Survival." *Art Journal* 67, no. 3 (Fall 2008): 47–67.

McLuhan, Marshall. "Automation: Learning a Living." In *Understanding Media*, 346–359. Cambridge, MA: MIT Press, 1997.

______. *The Gutenberg Galaxy: The Making of Typographic Man*. Toronto: University of Toronto Press, 1962.

______. "Radio: The Tribal Drum." In *Understanding Media: The Extensions of Man*, 298. Cambridge: MIT Press, 1994.

McShine, Kynaston, ed. *Andy Warhol: A Retrospective*. New York: Museum of Modern Art, 1989. Exhibition catalogue.

______. *Information*. New York: Museum of Modern Art, 1970.

Meadows, Donella H. et al. *The Limits to Growth*. New York: Universe Books, 1972.

Mee, Tom. "Notes and Comments on Clouds and Fog." In Klüver, Billy, Julie Martin, and Barbara Rose, eds. *Pavilion*, 224–227.

Mehring, Christine. "Television Art's Abstract Starts." *October* 125 (Summer 2008): 29–64.

Mekas, Jonas. "Movie Journal." *The Village Voice*, October 27, 1966.

Melman, Seymour. *The Permanent War Economy*. New York: Simon and Schuster, 1974.

Mendelsohn, Everett. "The Politics of Pessimism: Science and Technology circa 1968." In *Technology, Pessimism, and Postmodernism*, edited by Yaron Ezrahi, Everett Mendelsohn, Howard Segal, 151–173. Dordrecht, Boston: Kluwer Academic Publishers, 1995.

Metz, Christian. "Aural Objects." Translated by Georgia Gurrieri. *Yale French Studies*, no. 60 (1980): 29–30.

Miller, J. James. "Automation, Job Creation, and Unemployment." *The Academy of Management Journal* 7, no. 4 (December 1964): 300–307.

Miller, P. "The Engineer as Catalyst: Billy Klüver on Working with Artists." *IEEE Spectrum* 35, no. 7 (July 1998): 24.

Miller, R. G. “Technology and the Arts.” *Bell Telephone Laboratories Reporter* 15, no. 2 (March/April 1966): 18.

Millman, Sidney, ed. *A History of Engineering and Science in the Bell System: Communications Sciences, 1925–1980*. Murray Hill, NJ: Bell Telephone Laboratories: 1984.

Mills, C. Wright. *The Power Elite*. Oxford: Oxford University Press, 1956.

______. *The Sociological Imagination*. New York: Oxford University Press, 1959.

______. *White Collar: The American Middle Classes*. New York: Oxford University Press, 1951.

Milutis, Joe. “Radiophonic Ontologies and the Avantgarde.” In *Experimental Sound and Radio*, edited by Allan S. Weiss, 57–72. Cambridge: MIT Press, 2001.

Mindell, David A. *Between Human and Machine: Feedback, Control, and Computing before Cybernetics*. Cambridge: MIT Press, 2002.

______. “Opening Black’s Box: Rethinking Feedback’s Myth of Origin.” *Technology and Culture* 41, no. 3 (July 2000): 405–434.

Minnesota Mining and Manufacturing. “3M Scotchpak™ Heat-Sealable Polyester Film ES-241: Product Information.” 2005, n.p.

Moles, Abraham. *Art et Ordinateur*. Brussels: Casterman, 1971.

Moran, Nancy. “Art and Technology Merge at Exhibit.” *The New York Times*, March 3, 1970.

Morris, Robert. “Notes on Sculpture, Part II.” *Artforum International*, October 1966.

Morris, Catherine, ed. *9 Evenings: Art, Theatre, and Engineering*. MIT: List Center for the Visual Arts, 2005. Exhibition catalogue.

Morton, Jack A. “The Innovation Process,” n.d. Bell Laboratories. AT&T Archives.

Mueller, Eva. *Technological Advance in an Expanding Economy*. Ann Arbor, MI: Institute for Social Research, University of Michigan, 1969.

Mumma, Gordon. “Electronic Music for Merce Cunningham Dance Company.” *Choreography and Dance* 4, no. 3 (1997): 51–58.

"Music Hath Charms—With Kitchen Overtones." *Home Furnishings Daily*, New York, Oct. 19, 1966.

National Gallery of Art Painting Conservation Department. Conservation Department File for Field Painting. National Gallery of Art, Washington, D.C.

Nakaya, Fujiko. "Investigations into Methods of Fog Production." *Techne* 1, no. 2 (November 1970): 8–12.

______. "Making of 'Fog' or Low-Hanging Stratus Cloud." *Techne* 1, no. 2 (November 1970): 3. Published in an extended and revised version as Nakaya, "Making of 'Fog' or Low-Hanging Stratus Cloud." In Klüver, Billy, Julie Martin, and Barbara Rose, eds. *Pavilion*, 207–223.

Noble, David F. *Forces of Production: A Social History of Industrial Automation*. New York: Alfred A. Knopf, 1984.

Noll, A. Michael. "Early Digital Computer Art at Bell Telephone Laboratories, Incorporated." *Leonardo* 49, no. 1 (2016): 55–65.

O'Sullivan, William J. "Notes on Project Echo" (MS), n.d.

O'Connor, John J. "Art & Technology Make It Official." *The Wall Street Journal*, October 11, 1967.

O'Connor, Patrick. "'Theater, Engineering' Less Than Pleasing." *The Jersey Journal*, October 17, 1966.

O'Doherty, Brian. "New York: 9 Armored Nights." *Art and Artists* 1, no. 9 (December 1966): 14–17.

______. "Robert Rauschenberg I." In *Object and Idea: An Art Critic's Journal 1961–1967*, 112. New York: Simon and Schuster, 1967.

______. "Rauschenberg and the Vernacular Glance." *Art in America*, September/October 1973.

Othmer, David. *The Wired Island: The First Two Years of Public Access to Cable Television in Manhattan*. New York: Fund for the City of New York, 1973.

Paik, Nam June. "Essays." In *An Anthology of Chance Operations*, edited by George Brecht, LaMonte Young et al, n.p. New York: George Maciunas and Jackson MacLow, 1962.

Pandora's Hope. Cambridge, MA: Harvard University Press, 1999.

"Paris Bienale [sic]—Competition." *E.A.T./LA Survey* 7 (January 1971): 15.

"Park Place Pianos." *Village Voice*, March 16, 1967.

Park, Tae Hong. "An Interview with Max Mathews." *Computer Music Journal* 33, no. 3 (Fall 2009): 9–22.

Parker, Peter. "The Role of the International Company." In *Technological Change and Human Development: An International Conference, Jerusalem, April 14–18, 1969,* edited by Wayne L. Hodges and Matthew A. Kelly, 281–304. Ithaca, NY: New York State School of Industrial and Labor Relations and The American Foundation on Automation and Employment, 1970.

Parsons, Talcott. *The Social System*. London: Routledge, 1991.

Pask, Gordon. "The Architectural Relevance of Cybernetics." *Architectural Design* 39 (September 1969): 496.

Patterson, Zabet. *Peripheral Vision: Bell Labs, The S-C 4020, and the Origins of Computer Art*. Cambridge, MA: MIT Press, 2015.

Paxton, Steve and L.J. Robinson. "Art and Technology: A Dialogue." *IKON* 1, no. 1 (February 1967): 21–22.

Pearce, John. "An Architect's View." In Klüver, Billy, Julie Martin, and Barbara Rose, eds. *Pavilion*, 255–265.

Pierce, John R. and A. Michael Noll. *Signals: The Science of Telecommunications*. New York: Scientific American Library, 1990.

Pierce, John R. "Orbital Radio Relays." *Jet Propulsion* 25 (April 1955): 153–157.

______. *An Introduction to Information Theory: Symbols, Signals, and Noise*. New York: Dover, 1980.

"Plans for 1969–1970." *E.A.T. Proceedings*, no. 9. (May 19, 1969): 16.

Pottasch, Alan. Oral history interview, 1984–85. The "Pepsi Generation" Oral History and Documentation Collection. Subseries 3.1. Archives Center, National Museum of American History, Smithsonian Institution.

Potter, Keith. *Four Musical Minimalists: La Monte Young, Terry Riley, Steve Reich, Philip Glass*. Cambridge: Cambridge University Press, 2002.

"Press Conference for Ecology of the Skin and Biofeedback and the Arts." 1970. Collection of Julie Martin. Video.

"Preview: Automation House, New York City." *Architectural and Engineering News* 10, no. 3 (March 1968): 77.

Price, Cedric. "Fun Palace," unpublished document, 1965. Fonds Cedric Price, Canadian Center for Architecture, Montreal.

Pringle, Douglas. "Les Levine: Body Control Systems and John and Mimi's Book of Love." *artscanada* (June 1970): 60.

Pritchett, James. *The Music of John Cage*. Cambridge: Cambridge University Press, 1993.

"Projects." *TECHNE* 1, no. 1 (April 14, 1969): 11–12.

Pulsa. "The City as an Artwork." In *Arts of the Environment*, edited by Gyorgy Kepes, 220. New York: Braziller, 1972.

Rabinbach, Anson. *The Human Motor: Energy, Fatigue, and the Origins of Modernity*. Berkeley: University of California Press, 1992.

Rainer, Yvonne. "Don't Give the Game Away." *Arts Magazine*, April 1967.

______. *Feelings are Facts*. Cambridge, MA: MIT Press, 2006.

______. *Work 1961–1973*. Halifax: Nova Scotia College of Art and Design, 1974.

Rasch, William and Cary Wolfe, eds. *Observing Complexity: Systems Theory and Postmodernity*. Minneapolis: University of Minnesota Press, 2000.

Rauschenberg, Robert. Oral history interview by Dorothy Gees Seckler. December 21, 1965. Archives of American Art. Smithsonian Institution.

______. *Rauschenberg*. Interview by Barbara Rose. New York: Vintage, 1987.

______. "Random Order." *Location* 1, no. 1 (Spring 1963): 27–31.

______. *Currents*. New York: Castelli Graphics, 1970.

Rawson, Eric. "Pond." *TECHNE* 1, no. 1 (April 14, 1969): 10.

Reddy, Sanjay G. "Claims to Expert Knowledge and the Subversion of Democracy: The Triumph of Risk Over Uncertainty." *Economy and Society* 25, no. 2 (1996): 222–254.

Reich, Leonard. *The Making of American Industrial Research: Science and Business at GE and Bell, 1876–1926*. New York: Cambridge University Press, 1985.

Reichardt, Jasia, ed. *Cybernetic Serendipity*. London: W&J Mackay, 1968.

______. "E.A.T. and After." *Studio International* CLXXV (1968): 236–37.

Retijles, Francis J. *Numerical Control: Making a New Technology*. New York and London: Oxford University Press, 1991.

Roads, Curtis. *Composing Electronic Music: A New Aesthetic*. Oxford: Oxford University Press, 2015.

Roberts, Benjamin C. "Concluding Panel." In *Technological Change and Human Development: An International Conference, Jerusalem, April 14–18, 1969*, edited by Wayne L. Hodges and Matthew A. Kelly, 360–61. Ithaca, NY: New York State School of Industrial and Labor Relations and The American Foundation on Automation and Employment, 1970.

Roberts, Jennifer. *Mirror-Travels: Robert Smithson and History*. New Haven: Yale University Press, 2004.

Robinson, Julia, ed. *The Anarchy of Silence: John Cage and Experimental Art*. Barcelona: Museu d'Art Contemporani de Barcelona, 2009. Exhibition catalogue.

______. "In the Event of George Brecht." In *George Brecht: Events, A Heterospective*, edited by Alfred Fischer, 16–181. Köln: Walther König, 2006.

Rodenbeck, Judith. "Madness and Method: Before Theatricality." *Grey Room* 13 (Fall 2003): 54–79.

Rose, Barbara. "Art as Experience, Environment, Process." In Klüver, Billy, Julie Martin, and Barbara Rose, eds., *Pavilion*, 60–104.

Rose, Barbara. "Art: Getting It Together." *Vogue*, September 1, 1970.

Rosenboom, David, ed. *Biofeedback and the Arts: Results of Early Experiments*. Vancouver: Aesthetic Research Centre of Canada, 1975.

______. *Extended Musical Interface with the Human System*. San Francisco: Leonardo Monograph Series, 1997.

Rothkopf, Scott. *Mel Bochner Photographs:1966–1969*. New Haven and London: Yale University Press, 2002.

Rutkoff, Rebekah. “Painting by Numbers: The Art of Lillian Schwartz.” *Artforum International*, October 2016.

Ryan, Paul. “Cybernetic Guerilla Warfare.” *Radical Software* 1, no. 3 (Spring 1971): 1–2.

______. Letter to Howard Wise. March 2, 1969. Paul Ryan Papers, 1943–2009. Archives of American Art. Smithsonian Institution.

Sas, Miryam. “Intermedia, 1955–1970.” In *From Postwar to Postmodern, Art in Japan 1945–1989*, edited by Doryun Chong, Michio Hayashi, Fumihiko Sumimoto, Kenji Kajiya, 138–157. MoMA Primary Documents. New York: Museum of Modern Art; Durham, NC: Duke University Press, 2012.

Schiff, Eric. “How Do Neon Lights Work?” *Scientific American*, December 4, 2001. http://www.sciam.com/article.cfm?id=how-do-neon-lights-work.

Schneemann, Carolee. Interview with Gene Youngblood. In *Expanded Cinema*, 369. New York: P. Dutton & Co., Inc., 1970.

______. *More Than Meat Joy*. London: McPherson, 1979.

Schoolman, Carlota. “Video History: Making Connections Conference.” Interview by Kathy High. October 16–18, 1998, Syracuse University. Experimental Television Center. http://www.experimentaltvcenter.org/sites/default/files/history/pdf/HighKInterview_2_2571.pdf.

Schwarz, Robert. *Minimalists*. London: Phaidon, 1996.

Seawright, James. “Phenomenal Art: Form, Idea, and Technique.” In *On the Future of Art*, edited by Arnold J. Toynbee, 77–93. New York: Vintage, 1970.

Sennett, Richard. “Bureaucracy.” In *The Culture of the New Capitalism*, 15–16. New Haven: Yale University Press, 2006.

Sennett, Richard. *The Uses of Disorder: Personality and City Life*. New York: Knopf, 1970.

Shabecoff, Philip. “Glittering, Clicking, Clanking Expo ’70, in Japan, Emphasizes the Practical Use of Modern Technology.” *New York Times*, March 22, 1970.

Shannon, Claude E. *The Mathematical Theory of Communication*. Urbana: University of Illinois Press, 1998.

Shannon, Joshua A. “Black Market: Materiality, Abstraction and Built Environment in the New York Avant-Garde, 1958–1962.” Ph.D. diss., University of California, Berkeley, 2005.

Sharp, Willoughby. *Air Art.* New York: Kineticism Press, 1968.

Siegert, Bernhard. *Cultural Techniques: Grids, Filters, Doors, and Other Articulations of the Real*. Translated by Geoffrey Winthrop-Young. New York: Fordham University Press, 2014.

Silverman, Kaja. *The Miracle of Analogy*. Stanford: Stanford University Press, 2015.

Skrebowski, Luke. “All Systems Go: Recovering Hans Haacke’s Systems Art.” *Grey Room* 30 (Winter 2008): 54–83.

______. “Productive Misunderstandings: Interpreting Mel Bochner’s Theory of Photography.” In *Photography after Conceptual Art*, edited by Margaret Iversen and Diarmuid Costello, 117–147. West Sussex: Wiley-Blackwell, 2010.

Smith, F. Leslie. *Perspectives on Radio and Television: Telecommunications in the United States*. New York: Harper & Row, 1985.

“Some More Beginnings.” *TECHNE* 1, no. 1 (April 14, 1969): 2.

Sontag, Susan. “The Aesthetics of Silence.” *Aspen* 5+6 (Fall/Winter 1967): Item 3.

Spigel, Lynn. *TV By Design: Modern Art and the Rise of Network Television*. Chicago: University of Chicago Press, 2008.

“*Spaces*, December 30, 1969–March 1, 1970.” Exhibition File #917b. The Museum of Modern Art Exhibition Records 1960–1969. The Museum of Modern Art Archives, New York.

Steinberg, Leo. *Other Criteria: Confrontations with Twentieth-Century Art*. New York: Oxford University Press, 1972.

Streeter, Thomas. “The Cable Fable Revisited: Discourse, Policy, and the Making of Cable Television.” *Critical Studies in Mass Communication* 4, no. 2 (June 1987): 174–200.

Strongin, Theodore. “Concert is Given by Percussionist: Neuhaus Rubs, Tickles and Pats Variety of Instruments.” *New York Times*, June 3, 1964.

Sutton, Gloria. *The Experience Machine: Stan VanDerBeek’s Movie Drome and Expanded Cinema*. Cambridge, MA: MIT Press, 2015.

Swenson, G. R. “Rauschenberg Paints a Picture.” *Art News*, April 1963.

“Symbolic Card Format.” In “Fortran Assembly Program (FAP) for the IBM 709/7090.” *IBM 709/7090 Data Processing System Bulletin* (1960).

Tambellini, Elsa. “The Gate Theater.” *artscanada* (October 1967).

Teasdale, Parry. *Videofreex: America’s First Pirate TV Station and the Catskills Collective That Turned it On*. Hensonville, NY: Black Dome Press, 1999.

TECHNE: A Projects and Process Paper 1, no. 1 (April 14, 1969).

“Technology and the Arts.” *Bell Telephone Laboratories Reporter* 15, no. 2 (March/April 1966): 16–19.

“Technology and the Individual.” *E.A.T. Proceedings*, no. 9 (May 19, 1969): Appendix VI, n.p.

“Technology Art Group Gets Labor, Industry, US Backing.” *Electronic News*, October 16, 1967.

Tenney, James. “Computer Music Experiences, 1961–1964.” 1964.

Tomkins, Calvin. “Outside Art.” In Klüver, Billy, Julie Martin, and Barbara Rose, eds. *Pavilion*, 105–171.

Tönnies, Ferdinand. *Community and Society*. Translated by Charles P. Loomis. East Lansing: Michigan State University Press, 1957.

Tōno, Yoshiaki. “Artists Participating in the World Expo, Speak Out!” In *From Postwar to Postmodern, Art in Japan 1945–1989*, 247–252.

“Transistorized Tunnel of Light.” *Time* 91, no. 23 (June 7, 1968).

Tschudi, Erwin W. “Steel Ball on Curvilinear Track.” *TECHNE* 1, no. 2 (November 6, 1970): 12.

Tudor, David. Interview in *David Tudor: Bandoneon ! (a combine)*. New York: ARTPIX and Experiments in Art and Technology, 2009. DVD.

Turner, Fred. “The Corporation and the Counterculture: Revisiting the Pepsi Pavilion and the Politics of Cold War Multimedia.” *The Velvet Light Trap* 73 (Spring 2014): 66–78.

Turner, Fred. “Romantic Automatism: Art, Technology, and Collaborative Labor in Cold War America.” *Journal of Visual Culture* 7, no.1 (April 2008): 5–26.

"TV as a Creative Medium." New York: Howard Wise Gallery, 1969. Exhibition brochure.

Udelson, Joseph H. *The Great Television Race: A History of the American Television Industry, 1925–1941*. Birmingham, AL: University of Alabama Press, 1982.

Vallye, Anna. "The Reenchantment of the World: Ruth Vollmer's Science." In *Thinking the Line: Ruth Vollmer, 1961–1978*, edited by Nadja Rottner and Peter Weibel, 98–115. Ostfildern: Hatje Cantz, 2006.

Van den Belt, Henk and Arie Rip. "The Nelson-Winter-Dosi Model and Synthetic Dye Chemistry." In Bijker, Hughes, and Pinch, eds., *The Social Construction of Technological Systems*, 129–154.

Van den Ende, J., W. Ravesteijn, and D. de Wit. "Shaping the Early Development of Television." *IEEE Technology and Society Magazine* 16, no. 4 (Winter 1997/1998): 13–26.

Varnedoe, Kirk. "Introduction: A Sense of Life." In *Jasper Johns: A Retrospective*, edited by Kirk Varnedoe, 26. New York: The Museum of Modern Art, 1996. Exhibition catalogue.

Virno, Paolo. *A Grammar of the Multitude*. Cambridge, MA: Semiotext(e), 2004.

Vismann, Cornelia. *Files: Law and Media Technology*. Translated by Geoffrey Winthrop-Young. Stanford: Stanford University Press, 2008.

W. B. "Andy Warhol." *Arts Magazine*, June 1966.

Wagner, Anne M. "Performance, Video, and the Rhetoric of Presence." *October* 91 (Winter 2000): 59–80.

Wallis, Brian, ed. *Hans Haacke: Unfinished Business*. New York: New Museum of Contemporary Art and Cambridge, MA: MIT Press, 1986.

Warhol, Andy and Pat Hackett. *POPism: The Warhol 60s*. New York: Harcourt Brace Jovanovich, 1980.

Warhol, Andy. Interview with Alan Solomon, 1966. Quoted in Crone, Rainer. *Andy Warhol*. New York: Praeger, 1970.

______. *The Philosophy of Andy Warhol (From A to B and Back Again)*. New York: Harcourt Brace, 1975.

Warshaw, Laurence. “Intermedia Workshop.” In “The Arts of Activism,” edited by Edward Kamarck, *Arts in Society* 6, no. 3 (Fall/Winter 1969): 448–451.

Watts, Robert. Quoted in interview with Larry Miller, “Robert Watts: Scientific Monk.” In *Experiments in the Everyday: Allan Kaprow and Robert Watts—Events, Objects, Documents,* edited by Benjamin H. D. Buchloh and Judith Rodenbeck. New York: Wallach Art Gallery, Columbia University.

Waymouth, John. *Electric Discharge Lamps*. Cambridge: MIT Press, 1971.

Weaver, Warren. “Some Recent Contributions to the Mathematical Theory of Communication.” In Shannon. *The Mathematical Theory of Communication*, 1–28.

Webb, Beatrice. *The Cooperative Movement in Great Britain*. London: Swan Sonnenschein & Co., 1891.

Weber, Max. *The Protestant Ethic and the Spirit of Capitalism*. Translated by Talcott Parsons. New York: Scribner, 1958.

______. *The Theory of Social and Economic Organization*. Translated by A. M. Henderson and Talcott Parsons. New York: The Free Press, 1947.

Weber, Samuel. “Television: Set and Screen.” In *Mass Mediauras: Form, Technics, Media*, 117–121. Stanford: Stanford University Press, 1996.

Wechsler, Lawrence. *Seeing is Forgetting the Name of the Thing One Sees*. Berkeley: University of California Press, 1982.

Weinberg, Alvin. “Impact of Large-Scale Science on the United States.” *Science* 134, no. 3473 (July 21, 1961): 161–164.

______. *Reflections on Big Science*. Cambridge, MA: MIT Press, 1968.

Weiss, Jeffrey. “Painting Bitten by a Man.” In *Jasper Johns: An Allegory of Painting*, edited by Jeffrey Weiss, 2–57. Washington, D.C.: National Gallery of Art, 2007. Exhibition catalogue.

“Whatever it was it wasn’t fun.” *Village Voice*, October 20, 1966.

White, Anthony. “Lucio Fontana: Between Spectacle and Kitsch.” *Grey Room* 5 (Fall 2001): 55–77.

Whitman, Robert. Interview by the author, September 28, 2005

Whitman, Simone [Forti]. “Interview with Max Neuhaus and Ted Wolff.” *TECHNE* 1, no. 1 (April 14, 1969): 4.

Whitman, Simone. “Nine Evenings: Notes of a Participant.” *Artforum International*, February 1967.

Whole Earth Catalog 1010 (Fall 1968).

Whyte, William H. *The Organization Man*. New York: Simon and Schuster, 1956.

Wiener, Norbert. *Cybernetics: Or Control and Communication in the Animal and the Machine*. Cambridge: MIT Press, 1994.

______. *The Human Use of Human Beings: Cybernetics and Society*. Boston: Houghton-Mifflin, 1950.

Wigley, Mark. “Network Fever.” *Grey Room* 4 (Summer 2001): 82–122.

Williams, Emmett. *A Valentine for Noël*. New York: Something Else Press, 1973.

Williams, Raymond. *Television: Technology and Cultural Form*. New York: Schocken 1975.

Williams, Robert V. “Punch Cards: A Brief Tutorial.” *Annals in the History of Computing*, 2002. Accessed May 5, 2015. http://www.computer.org/web/computingnow/annals/extras/cardsvol24n2.

______. “The Use of Punched Cards in US Libraries and Documentation Centers, 1936–1965.” *Annals of the History of Computing*, *IEEE* 24, no. 2 (April–June 2002): 16–33.

Wise, George. *Willis R. Whitney, General Electric, and the Origins of U.S. Industrial Research*. New York: Columbia University Press, 1983.

Wisnioski, Matthew. *Engineers for Change*. Cambridge, MA: MIT Press, 2012.

Woodward, Kathleen N. “Art and Technics: John Cage, Electronics, and World Improvement.” In *The Myths of Information: Technology and Postindustrial Culture*, edited by Kathleen N. Woodward, 171–192. Madison, WI: Coda Press, 1980.

Yoshimoto, Midori. “Expo ’70 and Japanese Art: Dissonant Voices, an Introduction and Commentary.” *Review of Japanese Culture and Society* 23 (December 2011): 1–12.

______. "From Space to Environment: The Origins of Kankyō and the Emergence of Intermedia Art in Japan." *Art Journal* 67, no. 3 (Fall 2008): 24–45.

Young, Joan and Susan Davidson. "Chronology." In Hopps and Davidson, *Robert Rauschenberg: A Retrospective*, 550–587.

Young, Niels O. "Standing Loops of Limp String." *TECHNE* 1, no. 1 (April 14, 1969): 8–9.

Youngblood, Gene. "Technology as Empire." *Los Angeles Free Press*, October 3, 1969.

______. "Video Computer Interface." *E.A.T./LA Survey* 2 (February 1970): 7–8.

______. *Expanded Cinema*. New York: Dutton, 1970.