03

The Hands-On Process
Engineering Collaboration at E.A.T.

Friction is as necessary to generate esthetic energy as it is to supply the energy that drives machinery.
—John Dewey, *Art as Experience*

Bell Telephone Laboratories, Incorporated was formed out of the engineering department of the Western Electric Company in 1925 and based on West Street in New York City, where the building complex extended back a full city block. Several facilities were based in New Jersey, including the radio research stations at Whippany, where the first experimental television broadcast in the US was conducted in 1927, and Holmdel, where radio astronomy was invented in 1932. It was south of Whippany, however, at Murray Hill that the expanding Bell Labs would make its New Jersey center of operations in 1941. Imagined from the start as a custom-built R&D facility, the purpose of the proposed new lab complex, Bell president Frank Baldwin Jewett told local residents in 1931, "is something along the lines of a miniature college or university" (quoted in Mozingo 2011, 56). The Great Depression held up the project, but the site, designed by landscape architects Olmstead Brothers and architects Voorhees, Walker, Foley, and Smith, was eventually completed in 1942, with additional buildings added in 1949 and 1958, by which time *Fortune* magazine was willing to name Bell Labs "The World's Greatest Industrial Laboratory" (Bello 1958).[1]

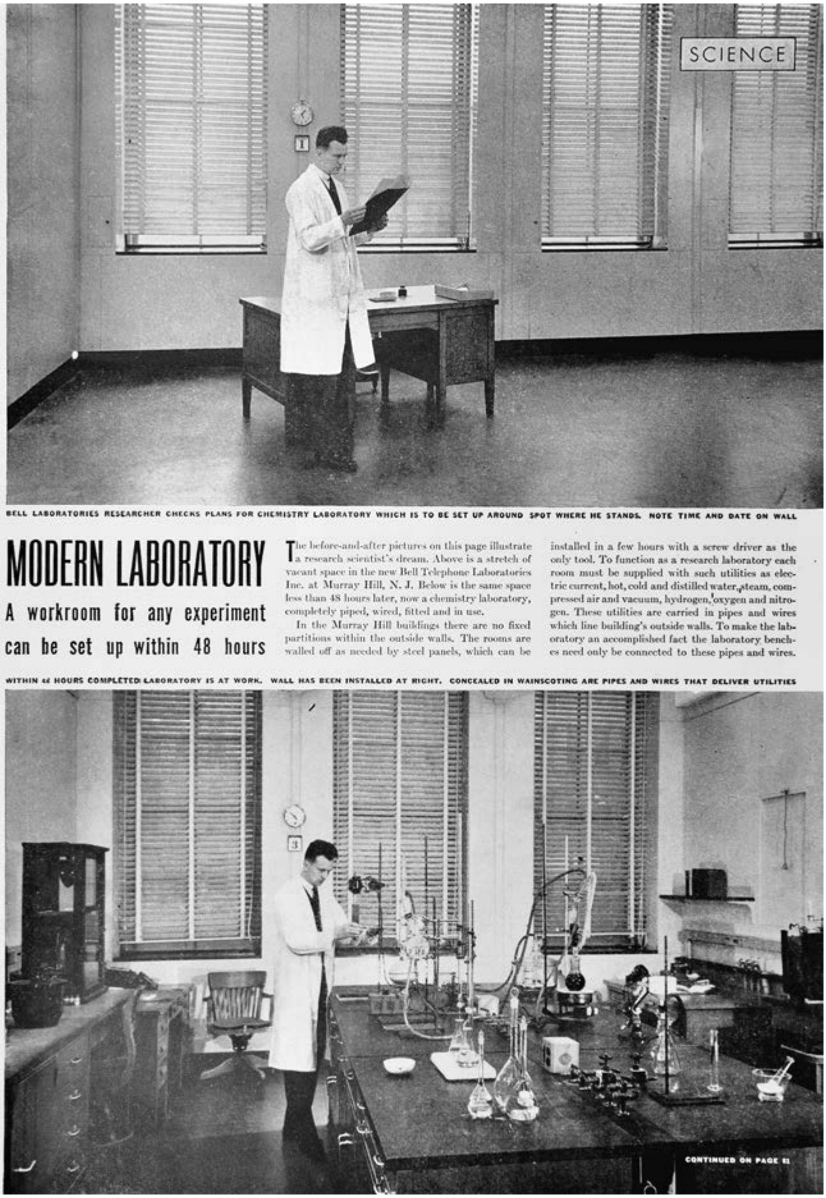
The pastoral surrounding was a key feature of the lab, and though the finished site had less of a campus feel than the original early 1930s design promised, the stress on intellectual and creative freedom remained. A 1954 feature in *Business Week* typically noted that the rural setting of Murray Hill gave the site a "university ambiance," while wondering how the "notoriously uncontrollable" scientists "can be kept working in such fruitful harmony without visible control" (quoted in Mozingo 2011, 62). The impression of freedom noted here was a powerful effect of the campus-like surroundings, marked by an apparent absence of corporate oversight and disinterest in commercial affairs. Such an effect was in part designed, as Louise Mozingo explains, "to attract, foster, separate, and elevate the research activities" of the Bell scientists, an intention which the success of the labs seemed to confirm (2011, 64).

While the conception of the Murray Hill campus preceded World War II, the site was completed amid the massive surge in government funding for new technologies that accompanied the war. In the first few years after Pearl Harbor, writes Jon Gertner, "Bell Labs took on nearly a thousand different projects for the military—everything from tank radio sets to communications systems for pilots wearing oxygen masks to enciphering machines for scrambling secret messages" (Gertner 2013, 62). Murray Hill was bigger and more prestigious than other industrial laboratories, and internationally recognized alongside Harvard and MIT (Knowles and Leslie 2001, 22). General research director Mervin J. Kelly had built up a strong solid-state physics group during the 1930s, including three future Nobel Prize winners, and Bell Labs, according to Knowles and Leslie, "beat other industrial and academic groups to the transistor largely because of the interdisciplinary collaboration and engineering resources unique to Murray Hill" (24).

It was with regard to disciplinarity that the Murray Hill lab self-consciously differed from the university model. There were no buildings for separate departments, and staff members with different expertise and roles were expected to work together (Gertner 2013, 56). When Kelly became executive vice president in 1945 he set about restructuring the organization by creating interdisciplinary groupings—"combining chemists, physicists, metallurgists, and engineers; combining theoreticians with experimentalists" (79)—to work on new electronic technologies. The attempt to cultivate free-ranging intellectual inquiry at Bell Labs was in keeping with the emerging consensus on the value of interdisciplinary collaboration. It was also a means of avoiding the kind of compartmentalization that, by the 1950s, was identified as one of the worrying hallmarks of American social conformism. The new, affluent research universities and laboratories were driven less obviously by disinterested intellectual inquiry, despite the pleas of basic research advocates like Vannevar Bush, and more by the demands of the military and business. The everyday responsibilities of the government-sponsored scientific researcher was as likely to involve, in addition to research itself, managing contracts, projects, and staff, and committee and government agency work. The bureaucratic demands of the new order, increasingly set either on campus itself or in faux university environments like Murray Hill, produced a kind of R&D version of William H. Whyte's organization man (see Kaiser 2004).

Coupled with the demands that researchers comply with the patriotic ethos of cooperative loyalty to their project and their laboratory, the federally funded scientist's workload suggested that the pressures of research work left little room to be, as *Business Week* imagined scientists, "notoriously uncontrollable." Yet the article on Bell Labs' pastoral ambience had already half-answered its own question about how the work would get done in such luxurious surroundings when it recognized that, despite the expansiveness of the surroundings, "Partly the Freedom is illusory. The lab has firm plans and knows precisely what it wants. . . . Over the years men have been meticulously selected and precisely trained. Men chosen to fit the mold will fall into the desired pattern without any pressure from the mold itself" (quoted in Mozingo 2011, 62). The interdisciplinary openness, and the easy ambiance of the environment at Bell Labs, belied, according to this account, a more ingrained sense of discipline that required no compulsion. While it is unlikely that *Business Week* was developing a critique of the organization man in these comments, the grudging admiration of the Murray Hill campus is modified by the assumption that the rigor of the organization's selection and training processes has rendered such temptations redundant.

The *Business Week* assessment probably says more about how the business world imagined the lives of scientific researchers than about scientists themselves, but it is true that the challenge of protecting intellectual freedom amid an increasingly bureaucratized workplace environment remained a problem. As well as facilitating interdisciplinary movement across fields by avoiding discipline-specific buildings, Murray Hill further sought to engineer fluidity by making the laboratories themselves physically flexible. The buildings had no fixed partitions and rooms, and equipment and facilities could be assembled and taken apart at short notice. As depicted in a 1944 article in *Life* magazine, the impression of the magically appearing research lab stresses the capacity of the company to fit research around the needs of the scientist (see figure 3.1).



SCIENCE

BELL LABORATORIES RESEARCHER CHECKS PLANS FOR CHEMISTRY LABORATORY WHICH IS TO BE SET UP AROUND SPOT WHERE HE STANDS. NOTE TIME AND DATE ON WALL

MODERN LABORATORY

A workroom for any experiment can be set up within 48 hours

The before-and-after pictures on this page illustrate a research scientist's dream. Above is a stretch of vacant space in the new Bell Telephone Laboratories Inc. at Murray Hill, N. J. Below is the same space less than 48 hours later, now a chemistry laboratory, completely piped, wired, fitted and in use.

In the Murray Hill buildings there are no fixed partitions within the outside walls. The rooms are walled off as needed by steel panels, which can be installed in a few hours with a screw driver as the only tool. To function as a research laboratory each room must be supplied with such utilities as electric current, hot, cold and distilled water, steam, compressed air and vacuum, hydrogen, oxygen and nitrogen. These utilities are carried in pipes and wires which line building's outside walls. To make the laboratory an accomplished fact the laboratory benches need only be connected to these pipes and wires.

WITHIN 48 HOURS COMPLETED LABORATORY IS AT WORK. WALL HAS BEEN INSTALLED AT RIGHT. CONCEALED IN WAINSCOTING ARE PIPES AND WIRES THAT DELIVER UTILITIES

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Figure 3.1. One of the pop-up laboratories at Bell Labs' Murray Hill campus, featured in *Life* magazine, September 18, 1944, p. 79.

The conception of the Cold War scientist, then, oscillated between the internalized discipline of the managerial class and the freewheeling inventiveness of the creative individual. Bell Labs, unhindered by the institutional and disciplinary loyalties of conventional university departments, managed to combine this mixture of conformity and free-thinking by cultivating inventiveness within, as *Business Week* suspected, a regime of rigorous selection and training. In this, Bell was able to harness something of the glamour and prestige associated with postwar scientific research while maintaining its business and military connections. Yet even within the innovative structure of Bell Labs, it is hard to see how such a corporate, managed environment might appeal to workers in the arts. Nevertheless, during the 1960s Bell became a focal point for arts-and-technology activity.

In part, the lure of the laboratory for non-scientists may be due to what used to be called cultural lag—the public celebration of physicists in particular, and scientists and technologists in general, during the 1950s created a perception of scientists as the true visionaries of the present, the avant-garde of the American century, powered by government largesse and public acclaim. While the pioneer phase of nuclear physics, with its eccentric European émigrés and charismatic leaders, was mostly over by the end of the 1950s, replaced by bureaucratic sprawl helmed by the big science organization men described by David Kaiser, the persistent aura of the scientist as a heroic innovator remained a persuasive prospect.[2] From a more practical point of view, the resources that research in science and technology had at its disposal were a more immediate source of attraction to artists. Many of the artists who became involved in art-and-technology projects during the 1960s thought mainly about how science and technology might be brought to bear on artistic problems—either practically and technically, in relation to materials and production, or theoretically through the introduction of new modes of expression (such as computers). In terms of prestige and resources, science and technology promised much for artists.

Less obvious, though no less important, is the question of how and why scientific and technological researchers might be interested in, and willing to become involved with, artists. If the allure of the laboratory for artists lay in the promise of otherwise inaccessible expertise and novel materials and methods, the attraction among science and technology professionals for art is less clear, especially now that the notion of the creative scientist had become a plausible framework within which to situate research. As we have seen, however, the possibility of the laboratory as a space for creative investigation and invention was more of an aspiration than a reality for most research scientists. The idea of the scientist as creator, though, fortified by Cold War social science's celebration of creativity as the engine of liberty, remained as powerful a spur among scientists and engineers as it did for artists. The Bell Labs model of interdisciplinary collaboration appeared to offer a solution to the restricted demands of specialized and compartmentalized research that might be extrapolated to resolve the "two cultures" problem that notionally continued to prevent scientists and artists from collectively pooling their creative energies. This, at least, was the thinking behind what would become perhaps the most ambitious art and technology project of the 1960s, Bell scientist Billy Klüver's Experiments in Art and Technology.

While American art certainly did not command the same high status as American science in the 1950s and 1960s, the ascendancy of New York as the center of the global art world and the "triumph" of American art during the postwar period did elevate the self-image of American artists and aligned them with the perceived cutting edge of American innovation.[3] To some degree, then, the desire to forge an alliance of art and technology is an imagined coming together of the great creative forces of the day. Klüver joined the Communication Sciences Division at Bell Labs in 1958, where he worked on backward-wave magnetron amplifiers, linear tubes, and small-signal power-conservation theorems. Klüver was far from the organization man, however, and whether it was Murray Hill's history of interdisciplinary collaboration or the labs' geographical proximity to New York City that encouraged him, Klüver soon found himself deep inside the art world.

Klüver had assisted artists in developing projects since he worked with Jean Tinguely in the construction of *Homage to New York*, his self-destructing sculpture machine, in 1960. It is around this time that Klüver began inviting artists to Murray Hill. "From 1960 on," he later explained, "I brought some 50 to 100 artists through Bell Labs," providing a tour of the site and exposure to advanced technological experiments otherwise inaccessible to outsiders. The artists could see, he noted, "the hands-on process and that one could actually DO things" (Ramljek 1991, 32). By the spring of 1966, Klüver's involvement with artists was notable enough for him to make the cover of the in-house Bell Labs magazine the *Reporter*. In a guest editorial by Klüver's boss John R. Pierce, executive director of the Research Communications Sciences Division, Pierce reminded readers that the collaboration between engineers and artists was nothing new at Bell Labs. In the 1930s, engineer Harvey Fletcher worked with composer Leopold Stokowski on stereophonic sound, and the labs' research on speech, hearing, and visual perception had a hand in the development of sound in films and the beginnings of television. Frequent visitors to the labs, noted Pierce, included the conductor Hermann Scherchen and the composers Gerald Strong, Milton Babbitt, Vladimir Ussachevsky, and Otto Luening, as well as Edgard Varèse, who sought assistance from Bell with the electronic aspects of his *Déserts* (premiered 1954). "We are now," Pierce claimed, "in a period of increasing appreciation of the impact that science and engineering can have on art. We are also becoming aware of the fact that art can have an impact on science and engineering" (Pierce 1966, 1). An effectively designed telephone, he wrote, is not the result of "an occult effort of artistic genius" but of the combined energies of engineers, designers, and psychologists (1). The "intellectual barriers of the compartmentalization of the past" are, according to Pierce, being destroyed by human understanding and knowledge and he imagined a future where the barriers "of ignorance and temperament" that divide science and the arts will be overcome (1).

Pierce's faith in interdisciplinary knowledge exchange reflects the Bell ethos and a recognition of the commercial benefits to be gained by cultivating relations with creative types. A sometime science-fiction writer, Pierce supervised the team that developed the first transistor (and was responsible for naming it) and worked extensively on satellites, including Telstar, the first communications satellite. He was also, as indicated in the name checking of composers, a prominent researcher in computer music, a field he pursued after retirement at Stanford's Center for Computer Research in Music and Acoustics.[4] Klüver's involvement with contemporary art was, then, less unlikely than first appears, and Pierce himself had, around the same time as Klüver, started inviting artists to Bell Labs and welcomed composers such as James Tenney to Murray Hill. Tenney worked at Bell Labs for around two and a half years, from September 1961 to March 1964, collaborating with Pierce, Max Mathews, and others on computer-synthesized sound. At the time, Tenney observed later, "they found it remarkable that anybody in the outside world would be interested in what they were doing" (quoted in Kahn 1999). The same, of course, might be said for much of the art world activity of the early 1960s, which occupied its own insular realm. People like Tenney and his then wife, artist Carolee Schneemann, bounced back and forth between the mutually supportive environments of Murray Hill and New York City, as did Klüver and the Bell Labs engineers.

A third site triangulates Bell Labs and the New York art world and provides an articulation of a generalized sense of shared mission among the scientific and artistic avant-garde. Less than twenty miles south of Bell Labs, the Rutgers University–Douglass College cluster of educators, artists, and students comprised what Claes Oldenburg called the New Jersey School: Allan Kaprow, George Segal, George Brecht, Robert Whitman, Robert Watts, Lucas Samaras, Geoffrey Hendricks, and Roy Lichtenstein (see Marter 1999). Kaprow had taught art at Rutgers since 1953 (though he was refused tenure and left in 1961), the same year Watts began teaching at Douglass and Brecht settled in New Jersey to work as a chemist at Johnson and Johnson. Hendricks joined the Rutgers staff in 1956, and Samaras was a Rutgers undergraduate. It was while teaching at Rutgers between 1960 and 1964 that Lichtenstein developed his interest in paintings derived from commercial printing processes. And it was Segal, living on a chicken farm in nearby South Brunswick, who introduced the Rutgers crowd to John Cage, whose Black Mountain College experiments in multimedia performance anticipated the environments and performances staged by Kaprow and his New Jersey associates through the late 1950s and early 1960s. Segal, Kaprow, and Watts all attended Cage's experimental composition class at the New School for Social Research in New York City, as did George Maciunas. The emerging Fluxus activity around Maciunas, Brecht, and Kaprow drew heavily on the New Jersey contingent—Klüver and his girlfriend Letty Eisenhauer (who studied with Watts at Douglass and was to become Lichtenstein's girlfriend) both featured in Kaprow events, as did performance artists Schneemann and Olga Adorno (who married Klüver).

Bell Labs, in short, despite its appearance as a suburban, buttoned-up corporate enclave, was a key node in a network of technological and artistic innovation throughout the early part of the 1960s. The current of influence, and admiration, surged both ways, as composers and artists picnicked on the lawns at Murray Hill while Klüver assisted artists with technical matters in Manhattan. The collaborative spirit of the Fluxus projects and the interdisciplinary investigations at Bell Labs, while radically different in many ways, equally drew on the Deweyan ethos of thinking by doing—what Klüver would recall as the "hands-on process." The sense of shared purpose was clear enough to Klüver, who went on to develop his guided tours for artists into a fully fledged network of engineering and artistic collaboration.

Klüver the Transducer

For a lecture to be delivered at MIT on April 21, 1967, five months after Experiments in Art and Technology (E.A.T.) was established, Klüver divided his material into four sections. The first was to be a taped introduction accompanied by eighty slides, each shown for ten seconds, beamed from six carousel projectors. The slides would themselves come in four "waves": contemporary art works; Claes Oldenburg "happenings"; black and white shots taken backstage at 9 Evenings: Theatre and Engineering, the series of multimedia events

Klüver hosted, with, among others, Cage and Rauschenberg, at the 69th Regiment Armory in New York in October 1966; and finally, color images of 9 Evenings itself. This compressed audiovisual contextualization of Klüver's project not only demonstrated E.A.T.'s commitment to Bell-style multimedia communications but also acknowledged the inspirational influence, through its distillation in Oldenburg, of the Rutgers contingent's emphasis on process and performance. Most importantly, 9 Evenings provided Klüver with evidence that his organizational chops were sufficiently developed to pull off a complex, high-visibility arts and technology event. It was 9 Evenings that inspired Klüver, his Bell colleague Fred Waldhauer, Robert Rauschenberg, and Robert Whitman to form E.A.T., and it was the Armory events, symbolically performed at the venue responsible for hosting the epochal 1913 International Exhibition of Modern Art (or Armory Show, as it is commonly known) that brought European modernism to the attention of the American public, that captured for Klüver the spirit of experimental overreach and glitch-prone adventurism he wanted E.A.T. to disseminate throughout the networks he aimed to create among engineers, inventors, industrialists, business leaders, and artists of all stripes.

Impossible to summarize, Klüver and his associates hurled everything Bell engineers could supply at the 9 Evenings events. Deploying four dancers (Deborah Hay, Yvonne Rainer, Lucinda Childs, Steve Paxton), two musicians (John Cage, David Tudor), four visual artists (Robert Rauschenberg, Öyvind Fahlström, Alex Hay, Robert Whitman), and over thirty engineers from Bell Labs, 9 Evenings variously used closed-circuit television and television projection, fiber optic and infrared television cameras, a Doppler sonar device, portable wireless FM transmitters and amplifiers, and a multitude of complex video, sound, and light projection systems. Cage repurposed telephones, transistor radios, Geiger counters, contact microphones, and the brain waves of his collaborators to generate a real-time composition from sound siphoned through his numerous receivers into the Armory speakers. Rainer choreographed performers from the balcony using a walkie-talkie, while Rauschenberg staged a tennis match with amplified racquets that were also wired to cut the lights in the auditorium each time a ball was hit.[5] For Klüver, as he would explain to his MIT audience the following spring, this was merely a taste of what a successful orchestration of America's twin art and technology avant-gardes might achieve.

The creative energy Klüver believed E.A.T. was capable of generating was commensurate with the contemporary sense of US cultural ascendancy. Klüver was not shy in admitting that E.A.T. was catching the wave, and his taped introduction to the MIT presentation, over the surge of the first wave of slides, announced the triumph of American culture:

> Over the last 15 years the best Contemporary Art has been produced in the United States. During this period at least three original schools of painting and sculpture have originated or found their form here. The most interesting development in modern dance is American. The best contemporary writer is an American. A new form of theater has developed and is currently being absorbed by the commercial theater. The most interesting new development in film making comes from New York.[6]

The establishment of New York City as the capital of the art world was, for Klüver, an achieved fact; there are, he pointed out, some one thousand artists working in the city, and around five hundred artists from around the world travel to New York to meet American artists and show their work. "The richness and variety of contemporary American art," Klüver insisted, "far exceeds what was produced in Paris during the Golden Years of the Twenties."

Klüver took Claes Oldenburg as his primary example because Oldenburg seemed to best characterize the contemporary artist's "transgression" of disciplinary boundaries—in the case of Oldenburg, from painter and sculptor to theater writer. Klüver's brief description of Oldenburg's practice in staging the 1962 happenings emphasized the process-led modifications that took place throughout. "Unskilled actors" were used as the artist's "primary material," and the script changed during rehearsals to fit the "character and peculiarity of each particular performer." By the end of the process, Klüver noted, "sometimes every detail in the original script had been changed." The keynote here, for Klüver, is transformation: the artist moves across disciplines and is responsive to the environment while maintaining agency and control. As a prelude to his introduction to 9 Evenings, the happenings establish a precedent and a method that the Armory events radically amplify. On 9 Evenings, Klüver stressed the numbers: ten artists, thirty engineers clocking in 8,500 engineering hours, over thirty technical projects, each developed out of an artist's idea. The event, explained Klüver, was a "deliberate attempt to prove a point"—that "they could talk and work together." Despite difficulties, "everyone seems to agree that the collaboration was a fact." For Klüver, the real lesson of 9 Evenings was not aesthetic but organizational: he had proved the point that collaboration could happen.

The talk for which this thirteen-minute audiovisual section served as an introduction was called, with a deft removal of connectives that gives the title an equation-like efficiency, "Interface: Artist/Engineer," and Klüver's broader aim was to explain the purpose of E.A.T.[7] Only five months old, the new project had been kick-started with $8,000 from John Hightower at the New York State Council on the Arts that allowed E.A.T. to establish an office on the top floor of 9 East Sixteenth Street, where the organization held a weekly open house on Sundays. The purpose of E.A.T. was not to provide technical services for artists, though Klüver had initially thought along these lines, his own involvement with artists having begun when he lent his expertise to Tinguely and in his subsequent work helping Rauschenberg construct *Oracle*, as well as the technical assistance he gave Jasper Johns with the use of neon and in repairing one of the spinning discs of Marcel Duchamp's *Rotoreliefs* (see Klüver 1994). Instead, at Rauschenberg's insistence, E.A.T. aimed to facilitate genuine collaboration across the arts, sciences, and industry capable of generating unforeseen new forms and ideas (Miller 1998, 28). This ambitious goal was the theme of Klüver's talk at MIT.

He launched the talk on interdisciplinary collaboration with a survey of contemporary art because, Klüver explained, the new relationship between art and technology had "been born out of the direction and the nature of contemporary art itself" (1967b, 2). Historically, argued Klüver, technology had provided new materials, techniques, and imagery for art, but it was rarely inspired by art. After Duchamp, according to Klüver, it was clear 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" (3). In other words, art has become a reflexive process of exploration unencumbered by an adherence to traditional tools or methods and unconstrained by an expected outcome. The meaning of art, Klüver insisted, "is not to communicate what we already know but what we don't know, to dislocate our vision, to make us look, to make us aware of our traces and tracks" (3). The contemporary artist "needs access to the contemporary world and he wants to be part of the world of the future"; he "sees the engineer as his collaborator, his material and his inspiration" (7). The ultimate purpose of E.A.T., claimed Klüver, "will be to act as a transducer between the artist and industry, to protect the artist from industry and industry from the artist, to translate the artist's dreams into realistic technical projects. We also hope that we will accumulate enough experience to give help to other institutions who want to set up similar cooperative programs" (15–16).

The evidence of only five months of operations suggested to Klüver that they were on to something. Klüver explained that E.A.T. had received applications from over 250 artists and drawn up a mailing list of over two thousand people. While a number of projects were already underway, what E.A.T.

needed was more engineers. The remainder of the talk addressed practicalities. The basic requirements for the artist/engineer interface must include, Klüver believed, full cooperation from industry, a professional attitude, the protection of artists and engineers in their own environment, short turnarounds for projects, and an emphasis on new technology. It is clear that Klüver's upbeat introduction about the vitality and centrality of art to contemporary American life is, in part, aimed at winning over a skeptical industrial sector. "If industry does not get involved," he makes clear, "the artist/engineer collaboration will go down with a whimper."[8] Allaying concerns that artists would take over the lab or workshop, Klüver told his audience that "the artist and the engineer both need their own environments to be creative." Furthermore, there was no need to worry about aesthetics. "The artist," Klüver explained reassuringly, "likes to deal with his problems in a matter of fact way and not 'esthetically'. Esthetic considerations will hinder the development of new art."

Beyond these operational practicalities, there were also clear benefits for industry in encouraging the artist/engineer interface, including the sort of social prestige companies already enjoyed by associating with local causes and education, as well as fostering a collective sense of shared purpose among employees. The presence of artists offered a fresh perspective on problems: "Artists are autonomous," Klüver explained. "They do not 'report' to anyone. As such they form an effective intelligence resource." More attractively, perhaps, there was also potential commercial gain to be had through patents, methods, products, and ideas. Furthermore, artists were likely to identify new applications for technology. Indeed, Klüver suggested that "feedback to industry that the collaboration will lead to is the most important reason why industry should support and sponsor projects." The artist sees the world differently from the engineer, Klüver explained, and it is "not necessary that our environment should always be born out of the engineering mind." Finally, collaboration with artists was likely to foster a greater public understanding of engineering and industry, according to Klüver.

So, what has to be done? Klüver offers a number of items. Professional "engineers in art" groups should be organized as part of existing engineering societies, able to disseminate through journals and conferences the results of their activities. There is also the problem of the different working habits of artists and engineers, and the need to break down misunderstandings about how the other half sees the world. It is important, finally for the engineer to keep focused on the common goal and not get too caught up in "his own contribution." For artists, Klüver suggests that it is important for artists and engineers to meet face to face "under relaxed conditions." Tours of laboratories and industries are essential so that artists understand working conditions, the nature of materials, processes, and so on. It is also essential that artists learn what they can reasonably expect from an engineer.

Klüver offered troubleshooting tips, or what he called "collaboration handicaps." Difficulties tend to arise, Klüver suggested, when there is a confusion of roles. "When an engineer says 'I am an artist' the collaboration usually breaks down." On the other hand, artists can confuse technical decisions with aesthetic decisions: "Where should the knob sit? What about the color of the batteries—does it matter?" Differences in the pace of work must also be accommodated: artists may work quickly and must understand that engineers require time to tackle problems. Klüver is warming to his subject here and lists "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." Finally, a word of warning about category mistakes: displaying the "products of technology in a gallery will not transform [them] into art." Technology is already beautiful, Klüver explained, "and it does not become more beautiful if it is put up for display."

Rauschenberg and Klüver had drafted a more concise version of E.A.T.'s purpose back in January 1967, where they explained that they wanted 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" (Rauschenberg and Klüver 1967). The stress here is on industry becoming cognizant of its duties; the integration of technology and the arts is presented as not merely desirable but necessary. In a statement prepared for a well-attended press conference to publicly launch E.A.T. held in Rauschenberg's studio on October 10—reported in the *New York Times* as "enlivened by revolving painted disks, film projections, floating pillows and miniskirted girls in paper smocks" (Lieberman 1967, 49)—E.A.T. announced a "working alliance" with the American Foundation on Automation and Employment (AFAE), a nonprofit organization focused on promoting automation by "solving the labor problems it creates."[9] Here, the notion of industry's responsibility is underscored by stressing the inevitability of the convergence of art and technology: E.A.T., according to the statement, "functions as a catalyst for the inevitable fusing of specializations creating a responsible man operating in the present":

> The mutual objectives are to maintain a constructive climate for the recognition of the new technology and the arts by a civilized collaboration between groups unrealistically developing in isolation. Both organizations [E.A.T. and AFAE] are committed to the elimination of the separation of

the individual from technological change and to expand and enrich technology to give the individual variety, pleasure, exploration and opportunity of self-fulfillment in contemporary life. We will encourage industrial initiative generating original forethought, instead of a compromise in aftermath, and precipitate a mutual agreement in order to avoid the waste of a cultural revolution.

The "adjustment" that needed to be made involved gaining for artists "free access to technology, engineering and the technical processes." Meeting the challenge of achieving this, for E.A.T., "is not only a cultural, educational or aesthetic problem but amounts in fact to an organic social revolution." The vision here is entirely one of mutual transformation: "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." The ultimate aim of E.A.T. is to disappear as a separate organization and to be absorbed into "engineering institutes, universities and industry. This is a nationwide project."

It is striking how much of Rauschenberg's and Klüver's rhetoric draws on the vocabulary of progressive liberalism Dewey made commonplace during the 1920s and 1930s. The emphasis on "adjustment," "responsibility," "integration"; the rejection of the cultural and aesthetic as a separate sphere and instead the call for an "organic" social revolution through the collapsing of boundaries between art and technology; the notion of technology as a "natural" environment rather than as an externalized set of procedures and techniques—all of these positions carry with them the powerful social democratic ethos Rauschenberg brought with him from Black Mountain College and which, as we have seen, Black Mountain derived from its hybrid Dewey-Bauhaus inheritance.

What is also true, however, is that this language of adjustment and adaptation had long since been loosened from its radical democratic moorings and had come to serve corporate liberalism's post-ideological culture of consensus. As a consequence, it is hard to tell from the rhetoric quite what Rauschenberg and Klüver had in mind by an "organic social revolution." There is little doubt, though, that they saw their undertaking as ambitious, with E.A.T. as a means of radically reorienting the way things are done in the arts, sciences, and industry. On a practical level, it was clear that such a project needed to present itself effectively to the business world, and Klüver and Rauschenberg were adept enough to structure the organization more along the lines of a corporation than a revolutionary art movement. Soon, E.A.T. had a president, a board of directors, an advisory council, a small staff, and its own newsletter. Francis S.

Mason Jr., dance critic and former cultural ambassador to London, was appointed president of E.A.T.; art collector John G. Powers was made chairman of the Business Committee; and Theodore W. Kheel, an attorney, labor negotiator, and president of AFAE, served as chairman of the Executive Committee. Klüver and Rauschenberg were, respectively, chairman and vice-chairman of the board. By November 1967 the E.A.T. newsletter could announce that the organization had the formal support of AT&T and the union federation AFL-CIO. Kheel made available to E.A.T. the AFAE's new building, Automation House, on 68th Street.

Kheel was strongly influenced by the view of technological change promoted by Emmanuel Mesthene, director of the Harvard Program on Technology and Society, and stressed the need for adaptability in the face of the transformations technology would inevitably bring to social organization (Wisnioski 2012, 143). Klüver's position tended to broadly follow this line, though at times he would back away from the large social claims made by E.A.T., more pragmatically highlighting the innovations that art and engineering collaboration made possible. Klüver's main objective was to grow the organization and raise funds, and to this extent the language of adjustment and the rhetoric of transformation had to be held in some sort of balance.

Klüver made sure that the fundraising and PR statement drafted in January 1967 carried an endorsement from Bell Labs, in the form of statements from John R. Pierce and Max Mathews, director of Bell's behavioral research laboratory and computer music pioneer. A May 1967 E.A.T. promotional fundraising pack went further, including press cuttings about 9 Evenings (from *Fortune* and *Artforum*) and evidence of the "first technical 'fallout,'" as Klüver described it, of the event: a thermographic phosphor discovered during work with Rauschenberg and Whitman that "is now in daily use in infrared laser research at Bell Laboratories" (E.A.T. 1967a). How many projects could boast of coverage from the business and art worlds as well as the *Institute of Electrical and Electronic Engineers' Journal of Quantum Electronics*? The documentation included in the fundraising pack outlined E.A.T.'s organizational structure, explained how artists and engineers were matched and managed, and provided over seventy samples of artists' technical proposals as well as a list of over two hundred artists wishing to participate. Another list provided the names of around seventy-five "Member Engineers (List Incomplete)." Aside from a number of Bell Labs employees, Klüver had also recruited engineers from other major companies such as Eastman Kodak, Western Electric, Astrosystems, Inc., and RCA, as well as top-drawer universities like MIT, Northwestern, and Cornell. A final three-page list of names and addresses evidenced expressions of interest.

The organic social revolution Rauschenberg and Klüver imagined in January 1967 was fleshed out in the November newsletter. Following the October press conference, the newsletter registers an emboldened tone, imagining that the scope of E.A.T.'s collaborative ethos must extend "further than the individual artist and engineers, and will necessarily involve the cooperation and support of other institutions in society: industry, universities, labor and even politics" (J. Martin 1967, 2–3). There is a sense of urgency to the editorial, which repeatedly stresses the need for an awareness of each "individual's responsibility for the environment he is creating for himself" (3). The artist-engineer relationship should serve as "a catalyst for re-examining and redefining individual responsibilities" (3). As well as its ongoing work with labor, universities, and industrial management, readers are told that E.A.T. must equally be able to "sell its ideas" to middle-management, since they are responsible for formulating company policy (4). A Council of Agents, including John Pierce, Alfred Barr, John Cage, György Kepes, liberal Republican senator Jacob Javits and Harry Van Arsdale Jr., president of the Central Labor Council, are charged with using their influence on behalf of E.A.T. "according to their authority and sympathy" (7).

The Role of the Engineer

The sense of urgency and the stress on social responsibility in E.A.T.'s public pronouncements are no doubt aimed at providing a broad context within which potential corporate sponsors could situate their understanding of what they were being invited to support. But the emphasis on responsibility also, we think, speaks to a need to address a growing disquiet about technology in American society generally and, more specifically, a longer-standing issue surrounding the status and function of the engineer in American life. While Klüver largely saw the artist as the primary agent in the art/engineering collaboration, it was engineers and corporate sponsors that needed persuading of the value of working with artists. Applications from artists poured into the E.A.T. offices from the start; finding willing engineers was more difficult, and snaring corporate support even more so. Making an appeal for a general sense of social and cultural responsibility was, then, a pitch aimed at the engineering profession and the corporate world. Unlike someone like Kepes, Klüver had from the start avoided considerations of art and science and was more interested in the technical and material processes of making and doing than anything theoretical (Halpern 2015, 96). Even the word "experiment" in the organization's name was problematic for Klüver, who would have preferred "something mundane" like "Foundation for Artists and Engineers" (1997, 316). The mundane names were already taken, so the group's lawyer registered Experiments in Art and Technology instead, a name he had come up with himself. Despite his advocacy of process, the provisional implications of the word "experiment" seemed to be what troubled Klüver, who later explained that "an artwork is either finished or it isn't, and the public should not be subjected to incomprehensible scientific or technical experiments" (Klüver 1997, 316–317; see also Goodyear 2004, 623). As science had become increasingly specialized, abstract, and abstruse, engineering, at least as Klüver conceived of it in its interaction with artists, retained a pragmatic, problem-solving appeal that made it closer to the explorative investigations of contemporary art.

For all its interdisciplinary credentials, Bell Labs nevertheless maintained a strict division between research and development, as Ross Bassett explains: "Bell Labs was a massive effort to control the chaotic and uncertain process of inventing and developing new technology" (2002, 18). While research "consisted mainly of scientists who used their superior knowledge of physical laws to produce novelty," once a new device was created it was quickly turned over to the development group charged with converting it into a product. Development, according to Basset, "was essentially an engineering function—concerned with economic and technological considerations. Managers at Bell Labs believed that if researchers worked on these types of problems they would lose their scientific edge" (18). It is clear from Klüver's investment in the hands-on work of engineers that it was the development end of the R&D process that he favored, rather than the more theoretical (and higher status) research work.

By the mid-1960s however, Klüver's conception of the engineer as maker was already at odds with the reality of an increasingly managed and compartmentalized profession. A Time Life volume titled *The Engineer*, published in 1966, the same year as the 9 Evenings events and the founding of E.A.T., explained that "the great majority of engineers today work in teams—behind desks or in laboratories—tackling mutual problems with slide rules, computers and microscopes." Although the modern engineer sounds versatile and capable ("He is part scientist, part inventor, part technician, part cost accountant"), he is nevertheless "almost always a specialist in a narrow field." A chemical engineer, for example, "may do nothing but study better ways to manufacture quick-drying paints" (quoted in Wisnioski 2012, 16). This popular account of the engineering life includes collaboration and interdisciplinary flexibility, but a dominant narrative of conformity, repetition, and blinkered specialization subsumes these virtues.

In many ways, the status of the engineer suffered from the same oscillation in public perspective that burdened the postwar scientist. The engineer was either the driver of technologically fueled prosperity and social progress or, conversely, the epitome of hollow technocratic alienation. As with science, the engineering profession prospered during the early postwar period, and by 1960 engineering was the most common white-collar occupation for men in the country, with one in fifty men in the labor force identifying as an engineer, and over 40 percent of engineers, directly or indirectly, employed by the government (Wisnioski 2012, 23). The compromised position of the scientist—at once the creative soul of the technological revolution and the sold-out functionary of the military-industrial state—was also true for the engineer. Klüver's ambition to grow E.A.T. into an integral aspect of the technological apparatus was, we think, an attempt to realign the role of the engineer according to the perceived creative freedom enjoyed in the arts in the face of a creeping corporatism. Such a move would free engineers from the subordinate position they frequently occupied in relation to scientists and establish engineering alongside art as the proper place for the creative deployment of technological innovation. The debates circulating in the pages of professional engineering journals over the status and role of the engineer during the 1960s are echoed in E.A.T.'s desire to appeal to industry and, at the same time, to maintain its artistic credibility and articulate a vision of engineering as a creative profession (see, e.g., Wisnioski 2012, 31).

The relations between artists and engineers on E.A.T. projects were, given this situation, mixed at best. Artists often felt that engineers relegated their collaborative input to their free time, while engineers tended to feel subordinated to the role of technical support. The engineers, inevitably, had to hold down jobs, and even John R. Pierce, despite his support for Klüver and his own involvement in music and computation, saw E.A.T. as "strictly comparable to golf, skiing, politics, public service, and other spare-time avocations" (quoted in Wisnioski 2012, 146). More problematic for Klüver was the difficulty of securing financial support. Despite the impressive listing of big corporations as sponsors in E.A.T. promotional literature, and Klüver's tireless campaign to enlist more substantial support, most donated only the $1,000 required to receive recognition.

The Pepsi Generation

At its peak in 1969, E.A.T. could claim around six thousand members, including approximately two thousand engineers and two thousand artists, and had made about five hundred collaborative matchings. There were over thirty US-based E.A.T. groups, along with overseas activity in South America, Europe, and Australia, while regional offices operated out of Los Angeles and Tokyo (Lindgren 1969b, 53). The *E.A.T. Operations and Information* bulletin of April 24, 1969 claimed that matchings were being made at the rate of forty per month, though a shortage of engineer and scientist members persisted in a number of fields. Never an organization to shy away from aggressive inventorial display, however, the list of technical areas in which matching had been made was provided in full, taking up almost a whole page. As a typical example of E.A.T.'s audacity and penchant for Whitmanesque volumetric posturing, the list operates as an exuberant psychedelic hymn to tech potentiality that is best captured by excessive citation:

> electrical and mechanical engineering, computer-generated films, mathematics—computers, printing electromagnetically on irregular surfaces, fiberglass manufacturing, environmental mobile/electric construction involving light/sound, mechanics for inflatables, intermedia, plastic forming and optics, holography, lasers, electro-dynamics, oceanography, geology, space, crystal growth, translucent and luminous aqueous colors, floating houseboats on foam, light machinery, projectors and projection systems, kinetic art, electric engineering/plastics, reorganizing language, effects of technology upon body physiology, earth/global simulation projection, light projectors—color organ, light projection, color organ, flashing lights, holography, use of light for robot [*sic*], electronics information display devices, flying and floating inflatable forms, vacuum molding, plastics, photoelasticity, rotating scrolls to which paper is attached, aerial projections, cinegraphics, chemical engineering, polyester sculpture, laser technology, computerized lighting, photographic collages, poetry and mathematics, high voltage coronas, random movement and sound, plastics, making use of computers for multisensory and dynamic pies, aquarium environmental simulation lasers, light box, holography, optical simulation—electrical engineering, video tape, projection of intense light, holography, light, mechanics, projection, holography, computers, plastics, liquid sculpture, retro recorder, electronic data processing systems, remote control, sound translations, films, etc., photocell-activated light show, electroluminescence, electric circuit layouts, painted aluminum for outdoor use, electronic music synthesizers, electrical/mechanical engineering, plastic forms filled with incandescent gases, chemical light sources—holography, structural engineering, computer programming and poetry, multi media use of computers, plastics, cultured rotating forms, fiber optics, antigravity machine, mechanical clock containing recordings, relief photography, experimenting with light/electronics, video-tape,

> selling and working with vinyl, neurology, plastic lamination, opaque and translucent art works, glass, light, mechanical engineer to assist in three-dimensional projections, electronic constructions with special lights, glass mirrors, computer-electronic music analyzer and synthesizer, computer graphics, audio-visual conversion, electrical mechanical engineering, mechanical engineering, outdoor constructions with electric lighting, earth grading, asphalt construction, electrical engineering, planar image assembling painting and film, mathematical formulae for sculpture, electronic media-music, optical and mechanical engineering, motorized steel panels, heating device for plastic fabrication box, castings and coding techniques, electronic music computer, plastic lamination, illuminated fluid moving in relation to lenses and mirrors, plastic objects flailing in liquid, computers and TV, computer-controlled light array, light effects from linear polarization, electroplating non-metallic material, computer-controlled audio-visual conversion, construction of plexiglas-neon/vacuum form, planted sheet metal constructions, moving holograms, traveling circus. (E.A.T. 1969, 2)

This is a catalog of potentiality, despite (or perhaps because of) some repetition, that is designed, presumably, to appeal to those who spend their spare time perusing the classified ads in *Popular Mechanics*. But it also revels in the rhythms, internal rhymes and barely suppressed erotics of the long list ("floating houseboats on foam," "plastic lamination, illuminated fluid," "flailing in liquid"). Klüver's catalog is a printed incantatory strobe effect designed to bewitch engineers.

Drumming up business was hard, but as far as sponsorship went, the final edition of the E.A.T. newsletter (which was replaced with the short-lived newspaper *Techne*) in April 1968 was able to list seventy-eight sponsors contributing $1,000 a year, an odd but representative mix of art-world patrons like John and Dominique de Ménil and gallery owners such as Virginia Dwan, and corporations including IBM, Schlumberger, and Xerox. Probably only E.A.T. could list as sponsors both the American Flange Company and Max's Kansas City.

The core aspect of the E.A.T. agenda was the Technical Service Program, founded in 1966, which sought to pair artists with engineers using information supplied by applicants on a simple form. Organized tours of Bell Labs and other industrial sites continued for artists as a means of opening dialog, providing a sense of what materials and resources might be available, and to instruct artists in the limits of what they might expect. In addition, E.A.T. also ran a weekly open house, offered rental equipment, and organized numerous conferences and lectures. In conjunction with a 1968 MoMA exhibition called *The Machine as Seen at the End of the Mechanical Age*, E.A.T. ran a competition for art-tech collaborations. The following year, 140 proposals were exhibited at the Brooklyn Museum in an exhibition called *Some More Beginnings: An Exhibition of Submitted Works Involving Technical Materials and Processes*.

Despite the ongoing funding issues, E.A.T. projects became more ambitious and international. In 1968, E.A.T. was enlisted by PepsiCo to design the American pavilion for the Osaka World's Fair, Expo '70. Coordinated by Klüver and filmmaker Robert Breer, the pavilion was envisaged as a rolling program of artist-led immersive environments. The stress on atmosphere and environment was rendered literal outside the pavilion as artist Fujiko Nakaya and research scientist Thomas R. Mee swathed the building in a manufactured fog. Inside, E.A.T. constructed an inflated spherical Mylar mirror and built an audiovisual system with a krypton laser. The cost of the pavilion came to over $1 million, twice the agreed-upon budget. Despite numerous technical and organizational problems, the pavilion opened on schedule, though E.A.T.'s proposed operating budget for keeping the site running for six months effectively ended Klüver's involvement after Pepsi refused to pay. The E.A.T. program prepared for inside the pavilion was replaced with a cobbled together, Pepsi-approved replacement, and the E.A.T. team returned to New York.[10]

In an essay on E.A.T.'s adventures in Osaka published in the *New Yorker*, art critic Calvin Tomkins was curious about the business side of the project and mentions, at the outset, what is often left unspoken in discussions of art-and-tech projects: who pays and why. A "surprising number" of big corporations have recently shown themselves willing to fund art-and-tech, wrote Tomkins, though the "businessman's motives in sponsoring projects of this sort are seldom entirely clear to anyone" and the "relationship between the new art and its potential patron remains somewhat confused and confusing" (1972, 105). Pepsi got involved with E.A.T. seemingly "inadvertently," according to Tomkins, through a "series of productive confusions that never quite reached the level of corporate decisions" (105). The initial contact between the corporation and E.A.T. came about because David Thomas, vice president for international marketing coordination at the company, asked Breer, a neighbor, if he knew any artists interested in working on the expo. Breer called Klüver, who put together a team after Pepsi agreed to finance a pitch. The competition was the East Village discotheque the Electric Circus, whose proposal was unapologetically well over budget; E.A.T. by default slid into position, though no contract was signed until a week before the event opened in November 1970. According to Tomkins, most of the information about E.A.T.'s plans received by Pepsi was judiciously mediated through Thomas, while Klüver made full use of the corporation's funding, with E.A.T. personnel making over one hundred trips to Japan and E.A.T. setting up shop in new premises on Park Avenue (128–129). Pepsi, for its part, was more interested in gaining a foothold in the Japanese market than in what form its expo presence would take, and it secured its site before having much of an idea what would go inside. No doubt Pepsi's resolute pursuit of the youth market—the "Pepsi generation" campaign had been running since the early 1960s but the drink was still being outsold by Coca Cola eight-to-one—influenced the company's willingness to take on the artists, but E.A.T.'s endless experimentation and undetermined end product, not to mention the rising cost, eventually proved too much for the company.

Aside from 9 Evenings, the Osaka pavilion at Expo '70 was the most ambitious project E.A.T. had undertaken, and Klüver had high hopes that it would serve to launch his organization on a new phase of ambitious, socially conscious activities "outside art." The withdrawal of Pepsi's financial support and the outstanding costs E.A.T. still had to pay all but put an end to such plans. The defeat, however, did not stop Klüver from shaping the pavilion project into a compelling narrative of organizational experiment through the 1972 publication of a detailed book edited by himself, E.A.T. newsletter editor Julie Martin, and art critic Barbara Rose (Klüver, Martin, and Rose 1972). Titled *Pavilion*, the book included a section on "hardware," with accounts by artists and engineers on the innovations they developed during the process, a detailed exploration of the planned "Live Programming," along with proposals received from an impressive array of composers and musicians—including Allan Kaprow, Alvin Lucier, Pauline Oliveros and Lynn Lonidier, Terry Riley, and La Monte Young. Accompanied by a technical as well as an E.A.T. bibliography, extensive black-and-white photographs and a sequence of color plates, and fortified by three narrative accounts of every detail of the project from the perspective of a technology writer (Nilo Lindgren) and two art critics (Rose and Calvin Tomkins, whose *New Yorker* essay is reprinted in full), *Pavilion* is at once an archive of E.A.T.'s energy, ambition, and outlook, and an exhaustive prospectus. The book, it is fair to say, has one eye on posterity and the other on possible future sponsors. Most importantly, perhaps, the book delivers a sustained examination of Klüver's vision of E.A.T. as an experiment in organization, since the expo pavilion project relied on an extensive network of (mostly) willing collaborators working across disciplines, languages, and nations.

The fullest account of Klüver's collaborative ethos is Lindgren's essay, which opens by recognizing that there is little original about the component parts of the pavilion; what is "new and impressive," though, he claims, and what makes the work significant, is the "in-depth" and "invisible" collaboration "of men and women from so many different professions, trades, and cultural backgrounds" (Lindgren 1972, 3). Although things did not go smoothly, he admits, it was the "*process* by which the Pavilion was realized" that was the "key ingredient" (3, original emphasis). The purpose of Lindgren's narrative, and indeed of the book as a whole, is to provide evidence of how a collaborative project works by detailing the practical, theoretical, and interpersonal negotiations underwent in order to complete the project. Much as Klüver had stressed from the outset, the real experiment in bringing art and technology together was organizational. The stress E.A.T. placed on open-ended inquiry meant that there was little in the way of a defined outcome, and every aspect of the project, including the delegation of tasks and the relation between individual expertise and interests and group objectives, had to be worked out collectively.

Getting artists and engineers to work together posed its own challenges, but Lindgren's initial discussion of collaboration focuses on the ostensibly more straightforward task of facilitating collaboration among artists. In the first meetings between the lead artists on the expo project, Klüver's organizational strategy was to employ the Delphi method developed at RAND by Olaf Helmer, Norman Dalkey, and Nicholas Rescher. The purpose of the Delphi method is to generate pathways toward unknowable outcomes by soliciting the judgment of an assortment of experts, which is then circulated and modified through what Dalkey called "iteration with controlled feedback" (Dalkey 1969, 15). In the context of the E.A.T. project, Klüver tasked the artists to concentrate on the design of the whole pavilion rather than their preferred approach, which was to each concentrate on their own area. The intention, Lindgren explains, was to "enrich the possibilities in the final convergence" (1972, 16). However, the Delphi method ("an ancient method for modern consensus" is how Lindgren subtitles this section of his account) did not work very well, according to Lindgren, in part because it rubbed hard against "our modern artistic traditions in the West" (17), which privilege the unique contribution of the individual rather than the routinely critiqued collective effort. Exposing artists to RAND-style groupthink challenged, in Lindgren's account, some deeply held notions about artistic labor and resulted in some revealing strategies for protecting professional integrity. The best and most inventive ideas an artist might produce could easily be dismissed or compromised by others, so it might be best to hold back and offer less good ideas in order to maximize the chance of the best work being accepted. This self-interested strategizing, though Lindgren does not say so, sounds like a version of the prisoner's dilemma, that other RAND-generated theory of decision-making, but what it reveals decisively for

Lindgren is that "collaboration between artists is a direct attack on tradition" (17). It is here, we are asked to consider, rather than in what the project finally produces, that the key to E.A.T.'s radicalism is situated. "For those who are on the threshold of such a culture change," writes Lindgren, "there is also the anxiety connected with a sweeping aside of established ground. To a certain extent, one is left floating anxiously" (17).

The assault on individual authorship, in Lindgren's telling, is more than a local organizational strategy and part of a broader reorientation of the culture away from individual self-interest and toward collective problem-solving. The Delphi method may not have been very effective at yielding results, but as a means of exposing the conventional thinking of the participants it appeared to work very well. As such, by peeling back the protective skin insulating the traditional notions of creativity and ownership harbored by the artists, Klüver, in Lindgren's terms, was able to sweep away hidebound expectations and open up a less comfortable—but presumably, as a consequence, more dynamic—imaginative space for collective practice.

The experimental dimension of Klüver's organizational strategies comes across in Lindgren's, at times, almost sociological or anthropological tone, as if he is reporting the results of a field observation. "In talking with the artists," he writes, "it becomes obvious that each in his own way was struggling to wrap his own conceptions around what was already given, or supposedly given. Following this process, we get insights into how these artists thought of themselves and of their functions" (Lindgren 1972, 17). Certainly, the focus of the account positions the development of the pavilion as a test case for Klüver's E.A.T. experimental R&D ambitions. After a few weeks of discussion, Lindgren writes, something begins to happen: the participants discover "how to work with one another" (19). At this point, when it seems that "perhaps the Delphi Method worked better" than Klüver initially thought, he introduces "a new ingredient" (19) in the form of architect John Pearce, who soon concludes that the artists have achieved nothing since they "didn't even seem to realize they were really building a building" (Pearce, quoted in Lindgren 1972, 19).

Klüver emerges from the narrative as a mixture of social engineer and project manager, at once impatient that progress is not being made while encouraging, and even adding new elements to, a swirl of open-ended dialog. The work does eventually begin to cohere, however, and Lindgren claims that by "thrashing out their ideas, the artists became increasingly committed to true, noncompetitive collaboration, discarding ideas, triggering new ideas in each other, and acting as catalysts for each other" (20). As they learn to adapt to the new working conditions, "the artists began to feel that they were onto a beautiful thing" (21), and Pearce, while keeping his involvement "relaxed," acted as a kind of reality check by assessing design features for architectural plausibility and managing the schedule. Though the Japanese were expecting delivery of a completed project, the expo pavilion was, writes Lindgren, "simultaneously a research project, a development project, and a construction project" (22), the outcome of which would not be fully known until it was finished.

From a collaborative point of view, the pavilion at Expo '70 yielded mixed results. Two of the main aspects of the design, a large inflatable mirror and a fog sculpture, were effectively delivered through the successful collaboration among a range of artists, scientists, and engineers able to resolve a number of logistical and aesthetic issues. Composer David Tudor (on the Black Mountain faculty from 1951 to 1953) and musician Gordon Mumma's plans for creating a distinctive sound environment for the pavilion, however, fared less well, with the engineer charged with facilitating the complex plans, Bell Labs' Larry Owens, having to make a series of what, to Tudor, were unacceptable compromises regarding Tudor's design in order for it to work on budget and on schedule. Owens found it a "real learning process," according to Lindgren. What Owens learned was that artists did not want to make up their minds months in advance, even though the use of technology might require such decisions to be made (57). He also learned that, when working with artists, "you are not making decisions based on facts. Sometimes you are making decisions based on the absence of facts!" (57). Faced with this situation, the engineer has "to invent facts, make a decision, implement the decision, and then come back to the artist and say 'Is this what you meant?'" (58). Owens concluded that artists did not know what engineering was, while Tudor, for his part, found the engineering solution to problems unable to accommodate nonengineering interventions, which were considered "meddling" (58). Smoothing things over, Lindgren remarks that "one should not lose sight of the fact that this was an ongoing experiment in a process that is attempting to bring together long-separated areas of endeavor" (59). He also, importantly, recognizes that the pavilion was more than a collaboration between artists and engineers, but also demanded collaboration between an art-and-tech group and a corporation, and between the US-based E.A.T. and Pepsi and Japanese business, art, and industry. Scaling up in this way illustrates for Lindgren not only the possibilities implicit in E.A.T.'s attempt to yoke together art and tech research, but also reveals the complexity of negotiating not only across disciplines but across sectors, nations, languages, and economic and cultural differences. From this perspective, the problems, mishaps, and deflated expectations appear minor setbacks in such an ambitious experiment in restructuring the way creative thinking-as-doing happens.

Calvin Tomkins notes that some of Klüver's art-world friends had urged him not to get involved with Pepsi, which, Tomkins observes skeptically, "they somehow seemed to regard as part of the military-industrial complex" (1972, 111). Though there is certainly an element of paranoid countercultural suspicion in such warnings, it was, after all, Pepsi-Cola that Nixon invited Khrushchev to drink at the first American trade exhibition ever held in the Soviet Union in 1959, and the scene of the famous "kitchen debate," a publicity coup engineered by the company's international head, Donald Kendall. However, E.A.T. had very little to say about politics, American foreign policy, or the Cold War in general. Whether or not this was a strategic decision intended to keep the lines of communication clear between E.A.T. and potential sponsors or a function of a deeper acceptance of the post-ideological rhetoric of American consensus culture is hard to say. Even in Barbara Rose's art historical contextualization of E.A.T. in *Pavilion*, a survey that sought to position E.A.T. as the inheritor of centuries of art and technology collaboration in the public interest that reaches back to antiquity, there was a resolute avoidance of the political ramifications of art or technology (Rose 1972). Noting the divorce of art and life brought about by industrial modernity and the rise of social fragmentation and disciplinary specialization, Rose had remarkably little to say of the political struggles driving the dissenters she named, from Mary Shelley, William Morris, and John Ruskin through the Futurists, Constructivists, Dadaists and Surrealists. The line Rose traced from the historical avant-garde through the Bauhaus, Black Mountain, and on to Kaprow and Cage is clear and accurate yet devoid of the strife and conflict that might render the narrative meaningful. Instead, Rose's art history, like Alfred Barr's torpedo diagram, implied the structural necessity of the present delivering an achieved synthesis of what has come before, in this case, "a new system of values" (61), embodied by E.A.T.'s collaborative process, based on "social interaction, control of technology toward fulfilling human needs, respect for the natural environment and its potentials and limitations, and a belief in the ability of individuals to take responsibility in democratic, noncoercive, nonhierarchical situations" (61).

By now we should be able to recognize this as art-and-technology boilerplate, and though Rose was right to note E.A.T.'s internationalism—in contrast to "the growing chauvinism of the New York School" (96)—its untypical willingness to employ women in "high-level positions" (98), and its ability to introduce the "values and goals" of art to executives, technicians and scientists (98), it must have been hard for many to see the PepsiCo pavilion, as Rose did, as the "realization of the vision of generations of modern artists" (98). The grand claims Rose made for the pavilion—for instance, that the mirrored dome is the modern equivalent of one of the ancient Seven Wonders—are underpinned, as they often were in Klüver's own purple passages, by a sense that the American present represents a historic turning point. "The collaborative process by which the Pavilion was realized," she wrote, "was a specifically American experiment in democratic interchange. The process by which it was created . . . , of people taking responsibility without an authoritarian chain of command, acting within the area of their own competence as the need arose, learning new techniques of communicating with each other and with members of a culture vastly different from their own, may be a model for social interaction" (102). Rose insisted that the pavilion was designed for social and aesthetic, rather than commercial, purposes, and, in confident consensus fashion, that the participating artists and engineers "served no given political ideology" (99). For these reasons, the result should not be seen as a "simple 'bread and circuses' experience for a passive, bored public" (99). Instead, Rose insisted, the pavilion is a work of art that "makes an important statement about the future of society as a cooperative enterprise" (99). Forget Pepsi-Cola and the Cold War, the pavilion is utopia in action, part of "the tradition of the *Gesamtkunstwerk* or Total work of art" that will in the future be recognized as "the American equivalent of Tatlin's Monument to the Third International, the great ambitious project, which met with similar hostility and misunderstanding" (101). The pavilion, for Rose, therefore stands as a compromised but heroically utopian monument to "values American society and the corporate structure that manages it are as unwilling to embrace as the bureaucrats who brought Tatlin's project to a halt were unable to understand his meaning" (101).

It is a wonderful piece of temporal legerdemain to position the PepsiCo pavilion proleptically as the Tatlin *Monument* of the future, and Rose did an effective job situating the structure, which was even then "a gradually deteriorating wreck on a desolate ruin outside of Osaka, Japan" (102), as tragic evidence of a utopian vision too virtuous to withstand the indifference of the instrumentalized society into which it was placed. The pavilion may not have turned out to be, she wrote, the "monument to American enterprise and advertising the Pepsi-Cola company bargained for," but the attempt here to position the corporation as the author of the pavilion's ruin overlooks the fact that without Pepsi funding there would be no ruin at all. Klüver's insistence that the pavilion was a work of art, a claim he did not make at the outset but increasingly pursued as the project unraveled, is an attempt to save the reputation of the Osaka project from the compromises enforced upon it by its sponsors. As a work of art, Pepsi's rejigged promotional program becomes more than a commercial enterprise salvaging something from its investment and starts to look like philistine desecration. On this point, Tomkins is more proportionate in his assessment of Pepsi's position, which he explains in terms of a mixture of concerns regarding finance and public relations. PepsiCo was only willing to spend so much and bend so far in terms of what it thought its audience would accept. In each case, the corporation decided E.A.T. had overreached.

Given that, according to Tomkins's account, the entire enterprise hinged on keeping Pepsi, with the willing involvement of insider David Thomas as go-between, at arm's length, it is remarkable that the pavilion ever got built at all. It is convenient, after the fact, to position PepsiCo as the shortsighted commercial interest resisting the "new system of values" Rose imagined the pavilion represented, but, aside from the warnings Tomkins claimed Klüver received about getting into bed with corporations, there is little sense that Klüver or others gave much thought to the implications of working on a project that would be meaningless to its sponsor if it was not promoting Pepsi-Cola and the broader values of American capitalism the company represented.

In her essay, Rose dismissed the pessimism of critics of technology like Jacques Ellul and the "nihilism" of Conceptual Art in favor of the optimism of Cage, Fuller, and McLuhan. In the face of an institutionalized avant-garde and the "establishment of a world art market for rare decorative objects" that converts "risk or critique" into "commercial investments" (98), Rose's defense of E.A.T. ideals—"group effort, collaboration, integration of the various spheres of artistic and scientific thought, submersion of the individual ego in the service of a common goal, and art as an active agent of social change" (97)—powerfully captures the progressive legacy that the 1960s art-and-tech projects embodied. Yet the expo pavilion was not the outcome of a Works Progress Administration project; it was (albeit by default) the winning bid in a corporate sponsorship deal. As such, the maneuvers that made the Expo '70 Pavilion possible reveal the fundamental disjunction between projects like E.A.T. and the corporate world they sought to win over. If Tomkins is right, the only time E.A.T. received serious money for a project, it was by accident.

E.A.T. outside Art

While the Expo '70 pavilion survived, the compromised E.A.T. project did little to enhance the organization's fortunes. It did, however, lead E.A.T. to explore bold non-art avenues, under the banner Projects Outside Art, in areas such as education and the environment, and in the developing world, though proper funding was never forthcoming.

Projects Outside Art developed some fairly modest projects, such as Children and Communication, which introduced children to communications technology; City Agriculture, featuring a hydroponic roof garden at E.A.T. HQ; and Recreation and Play, a Los Angeles-based investigation. A symposium and instructional exhibition were held at the AFAE's Automation House in New York. With funds from the John D. Rockefeller Foundation, E.A.T. organized a cultural exchange called American Artists in India during 1970 and 1971, which allowed artists to travel and work for a month. Participants included dancers and choreographers (Trisha Brown, Steve Paxton, Yvonne Rainer), composers (Lowell Cross, Terry Riley, La Monte Young) and visual artists (Jared Bark, Jeffrey Lew, Kate Redicker, Marian Zazeela).

More ambitious was a plan to broadcast Indian-made educational television programming to rural India by satellite, a project developed in 1969 by Klüver, Robert Whitman, and Vikram Sarabhai of the Nehru Foundation for Development (Delhi, India). In December of that year, the group traveled to the Anand Dairy Cooperative and set up educational assistance programs for female dairy farmers. The Nehru Foundation and E.A.T. proposed using half-inch video equipment to collect on-site visuals to be shown in educational television shows. In 1971, another E.A.T. telecommunications system (Telex: Q&A) was set up in Stockholm at an exhibition themed around the Paris Commune called *Utopier et Visioner 1871–1981.* Teleprinters connected New York City, Stockholm, Ahmedabad, and Tokyo and participants in each city were asked to comment on what they thought the world in 1981 would be like. Also in 1971, E.A.T. worked with Bell Labs psychologists to conduct comparative studies on advanced technologies used in statistical analysis, a project called Multi-Dimensional Scaling, and coordinated the cable broadcast of artists' videos in New York. Further explorations of possible satellite television projects during the early 1970s, with the El Salvador education department and with the United Nations, and a Klüver design for a giant-screen video projection system for the facade of the Centre Georges Pompidou in Paris, remained at the design stage.

For all the optimism about new modes of creativity being generated through a collaboration between artists and engineers, Klüver's model remained an individualistic one: the lone inventor and the solitary artist rather than the emerging mega-teams running Big Science projects. The Bell Labs Murray Park notion of the industrial lab as campus masked the increasingly managerial and hierarchical aspect of Cold War scientific and technological research. The popularity among American artists for new materials and processes rarely developed beyond innovative ways of fabricating objects, and the performative, improvisational, and politically radical directions of the Fluxus-oriented wing of the New York art world had little interest in support from corporate sponsors. The bigger, often unrealized or incomplete E.A.T. projects geared, in keeping with Great Society ambitions, to social issues tended to move away from the emphasis on art as such and toward a more sociological intervention that they were nevertheless financially and organizationally ill-equipped to support. In one way, Klüver's conception of an expanded E.A.T. shares Black Mountain's exploratory progressivism, yet Klüver's desire and need to court corporate sponsorship, not to mention his tendency, despite the rhetoric of collaboration, to elevate the status of the artist as creator, left E.A.T. awkwardly placed between the corporate administrative model and the patron-dependent entrepreneurial economy of the art world. The sharp decline in E.A.T. activity after 1971 was part of a broader shift in attitudes toward technology that, as will become abundantly clear in the context of LACMA's Art & Technology Program, effectively cut off the oxygen from art-and-tech collaborations.