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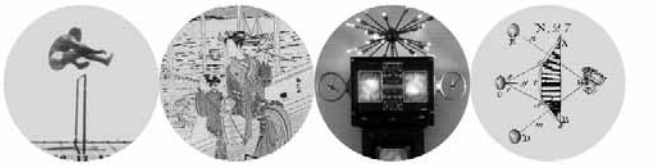

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Abstract
In the wake of the Second World War, John Cage, Robert Rauschenberg and other members of the New York art world helped transform popular understandings of what it might mean for human beings to work alongside information machines. This article shows how. Drawing on archival research, interviews and a survey of secondary sources, it follows Cage and Rauschenberg from Black Mountain College into their 1960s collaboration with engineers from Bell Laboratories in an organization called Experiments in Art and Technology (or E.A.T.). It then shows how, in 1970, at a Manhattan mansion packed with electronic media and christened 'Automation House', E.A.T. modeled a fusion of artistic collaboration and automated labor for the captains of American industry. In the process, the article concludes, E.A.T. helped set the stage for a re-imagining of computing in the workplace as a bohemian practice and of computers as tools for creative, peer-to-peer collaboration.

Keywords
art • automation • Billy Klüver • Experiments in Art and Technology • John Cage • Robert Rauschenberg

1952 was a watershed year in human–machine relations, though it has rarely been recognized as such. In the business world, 1952 was the year that corporate consultant John Diebold published his book *Automation* and introduced the title word into the public lexicon (Diebold, 1952; Ceruzzi, 1998: 32).[1] Communication and control technologies, he wrote, were transforming the world of labor. Increasingly, all could see that factories were not simply sites of manufacturing; they were 'systems' – recursive, self-

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monitoring ensembles of human and machine actors, working in concert toward the production of goods. Human and machine in turn resembled one another: both processed information, both performed work, and both were to be watched over by a hierarchy of executive experts. For Diebold, this resemblance promised greater efficiency in manufacturing but, for much of the public, it provoked a quiet terror. In Congressional hearings, in the smoking rooms of labor halls and in the pages of women's magazines, the automated factory soon became an emblem of a mechanistic, hierarchical society (Bix, 2000: 237–75). At the heart of that society lay the possibility of physical replacement and psychological fragmentation: computers would do the analytic work of all but the highest-level managers and what managers were left would become ever-more machine-like in the way they did their jobs. The factory itself would become a shell, hollowed of meaning, and machine-based labor – especially *information*-machine-based labor – would dehumanize all those who undertook it.

Yet, even as pundits and labor leaders were decrying the potential consequences of automation, a series of avant-garde artists were transforming the theories of subjectivity on which visions of the automated factory depended. 1952 was also the year that John Cage, Robert Rauschenberg and half a dozen compatriots at Black Mountain College staged what has since been recognized as the first Happening. What actually *happened* at the event remains in some dispute, but the usually reliable Calvin Tomkins has described a gathering in the Black Mountain dining room after dinner, during which Cage delivered a lecture from a ladder, Merce Cunningham danced through the audience trailed by a dog, David Tudor played the piano, Charles Olson and M.C. Richards read poetry, and movies and still photographs flickered across the surfaces of Rauschenberg's *White Paintings*. When the activity ended, the participants picked up a series of tea cups that had been set on clusters of chairs and walked away.

On the face of it, this evening would seem to have nothing to do with computers, automation and the factory floor. And, to date, scholars have in fact analyzed Happenings and the automation debates within two very separate fields: the history of art and the history of technology, respectively. Yet, in this case, the history of artistic practice and the history of the integration of computing into everyday life need to be seen as entwined. The automation debates and the Happening at Black Mountain grew out of a remarkably similar understanding of human subjectivity. Artists such as Cage and Rauschenberg each viewed themselves and their creations as elements in socio-technical production systems – systems that had to be automated to function properly. In the postwar years, these artists and others around them transformed the erasure of self, so feared by opponents of business automation, into the basis of a new form of artistic agency and a new, collaborative social style specifically opposed to the hierarchies of the automated factory – an agency and a style that I will call 'Romantic automatism'. Then, in a series of performances at the end of the 1960s, Cage, Rauschenberg and others presented this transformed subjectivity to the leaders of American industry and American labor – the same leaders who had

long debated the consequences of automation. In doing this, they offered those leaders a new ideological framework in which they could imagine themselves as creative agents and their factories not simply as sites of production, but as spaces for bohemian collaboration. In this way, Cage, Rauschenberg and others served as key intermediaries between the technical and artistic worlds, simultaneously embracing and rewriting the new forms of human–machine relations emerging around them.

The Automation Debates

As a material practice, postwar automation emerged as the product of extraordinary changes in the organization of manufacturing and in information technology. As Amy Bix (2000) has pointed out, wartime pressures on manufacturers to produce weapons and supplies led many to try to make labor-saving technological changes in their factories (pp. 237–8). These changes frequently involved replacing human beings with ensembles of machinery and control devices that, together, performed work with little or no direct human intervention. By the end of the war, business leaders had begun to imagine factories in which, as the editors of *Fortune* magazine put it, they would manage 'Machines without Men' (*Fortune*, November 1946: 165–6, 92–204). These new factories would not only cost less to run; they would also do for America's burgeoning consumer society what industry had recently done for its army. As manufacturers had lately outfitted the military with weapons for a war on fascism, so now they would equip consumers with new weapons in a war for personal satisfaction, leisure and self-fulfillment.

In the early 1950s, executives who had celebrated the automated factory encountered a new technology with which to control it: the computer. In the years just after the war, digital computers were little more than massive calculating devices (Ceruzzi, 1998: 1). The first had been developed during the war to help calculate firing tables for the US Army and most were still used for military purposes (p. 15; see also Yates, 1989, 2005). In 1951, UNIVAC shipped its first mainframe to the United States Census Bureau and computers began to enter the civilian workplace. Over the next five years, computers became ubiquitous features of a wide variety of industries, including life insurance, steel manufacturing, and electricity production (Ceruzzi, 1998: 28). By 1955, businesses were buying more than $6.5 *billion* worth of computer equipment (p. 57). In 1961, *The Nation* magazine reported that more than 10,000 computers had been installed in businesses that year alone (Buckingham, 1962: 10–11). By the mid-1960s, computers had replaced legions of typists and file clerks and had become the central processing agents for banks, airlines, and other firms whose livelihoods depended on keeping track of information (Ceruzzi, 1998: 47).

This first, massive wave of computerization coincided with a rise in unemployment in what was otherwise a booming economy. In the early 1950s, national rates of unemployment had hovered between 2 and 4 per cent; between 1957 and 1961, the national average rose to 5.8 per cent (Bix,

2000: 254).[2] In 1961, some 5.5 million people were out of work – more than at any time since before the war (p. 257). Yet, between 1949 and 1959, median family incomes had surged by 42.5 per cent (Levy, 1988: 47). According to many commentators, automation was to blame for this discrepancy. In a 1962 press conference, President John F. Kennedy made the point to the nation:

> The major domestic challenge of the Sixties is to maintain full employment at a time when automation is replacing men. It is a fact that we have to find over a ten-year period 25,000 new jobs every week to take care of those displaced by machines and those who are coming to the labor market. (quoted in Lee, 2004: 110)

While some analysts challenged Kennedy, arguing that in fact computers created jobs, much of the popular press agreed with the headline writers at *Newsweek* that Americans were living at a moment at which 'Machines Replace Men . . .' (*Newsweek*, 19 June 1961: 78–80).

Given the extraordinarily complex ways in which computers have since become integrated into everyday life, the claims that machines would take the place of human beings seem almost quaint. Yet, within them, we can glimpse a configuration of the relationship between human, machine and the idea of labor that carried a great deal of symbolic weight in the postwar years and that haunts discussions of digitized labor still. This configuration can be seen in its most garish form in Edmund C. Berkeley's 1949 bestseller, *Giant Brains, Or Machines That Think*. The book describes a series of calculating devices, ranging from punch card machines to the massive military computers of the Second World War. In each case, Berkeley aims to show that the machines are functionally much like human beings. To make his case, Berkeley (1949) describes an imaginary 'mechanical brain' that he calls 'Simon' (pp. 22–41). The machine looks vaguely humanoid – it consists of a box with two slots on top (which Berkeley calls 'ears'), two light bulbs in front ('eyes'), and pieces of punched paper carrying information that will be fed through Simon's ear-slots into the realm of calculation, reason and memory inside the box. When Simon has worked through the answers to problems posed to him on the tapes, his light-bulb eyes 'wink answers' to his interrogators (p. 23).

From the point of view of human–machine labor, Simon is a threat: because the machine fundamentally resembles a human being, Berkeley suggests, it can replace human actors in a variety of settings. The fear of such replacement cycled through the popular press across the 1950s and well into the 1960s, and soon became attached to digital computers. In its earliest incarnations, the notion of a human-like machine conjured up images of mechanical, goose-stepping Nazis and fears that, in the Cold War, Americans might adopt their former enemy's unthinking ways. As Berkeley pointed out, by 1949 the military was using computers to manage weapons systems and plan for nuclear conflict. Perhaps, he implied, our machines might take us over, might make our leaders into proto-fascists, and our people into slaves.

These fears lingered well into the 1960s. And as they did, they migrated, finding a new home in the economic landscape. For many, the same automated factories that promised to dispense consumer goods in untold abundance threatened to drive men from the factory floor and into lives of lassitude at home. If the robots of the factory were to be *Übermenschen*, the men they replaced would find themselves defeated, emasculated, and sent humbly home. By 1963, as unemployment rose across the country, *McCall's* magazine was asking its largely female readership, 'When Will Your Husband Be Obsolete?' (Diebold and Cahn, 1963: 64, quoted in Bix, 2000: 262).

Throughout the 1950s and into the 1960s, Berkeley's vision of a world ruled by giant electro-mechanical brains dominated press reports and Congressional hearings alike. Historian Paul Edwards (1996) has described this vision as a feature of 'cyborg discourse' – a reading of the human mind as an information processor that pervaded the social and psychological sciences and popular press throughout the Cold War (p. xiii, 147–73). As Edwards has shown, cyborg discourse grew out of MIT mathematician Norbert Wiener's cybernetics (1950: 179–90). Only four years before John Diebold published *Automation*, Wiener had published his own *Cybernetics, Or, Control and Communication in the Animal and the Machine*. In that volume, and in a very popular 1950 follow-up entitled *The Human Use of Human Beings*, Wiener suggested that at heart, individual men, machines, animals, and even society as a whole, could be thought of as information systems.[3] Though they might appear to be singular in their ambitions and total in their self-control, human beings and the social and mechanical systems within which they lived were, in fact, probabilistic entities, whose behavior was shaped by the chances they encountered and by the ways in which their bodies, biological or electro-mechanical, allowed them to learn from those chances.

The intellectual roots of Wiener's cybernetics run far deeper than I can dig here, but for the purposes of making sense of the otherwise less-than-intuitive links between the automation debates and the art worlds of Rauschenberg and Cage, cybernetics' debt to physics is particularly important. In his preface to *The Human Use of Human Beings*, Wiener (1950) argued that 'at its core', cybernetics partook of the probabilistic worldview that overtook physics around the turn of the century (p. 12). If the Newtonian universe had seemed to run like clockwork, the 20th-century world hovered on the edge of chaos. For several decades now, he wrote, human beings had known that they lived in a 'probabilistic universe', one in which 'chance has been admitted, not merely as a mathematical tool for physics, but as part of its warp and weft' (p. 11). For Wiener, as for other Americans in the postwar years, chance was more than a physical property; it was also a symbol of the psychological and social suffering wrought by the war. Moreover, the forces of chance could be found swirling equally within the psyche of the individual, the natural environment, and the social universe. As Wiener put it: 'This recognition of an element of incomplete determinism, almost an irrationality in the world is in a certain way parallel to Freud's admission of a deep irrational component in human conduct and

thought' (p. 11). Like many of his readers in the late 1940s, Wiener seemed to believe that irrationality had already broken through the social order to produce fascism and war; harnessed to the laws of physics and the atomic weapons programs of the Cold War, it threatened to break through yet again.

Thanks largely to Wiener, writers like Berkeley could see humans and information machines as functionally equivalent managers of otherwise chaotic, probabilistic systems. Information itself, as defined by Wiener's contemporaries Claude Shannon and Warren Weaver, was simply order amid random noise; to compute in the postwar era was in many ways to find and maintain order in an otherwise entropic world (Shannon and Weaver, 1949). At the same time though, in the Cold War context, the human struggle to contain the psychological and social forces of chaos threatened to turn humans into machines in their own right. On the battleground that was the automated factory, human beings might fall prey to the predations of mechanical others – machines possessed of a seeming fanaticism for order that conjured up the Nazi armies of propaganda. Managers in turn might become Dr. Strangeloves, fusing the control afforded by the new technologies with a deeply irrational love of power. Well into the 1960s, the automation debates left little room for compromise: when it came to machine-based labor, humans would become machine-like managers, or they would simply be replaced.

Romantic Automatism and Avant-Garde Art

During those same years, however, abstract expressionist painters, Black Mountain College students and faculty, and later, the makers of Happenings and new dances in lower Manhattan, were turning to forms of self-automation with an eye, early on, to liberating otherwise inaccessible parts of themselves, and later, to establishing explicitly democratic ensembles of people and things. In roughly the same years that the corporate world came to associate automation with bureaucracy and the erasure of individual agency, artists such as Jackson Pollock, John Cage and Robert Rauschenberg developed new, essentially Romantic varieties of automated experience. Within art historical accounts, Cage and Rauschenberg are often depicted as artists dedicated to overthrowing the solitary, emotive, and in that sense, Romantic sensibility of artists like Pollock and to replacing it with a focus on collectives, systems and group experience (Jones, 1993: 628–65; Roth, 1977: 46–53). While there is certainly a great deal of truth to this story, when it is set against the automation debates of the time and retold in light of the probabilistic worldview that underlay them, continuities also emerge. If the automation debates of the corporate world envisioned automation as an anti-human force, Pollock, Cage and Rauschenberg can be seen to have developed deeply congruent theories and practices of automation through which they reclaimed the probabilistic worldview developed in physics and the cybernetic parallel of machine to human as sources of, rather than threats to, individual and collective agency.

They could do so in part thanks to an earlier celebration of automatism in the arts. The history of artistic engagement with mechanism and automation is a long one and there is no room to trace it here; for the purpose of showing how artists later shifted public understandings of automation in the workplace, it is enough to note that abstract expressionism emerged during the Second World War as a number of American artists turned toward the automatism of the Surrealists (Belgrad, 1998: 35; Leja, 1993: 237; Ratcliff, 1996: 43–8). For the Surrealists, automatism had meant turning off the ego, turning away from other 'rational' guides, and thereby, allowing the truths of the Freudian unconscious to come to the fore. In his *Manifesto* of 1924, for instance, Andre Breton defined Surrealism as 'Psychic automatism in its pure state, by which one proposes to express . . . the actual functioning of thought. Dictated by thought, in the absence of any control exercised by reason, exempt from any aesthetic or moral concern' (Breton, 1993[1924]: 432).

For many painters in the 1940s and 1950s, and most publicly, for Jackson Pollock, automatism held a similar appeal. As Rosalind Krauss (1993) has shown, Pollock's encounter with automatist writing practices in the early 1940s dramatically shifted his sense of what the picture plane was for (pp. 281–3). From the Surrealists, Pollock learned that the picture plane could be a graphic representation of the artist's unconscious and that the brush, like the Surrealist's pen, could be a tool with which to dive into hidden regions of the mind. Yet, as Krauss has argued, Pollock never fully accepted the Surrealist notion that art resulted from an automated retrieval of otherwise hidden mental images. Rather, by 1951, when he was producing the drip paintings that made him an international icon, Pollock was telling art critic Robert Goodnough that his methods might 'be automatic at the start but that they quickly step beyond that, becoming concerned with deeper and more involved emotions' (Goodnough, 1951: 60, quoted in Karmel, 1999: 94). As Goodnough famously put it, Pollock's method was a sort of 'ritual dance' – back and forth across the canvas splayed on the floor, and by implication at least, back and forth between the material world of paint on canvas and the immaterial, flickering motions of the unconscious. To many outside the art world, Pollock's dance-like motions seemed to reveal the artist's strong-willed individuality and to demonstrate the power of self-automation as a form of psychic liberation. Paradoxically, by seeming to hold back his internal, rational mind and to allow his unconscious to act of its own accord, Pollock created himself as an anti-type of the mid-century corporate or military drone. He became a Free Man, in both the 19th-century Romantic sense of a man free to express the genius of his inner life, and in the 20th-century Cold War sense of a highly masculine, heterosexual icon of free speech (Guilbaut, 1983: 84–8; Leja, 1993: 276–83).

Pollock has of course been much criticized for his public image. But that criticism has made it harder to recognize the ways in which Pollock in fact joined the 19th-century Romantic ideal of the heroic artist to the understanding of the human mind as an information processor and, thus, as a force for managing an otherwise chaotic reality. As Daniel Belgrad (1998) has pointed out, in the work of many abstract expressionists, and particularly of

Figure 1 Jackson Pollock, 1950. Photograph by Hans Namuth. Courtesy Center for Creative Photography, University of Arizona. © 1991 Hans Namuth Estate.

Pollock, Surrealist automatism met the field theories of 20th-century physics. 'In classical (Newtonian) physics, an electromagnetic field was defined as an arrangement of discrete, electrically charged particles,' writes Belgrad. 'But modern (Einsteinian) physics inverted this concept, defining "particles" themselves as stable patterns of electromagnetic waves' (p. 120). Thanks to Einstein, objects could no longer be thought of as immobile artifacts to be depicted; rather, they had become 'events constituted by a field of energy in

space-time'. In 1947, as he turned away from the pursuit of recognizable images in his work and toward the drip paintings, Pollock likewise left behind the world of objects and entered a world of events. If the 19th-century Romantic artist stood alone, a singular mind unique in nature (and alone in his studio), the self-consciously heroic Pollock revealed himself to be enmeshed in the probabilistic systems of the psychological and material worlds.[4] Through his drip paintings, viewers could glimpse not only the apparently masculine, Romantic chaos inside Pollock's own being, but the messy fields of energy, mass and interaction that characterized both the natural world, and perhaps, in the atomic era, the human world as well. As Pollock himself put it in 1950, his paintings aimed to offer 'not an illustration' of the 'Experience of our age', but rather, '*the equivalent*' of that experience (Leja, 1993: 43, original emphasis).

In that sense, Pollock reinterpreted the probabilistic physics that underlay Cold War cyborg discourse in light of an artistic tradition in which the automation of work practices was thought to lead to greater self-understanding and more original art work. Like Berkeley's Simon, Pollock the artist became a boundary creature, caught between the black-box darkness of his own psyche and the spinning, tumbling jumbles of information and noise, order and entropy, that were the postwar social and natural worlds. Yet he was never mechanical; on the contrary, with his swooping, muscular gestures, he acted out the archetype of Romantic creativity. This fusion of the Romantic artist and the cyborg in turn helped define a form of agency-in-relation-to-system that John Cage would substantially extend. Caroline Jones (1993) has persuasively argued that the abstract expressionist painters were deeply preoccupied with their individual subjectivities and with establishing reputations as individual geniuses (pp. 640–1). By contrast, she suggests, particularly in his early work, Cage sought to burn the 'effigy of the Individual Ego' by turning toward new technologies for the production of music and new, collaborative modes of making it (p. 368). By the mid-1960s, Cage himself had decried the Surrealism and Freudianism that preoccupied so many abstract expressionists. 'Automatic art, in fact, has never interested me,' he told Richard Kostelanetz, 'because it is a way of falling back, resting on one's memories and feelings subconsciously, is it not? And I have done my utmost to free people from that' (Kostelanetz, 1988: 173, quoted in Joseph, 2003: 273).

Despite the many ways he distanced himself from Surrealist automatism and its abstract expressionist legacy though, Cage in fact did a great deal to automate his art and to expand the probabilistic field made visible on canvas by painters like Pollock. When Cage built his now legendary 'prepared piano' at the Cornish School in 1940, he in effect automated an aspect of his performance. By jamming screws and bits of weather stripping and felt between the strings, he turned the control of part of his performance over to a device that would behave, in part in response to his own actions at the keyboard, and in part in response to the laws of physics governing the interaction of strings, screws and felt. Much like Pollock and other abstract expressionists, Cage distributed his agency, locating it somewhere between

the free-standing agency of the 19th-century painter in his studio and the probabilistic systems described by 20th-century physics and cybernetics.

In one sense, Cage clearly broke with Pollock and painters like him: he did not see the probabilistic systems on which his music depended as synecdoches for his own, individual psyche. In another sense though, like Pollock, he did view his individual experience, that of the audience, and even the natural world itself, as a series of interlocking probabilistic systems, whose workings could be revealed and appreciated when the artist ceded some of his autonomy to communication technologies such as the prepared piano (Tomkins, 1980: 69). From this point of view, Cage stretched the boundaries of the probabilistic field opened up by Pollock and others, even as he rejected their preoccupation with the heroic individual. For Pollock, the automation of elements of the artistic process revealed the congruence of the inner struggles of the self and the outer struggles of the probabilistic universe – struggles with a deep resonance in Cold War America. For Cage, the programming of a piano transformed not a single object such as a painting, but a whole room, filled with dancers, audience members, chairs, walls and windows into a probabilistic universe of its own, available to experience for audience and performer alike.

Over the next 20 years, Cage turned to a variety of algorithmic strategies and tools – including charts, sound databases, and the *I Ching* – and to a series of mystical doctrines – Zen Buddhism, the writings of Meister Eckhart, Ananda Coomeraswamy, Aldous Huxley, Huang Po, and Lao Tze among them (Pritchett, 1993: 29–56). Each of these turns would lead to performances within which the artist (Cage) labored among algorithmic technologies for purposes of revealing the probabilistic nature of existence and rightness of the human being's place *within*, rather than astride, that nature. Even though Cage criticized abstract expressionist attention to the individual psyche, he also extended the abstract expressionist preoccupation with the self-in-relation-to-the-psychic-and-material-field. For Cage, the work of becoming, the work of action, was not only the work of art, but the work of daily life. By turning some portion of his artistic process over to deperson-alized, algorithmic systems and devices, and in that sense, automating his work, Cage expanded the arena of action and probability; his performances no longer pointed to invisible laws, but embodied them.

In practical terms, this expansion provided a rich theoretical grounding for artistic collaboration. In the spring of 1951, Cage met Robert Rauschenberg at the Betty Parsons Gallery in New York (Tomkins, 1980: 67). Since being discharged from the Navy in 1946, Rauschenberg had been pursuing an education in painting. In 1948, he sought out Joseph Albers at Black Mountain College, a painting teacher whom *Time* magazine had called 'the greatest disciplinarian in the United States' (quoted in Tomkins, 1965: 198). For Albers, Rauschenberg later remembered, the goal of painting was to express one's own taste in the choice of materials and thereby, to 'make order' (p. 199). 'As for me', he explained, 'I consider myself successful only when I do something that resembles the lack of order I sense.'

Rauschenberg, like Cage, saw the artist not as someone who might impose his will on a recalcitrant material reality, but rather as one whose job it was to reveal the disorder at the heart of that reality. In 1966, Rauschenberg went on to disavow any allegiance to the Surrealist automatism or Freudianism of painters like Pollock as well (Joseph, 2003: 273). 'I don't mess around with my subconscious,' he explained. 'I try to keep wide-awake' (Seckler, 1966: 76, quoted in Joseph, 2003: 273).

That said though, Rauschenberg, like Cage, was also fascinated with the notion of distributing agency in the production of his art to mechanical and inanimate objects. In the fall of 1951, Cage and Rauschenberg created a 22-ft print, as Calvin Tomkins (1980) put it, 'by automation' (p. 67). Together they spread ink on a slab of Manhattan pavement; with Rauschenberg pointing the way, Cage then drove his Model A Ford through the ink and over 20 sheets of paper. The following summer saw Cage and Rauschenberg together at Black Mountain College. Rauschenberg had completed his *White Paintings* less than a year before; in these paintings, Cage recognized a version of his own aims. Much as he had turned to algorithmic work practices in order to place his audiences more self-consciously within the systems that he believed constituted the natural world, so too had Rauschenberg created paintings that did not simply stand in for the probabilistic systems around him (as many thought, say, Pollock's had) but that brought those systems to life. As Cage himself would later suggest, to view the *White Paintings* was to become a part of the interplay of light and shadow, to be oneself and part of the physics of the everyday simultaneously (Cage, 1973: 102).

As Cage later told Richard Kostelanetz, the *White Paintings* helped inspire him to create his now-infamous *4'33''* (Joseph, 2000: 104). For Cage, the absence of music 'played' by a musician functioned like the whiteness of Rauschenberg's canvases: both provided framing devices within which the random elements of the material world might be revealed. In the process, they shifted the location of artistic agency, though they did not make it any less heroic. Cage and Rauschenberg no longer claimed sole authority over their works, but rather, like cyborgs, shared that authority with devices, systems, and the probabilistic physical world. Even so, they remained powerfully, and Romantically, attached to that world. If the artist no longer stood above nature, transforming it into paint and sound, he was no less heroic for asserting his place at the governing intersection of natural, social and artistic systems.

He was, however, more playful and more democratic. In 1952, when they gathered in the dining room at Black Mountain, the makers of the first Happening cleared the way for ever-more performative and egalitarian modes of art (Joseph, 2003: 22). Within a decade, the Happening, and associated forms of theater and dance, would flourish around the globe. But from the point of view of the integration of information technology into cultural life, Cage, Rauschenberg and their compatriots had also accomplished an important turn-around. Far from the confines of the computerized factory, and well outside the everyday life of the corporate world, they had

dramatically widened the probabilistic field revealed in the paintings of Jackson Pollock, and greatly increased the range of devices and situations to which a creative individual might cede his or her agency. If the probabilistic world was chaotic and terrifying, the examples of the Black Mountain artists demonstrated that one need not react to either that world or its machines with an excess of control. To embrace the world as it was, one need not become mechanical – on the contrary, one could join one's friends in a collaborative, even Bohemian, form of artistic labor. As the unemployment crisis of the early 1960s kicked in, that transformation would become an exemplary conceptual resource for corporate executives and labor leaders alike.

Back to the Factory: Experiments in Art and Technology

To see how, we need to leap for the moment over the late 1950s and go directly to Manhattan's 69th Regiment Armory on the evening of 14 October 1966 for *Open Score*, Robert Rauschenberg's contribution to *9 Evenings: Theatre and Engineering*. There, more than a dozen engineers from Bell Telephone Laboratories, dressed in crisp white shirts and neatly pressed ties, hovered around the control boards and tangled cables of a wireless radio system. On a huge tennis court laid out on the Armory floor in front of them, painter Frank Stella and tennis pro Mimi Kanarek, each dressed in proper whites, batted a tennis ball back and forth. Each time the ball hit a racket, a sound somewhere between a 'bong' and a 'thwack' echoed through the hall and an overhead light turned itself off. After a while, the room went completely dark and, when it did, luminous screens came on overhead, showing infrared images of crowds milling down below, all seemingly blonde and dressed in white, while above them, disembodied voices repeated various names.[5] These images and sounds in turn gave way to a distant keening, and Robert Rauschenberg walked out from the wings, picked up a bundle wrapped in white, and carried it to another place on the Armory floor. The Armory was silent and dark. When the lights came back up, some 1500 spectators, among them New York's Senator, Jacob Javits, much of the Manhattan art world, and any number of gentlemen in fine suits and ladies in glittering evening gowns, gave an extended ovation (Goodyear, 2002: 197–203; Klüver and Martin, 1966; Loewen, 1975: 75–87; Martin, 2007).

Over the years, *9 Evenings* has been hailed as a turning point in the development of multimedia art and in the massive migration of technology and industrial work processes into art that took place in the 1960s (Dyson, 2006; Wardrip-Fruin and Montfort, 2003: 211–12;). Yet, it also marked an important site at which the rewriting of cyborg discourse that had gone on in the art world for two decades began to be visible, and conceivably, legitimate, in the corporate and engineering worlds. *Open Score* was one of ten pieces created by as many artists, including John Cage, pianist David Tudor, and dancers Yvonne Rainer and Alex Hay, and performed over nine nights. In making and peforming their pieces, the artists collaborated with some 30

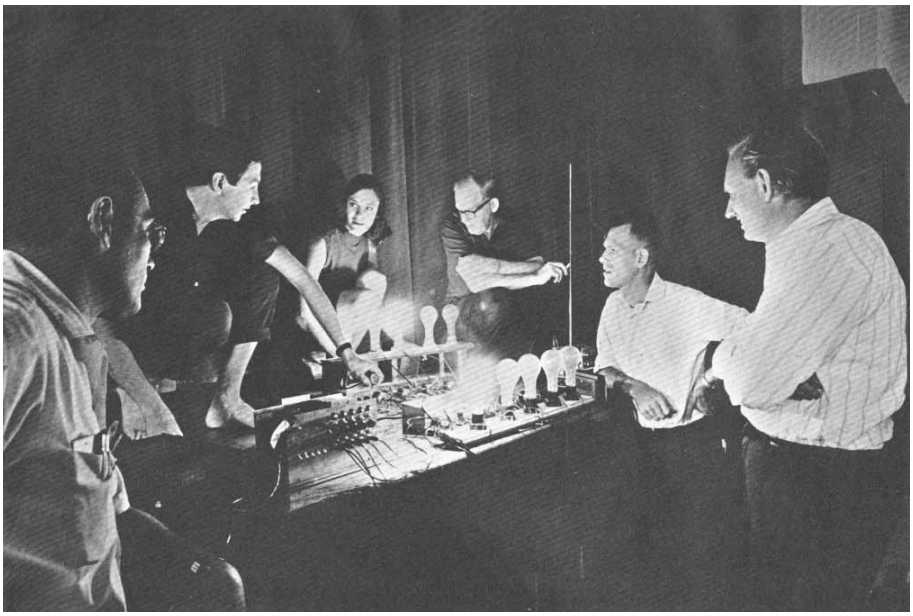

Figure 2 Herb Schneider, Robert Rauschenberg, Lucinda Childs, L.J. Robinson, Per Biorn, and Billy Klüver, during rehearsals for *9 Evenings*. Photographer unknown. Courtesy of Experiments in Art and Technology. All rights reserved.

engineers recruited by Bell Labs engineer Billy Klüver. Each of the performances, like *Open Score*, presented ensembles of humans and communication technologies, working together in such a way that both human and machine served as information processors. In his 'Grass Field', for instance, microphones and electrodes attached to various parts of his body relayed Alex Hay's heartbeat and other noises to an Armory-filling sound system. As he walked, his body movements became electronic signals and those signals in turn became a sound environment in which he moved. In Cage's *Variations VII*, sounds poured into the Armory over telephone lines as Cage, Tudor and a team of musicians scrambled to mix them. In one performance, Billy Klüver encouraged audience members to get up and move freely around the Armory floor. Slowly, the Armory became a huge, electrified variation on the room in which Cage had once played his prepared piano: once again, having turned his agency in part over to semi-automated devices, he had made audible the probabilistic universe of everyday life and invited his audience to experience it for themselves.

In this sense, when Rauschenberg, Klüver, Cage and the other artists and engineers of *9 Evenings* took the Armory stage in 1966, they committed an extraordinary act of cultural brokerage. In their performances, they fused the Romantic automatism of the art world with the engineering practices and the sorts of communication and control practices on which the automated factory depended. They did not use computers, which were still far too bulky for theater, yet the performances had everything to do with the cyborg

discourse still swirling around computing machines. As Klüver had told an audience earlier that year, the computer remained 'the great initiator of all this technological soul searching' (Klüver, 1966, quoted in Loewen, 1975: 45). For almost 20 years, newspapers and magazines had been filled with the suggestion that if humans admitted their fundamental likeness to information processors, if they turned over even a portion of their work to those machines, they would be deprived of their independence and exiled from the social world of the factory. But over the course of *9 Evenings*, some 10,000 audience members glimpsed a world in which artists shared their creative agency with an assortment of devices, procedures, programs and communities. Electronic signals penetrated and emanated from inanimate objects, electronic systems, and the human body alike. Over it all watched just the sort of industrial engineers whom the popular press had suggested might be replaced by, or might become ever more like, the machines they managed. Together, artists and engineers made visible a world in which giving some portion of one's autonomy over to electronic devices for communication and control resulted in the creation of new experiences – experiences not of humiliation and defeat, but of playful agency in and among probabilistic systems.

Audience members, many of whom might have expected *9 Evenings* to be more traditionally theatrical, were often confused by what they saw. Though audiences roundly applauded *Open Score*, other pieces were followed by smatterings of applause and silence. 'We made a lot of people awfully happy, but not the audience,' said Robert Rauschenberg (quoted in Tomkins, 1980: 248). Part of this response was clearly due to the perception that performances were clumsily executed, especially at the technical level. Expectations of technical control, however, may have been heightened by the cultural and social standing of the participants. By the mid-1960s, both the field of probabilistic play that had once been confined to the surface of the abstract expressionist painting, and the preoccupation with technology that had long concerned the corporate world, were beginning to meet one another in a wide variety of settings. In the early 1960s, inspired particularly by Cage, but also by Buckminster Fuller and Marshall McLuhan, artists and musicians had begun to create a cornucopia of technocentric theatrical events. On the West Coast, the beards and poetry of the Beat movement had given way to acid tests and the 1966 Trips Festival. In upstate New York, groups like the US Company blended mystical technology with then high-technology lighting and sound gear to pursue an egalitarian, tribal sense of togetherness (Turner, 2006: 48–51). In Manhattan, patrons of Happenings had begun to wander through three-dimensional theatrical environments and find themselves assaulted by flashes of light and amplified shouts of random words (Sontag, 1966: 263–74).

None of these settings, however, carried the cultural cachet of Robert Rauschenberg or Bell Telephone Laboratories. By 1966, Rauschenberg was no longer an unknown painter struggling to get by. In 1964, he had become the first American ever to win the grand prize for painting at the Venice Biennale; if not yet as famous as Pollock had been, he was well on his way

(Tomkins, 1965: 199). In 1962 he had begun working with Billy Klüver of Bell's Communications Research Department, to construct *Oracle*, a sound-emitting sculpture. By 1966, Klüver had been courting downtown New York artists for some time; by his own estimate, he had taken perhaps a hundred artists on tours of Bell Labs (Goodyear, 2002: 182). In technical circles, the Labs represented the epicenter of blue-sky research into new communication technologies. Its alumni even included Claude Shannon, the information theorist whose work underlay the development of digital computing and more than a little cybernetic theory. To the public, it represented the research wing of perhaps the single most ubiquitous and widely trusted communication network of the time: the telephone system.

In September 1966, as they were developing *9 Evenings*, Rauschenberg and Klüver began to turn the cultural legitimacy and social networks they were establishing into an institution, Experiments in Art and Technology (E.A.T.). That month, some 300 responded to their call for artists looking to work with engineers. Over the next several years, Rauschenberg, Klüver and a small staff would build a networking organization that, at its peak in 1968, would list about 3000 engineers and 3000 artists as participants (Tomkins, 1980: 251). In addition to helping pair more than 600 of these participants on individual projects, E.A.T. published a series of newsletters and Klüver himself traveled widely, promoting the notion of artist–engineer collaboration at universities, at corporations, and at the professional meetings of engineers. By 1969, E.A.T. had secured some 78 sponsors who had ponied up $1000 a year to receive the organization's publications and access to its membership (Klüver, 1969). These sponsors included a number of major American corporations that had been aggressively developing information technology, such as IBM and Xerox, or automating their production processes, such as oil industry giants Atlantic Richfield and Schlumberger. They also featured representatives from the unions who had most vocally opposed automation in the workplace in preceding years. These included the American Federation of Musicians (A.F.L.–C.I.O.), who had once established a fund for musicians put out of work by automated music players, the Transport Workers Union of America, and the International Association of Machinists and Aerospace Workers (A.F.L.–C.I.O.).

In 1967, a mutual friend introduced Klüver and Rauschenberg to Theodore Kheel, who had headed the National War Labor Board in the Second World War. Kheel had been an early, ardent proponent of collective bargaining and remained one of the nation's foremost labor mediators. For more than a decade, he had played a particularly important role in the automation debates. In 1962, together with labor leaders and executives from a number of industries, he created the American Foundation on Automation and Employment (A.F.A.E.). Over the next few years, the Foundation became an influential clearing house for ideas on how to solve the social and psychological challenges of automation. It promoted job training initiatives, studied the impact of computerization on middle management, and hosted a series of conferences at which managers and union officials could discuss the impact of computing and automation on labor.

In October 1967, Kheel helped Klüver and Rauschenberg stage a press conference to publicize E.A.T.'s role in promoting artists' collaborations with the scientific and industrial communities, and with labor. The speeches there suggest that E.A.T. offered both management and workers a way to re-imagine technocentric labor in terms set by the Romantic automatism of the art world. The conference was held at Robert Rauschenberg's loft. As reporters arrayed themselves in rows before the podium, they found themselves surrounded by fragments of technocentric art: floating metallic pillows made by Andy Warhol and Billy Klüver; a computer print-out of a nude woman made by L.D. Harmon and K.C. Knowlton; and Rauschenberg and Klüver's *Oracle* (Lieberman, 1967: 49). Speakers at the conference included New York Senator Jacob Javits, Ralph Gross (president of the Commerce and Industry Association), Herman Kenin (head of the A.F.L.–C.I.O.'s new Scientific, Professional and Cultural Employees Council) and Dr. Warren Brodey (a psychiatrist from MIT). Together, the speakers suggested that the fusion of the technological and the artistic would transform the workplace from a site of individual agency destroyed to one for the pursuit of holistic satisfaction. As the A.F.L.–C.I.O.'s Kenin explained, 'the members of A.F.L.– C.I.O. unions are concerned by the growing impersonalization of their work and by the frustrations they face in attempting to employ their knowledge and talents in making what they might consider a valid contribution to our civilization' (Kenin, 1967). In the collaborations of engineers and artists, Kenin and the other speakers thought they could glimpse a personalized alternative. Pointing to the 'computer-assisted factory' as an example, Warren Brodey (1967) told the assembled reporters:

> There is potential for living in a personalized environment if we merely can think our way out of the mass production mentality and into the immense choice and fun that industry's new talents and technology can make available . . . It is the artist who has the capacity to create this variability and to use and to make relevant what is outside the 'accepted systems'. He can point out relationships that were not seen before.

Even from this distance in time, we can hear in Brodey's remarks faint echoes of the upheavals of the 1960s. His calls for a 'personalized environment' in particular summon up the utopian individualism of the era's back-to-the-land and alternative technology movements. But we can also hear echoes of the 1940s and the 1950s. In the automation debates, computers threatened to replace workers precisely because computer and worker were seen as interchangeable information systems. Within those debates, human agency, like computer agency, depended on the ability to control the forces of chaotic probability that otherwise threatened to over-run the individual psyche and, as they had during the Second World War, the social world as well. As abstract expressionists turned the picture plane into an emblem of those forces, and as artists such as Cage and Rauschenberg opened that plane out into the world of performance, they carved out an alternative form of cyborg subjectivity. To be Cage or Rauschenberg was to recognize the probabilistic nature of existence and, with the aid of various, often semi-automated

technologies, to make that nature available to the senses of artist and audience alike. The 19th-century artist's Romantic control of his internal life (and his studio) had given way to a relationship in which the artist – not unlike the electro-mechanical information processor of cyborg discourse – stood poised between internal and external systems, natural, social and technological.[6] But rather than attempt to control these systems, and so risk an artistic version of the fanaticism that had lately afflicted Nazis and Cold Warriors alike, Cage and Rauschenberg exercised their individual creative forces in such a way as to open up the systems around and within them to individual, playful experience.

Automation House

By aligning themselves with these systems, however, artists had not rubbed off any of the Romantic luster that still clung to the arts, nor shed their creative authority. Rather, they had shifted the grounds on which they and others who followed their example might bring both to bear. Their vision in turn found its way back to corporate and labor leaders in Theodore Kheel's Automation House. By 1967, Kheel had come to believe that automation was inevitable and, ultimately, beneficial, but that it needed to be reimagined in more humanistic terms. Up until that time, he saw automation leading to 'job displacement and a sense of estrangement' among workers; in E.A.T., he saw a collaborative fusion of artistic autonomy with new technology that promised increased engagement and personal fulfillment (Kheel, n.d.). Beginning in 1967, Kheel brought labor leaders, executives and artists together to create what he hoped would be a more collaborative approach to automation. By 1970, he had provided offices for E.A.T. in a six-story former mansion at 49 East 68th Street in Manhattan, alongside the A.F.A.E. and the Institute of Collective Bargaining and Group Relations. Among the key players in these groups were such titans of American labor as Lane Kirkland (Secretary/Treasurer of the A.F.L.–C.I.O.), Joseph Bierne (President of the Communication Workers of America), and John Lyon (President of the International Association of Bridge, Structure and Ornamental Iron Workers). They were accompanied by their corporate boardroom counterparts, including Bruce Wiesley (a senior vice president at American Can Company), Urban Monihan (a vice-president at Magnavox) and Algie Hendrix (a vice president of General Dynamics Corporation).

As the affiliations of its tenants suggest, Automation House became a center for rethinking human–machine labor. In the coming years, it hosted collective bargaining sessions, concerts of electronic music, art exhibitions, and even television production facilities. But it was more than a simple staging ground for these activities. Equipped with a flexible internal architecture, sound and lighting systems, and closed-circuit television, Automation House was meant to be a model of the automated world as everyday system. 'Automation House has enough electric power to run a cinema in the cellar, computers in the attic, and put on a TV show in between . . . while dinner for

Figure 3 A Con Edison advertisement depicting Automation House, published in *The New York Times*, 1 February 1970. Courtesy of Con Edison.

500 is on the stove,' exclaimed a copywriter for a 1970 advertising supplement in *The New York Times*. 'Wild, huh?' (Con Edison, 1970). Far from replacing the human being, the communication and control technologies of Automation House promised to enrich everyday life. Moreover, they did so in terms set by the transformation of agency in relation to technology and system wrought by Cage, Rauschenberg and Pollock before them. In the Romantic automatist tradition, it had paradoxically become possible to assert creative agency by deploying automated technologies for the purpose of revealing the probabilistic, indeterminate nature of everyday life. As they wandered the floors of Automation House, moving from collective bargaining session to multimedia art exhibition, the leaders of American industry and labor could imagine themselves not as the unthinking

automatons that had populated the automation debates, but as creative, flexible individuals, whose agency and sense of self grew directly out of their understanding of the everyday world as a probabilistic place.

Conclusion

For the moment, the question of what effects those experiences had on the management practices of American industry in the early 1970s will have to wait on further research. Yet, almost 40 years later, it *is* clear that the particular vision of human–machine interaction that guided the development of Automation House has had a substantial cultural impact. As computers have become smaller and ever-more-widely distributed, Romantic automatism has become a ubiquitous ideological resource for technical laborers, marketers and managers alike (Streeter, 2003: 648–68). Traveling salesmen, typing away on their laptops in airport lobbies; middle-managers gathering around computer screens for 'virtual meetings'; even blue-collar laborers, monitoring digital gauges in massive production facilities – all have been summoned by advertisers to exemplify the now ubiquitous notion that to place oneself within the techno-social web of computerized labor is to free oneself to pursue personal fulfillment. To many historians of information technology, computers themselves seem to be the prime movers behind this configuration of self and machine in the workplace. Yet, as the history of art in this period suggests, that configuration came into being not because of computers, but alongside them. Together, Pollock, Cage, Rauschenberg and the members of E.A.T. opened a conceptual space in which the individual could, like the cyborg of the 1950s, stand poised between the chaotic, probabilistic forces of multiple systems – social, technical, psychological. And rather than stand frozen there, he or she could act creatively, with a Romantic degree of agency. As individual practitioners, Pollock, Cage, and Rauschenberg have long been recognized for having transformed the conceptual scaffolding of art. Yet, they also served as influential mediators between the technical and artistic worlds. When they did, these artists created a vision through which workers have continued to translate their economically inevitable encounters with machines into hopes for autonomy, community, and bohemian play.

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Notes

1. As Ceruzzi has pointed out, the term 'automation' was first coined at the Ford Motor Company in 1947, and was popularized by Diebold.
2. These numbers should be taken with a grain of salt; as economist Frank Levy (1988) points out, in the late 1950s, unemployment among African-American males, for example, averaged 10 per cent, while unemployment among white males averaged just 4 per cent (p. 136).
3. This analogy has a history of its own and, as several critics have pointed out, has had an enormous influence on American culture since the Second World War (see Bowker, 1993; Galison, 1994; Hayles, 1999: 50–112; Turner, 2006: 11–28).
4. For an analysis of the 19th-century Romantic artistic ideal as a work practice and its links to Pollock and abstract expressionism more generally, see Jones (1996: 1–59).
5. Julie Martin, widow of Billy Klüver, and his partner in E.A.T., reports that Rauschenberg had asked each person in the crowd to say 'My name is . . .', and that these were the voices that the audience heard (Martin, 2007).
6. This position bears a strong resemblance to the subjectivity Michael Leja (1993) has outlined in connection with mid-century Modern Man discourse and Jackson Pollock (p. 278). Yet, it is quite different from the executive mode emerging elsewhere in the New York art world in the 1960s. For an analysis of the artist as industrial manager, see Jones (1996) and Molesworth (2003). For an important account of an earlier attempt to bridge industrial production and collectivist idealism in art practice, see Gough (2005: 151–7).

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