Why MIT Institutionalized the Avant-Garde: Negotiating Aesthetic Virtue in the Postwar Defense Institute

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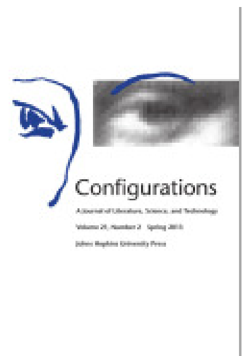

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Why MIT Institutionalized the Avant-Garde: Negotiating Aesthetic Virtue in the Postwar Defense Institute

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ABSTRACT: This essay explores MIT's Center for Advanced Visual Studies to address two major absences in understandings of art/science/technology collaboration: 1) what drew scientists and engineers—not just elite policymakers and polymaths, but thousands in the rank and file—to the arts in the first place; and (2) what compelled the institutions of postwar technoscience to provide financial and material support for such endeavors? The essay employs the notion of "aesthetic virtue" to explain the linkage of the contradictory ideals of creativity and to demonstrate the vital role of institutionalization in an increasingly professionalized and academic domain of contemporary art.

> "If last year's series of exhibitions is any indication, I'm afraid the humanization program of MIT is likely to be as successful as the pacification program in Viet Nam."
>
> —William Thompson (1969)[1]

The "technological arts," "new media art," and the category of "art/science/technology" have ascended to such heights that the unwieldy referents that mark them apart from the mainstream art world no longer seem necessary. Although auction houses and curators continue to debate the market for new media art, by almost any measure, science and technology have become central to artistic practice. For the professional avant-garde, the Venice Biennale hosts

1. William Thompson, "Art and Science: Shotgun Wedding," *Thursday*, May 1, 1969.

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an Internet Pavilion and showcases the video work of masters like Bill Viola, while the recent documenta (13) festival included events on "artistic research" and lectures by Arjun Appadurai and Donna Haraway. In the popular art and entertainment industries, one is hard-pressed to find work that is *not* technologically mediated, so much so that Camille Paglia has declared George Lucas the greatest artist of our time for "clos[ing] the gap between art and technology."[2]

Historical analysis of the technological arts also has come of age. For almost three decades, the leading texts had been practitioner accounts from the utopian 1960s, voicing technological collaboration, and the early 1970s, in which those aspirations were repudiated.[3] Once considered object lessons of a "panacea that failed," art and architectural historians have rapidly canonized the participatory, multimedia projects of Experiments in Art and Technology (E.A.T.), USCO, and the Center for Advanced Visual Studies (CAVS).[4] Scholars of science studies likewise have been drawn to the arts to understand the spread of cybernetics into diverse professional fields.[5] The discovery of cold war experiments in aesthetic realms has had the largest impact in new media studies, where John Cage, Billy Klüver, and others are considered harbingers of a twenty-first-century creative ontology.[6] Consequently, we now have a rich cultural-intellectual

2. Camille Paglia, "George Lucas's Force," *Chronicle Review*, October 15, 2012. http://chronicle.com/article/Why-George-Lucas-Is-the/134942/.

3. Jonathan Benthall, *Science and Technology in Art Today* (London: Thames & Hudson, 1972); Douglas Davis, *Art and the Future: A History-Prophecy of the Collaboration between Science, Technology and Art* (London: Thames & Hudson, 1973); Jack Burnham, "Art and Technology: The Panacea That Failed," in *Video Culture: A Critical Investigation*, ed. John G. Hanhardt (Rochester, NY: Gibbs M. Smith, 1986), pp. 232–248.

4. Arindam Dutta, ed., *A Second Modernism: MIT, Architecture, and the 'Techno-Social' Moment* (Cambridge, MA: MIT Press, 2013); Reinhold Martin, *The Organizational Complex: Architecture, Media, and Corporate Space* (Cambridge, MA: MIT Press, 2003); Anne Collins Goodyear, "György Kepes, Billy Klüver, and American Art of the 1960s: Defining Attitudes Toward Science and Technology," *Science in Context* 17:4 (2004): 611–635; Caroline A. Jones, *Machine in the Studio: Constructing the Postwar American Artist* (Chicago: University of Chicago Press, 1996); Anna Vallye, "Design and the Politics of Knowledge in America, 1937–1967: Walter Gropius, György Kepes" (Ph.D. diss., Columbia University, 2011).

5. Andrew Pickering, *The Cybernetic Brain: Sketches of Another Future* (Chicago: University of Chicago Press, 2010); Christina Dunbar-Hester, "Listening to Cybernetics: Music, Machines, and Nervous Systems, 1950–1980," *Science, Technology & Human Values* 35:1 (2010): 113–139; Fred Turner, "Romantic Automatism: Art, Technology, and Collaborative Labor in Cold War America," *Journal of Visual Culture* 7:1 (2008): 5–26.

6. Noah Wardrip-Fruin and Nick Montfort, eds., *The New Media Reader* (Cambridge, MA: MIT Press, 2003); Oliver Grau, ed., *MediaArtHistories* (Cambridge, MA: MIT Press, 2007).

history of the nexus of the rise of the information sciences, the postwar evolution of the human sciences, and the broader politics of the creative mind in a free society that puts the early flourishing and decline of the technological arts into context.

This essay takes a less rarified point of view than "gestalt cybernetics," "romantic automatism," and other conceptual heuristics of the new historiography of the technological arts to address two major absences in understandings of the rise and evolution of art/science/technology collaborations.[7] What, I ask, drew scientists and engineers—not just elite policymakers and polymaths, but thousands in the rank and file—to the arts in the first place? And, what compelled the institutions of postwar technoscience to provide financial and material support for such endeavors?

By locally grounding the advent of the technological arts in an organizational context, my goal is to account for a striking feature of contemporary art/science/technology hybrids: namely, their expanding presence in university centers of high technology, and the impact of that presence on the self-definition both of artists and of technoscientific practitioners.[8] In the past decade, hundreds of millions of dollars have supported artistic projects at polytechnic institutes seeking to remake themselves as universities of technology that transcend the training of engineers and scientists with the ambition of instead educating "creative innovators." For example, at the Virginia Polytechnic Institute and State University—which has rebranded as Virginia Tech—an Institute for Creativity, Arts, and Technology currently is rising on the former site of a dining hall for military cadets (fig. 1). Similarly, in 2008, the Rensselaer Polytechnic Institute christened the Curtis R. Priem Experimental Media and Performing Arts Center in which the "arts, sciences, and technology interact with and influence each other by using the same facilities, technologies, and by breathing the same air."[9] Its director, Johannes Goebel, hails from Karlsruhe's Zentrum für Kunst und Medientechnologie, Europe's leading new-media art center.

7. Turner, "Romantic Automatism" (above, n. 5); Cornelius Borck, "Gestalt Cybernetics," paper presented at the 2012 eikones NFS Bildkritik workshop "György Kepes—Form und Information," Basel, Switzerland, October 25–26. http://arthist.net/archive/3995/.

8. This approach remains largely unexplored. One of the few exceptions is Cyrus C. M. Mody and Andrew J. Nelson, "'A Towering Virtue of Necessity': Interdisciplinarity and the Rise of Computer Music at Vietnam-Era Stanford," *Osiris* 28 (forthcoming).

9. Curtis R. Priem Experimental Media and Performing Arts Center website. http://empac.rpi.edu/about.

Figure 1. Amphitheatre, with projection on the Collaborative Performance Laboratory at Virginia Tech. (Photo: Courtesy of Virginia Tech Center for the Arts.)

Nowhere does the contemporary ideal of aesthetic innovators shine brighter than at the Massachusetts Institute of Technology. Indeed, MIT is the model for efforts elsewhere, providing the intellectual and organizational blueprint that others seek to appropriate and extend. In stark contrast to late-1960s critical imaginaries of technicians as regimented weapons-makers, the public face of MIT now is represented by the Nicholas Negroponte–founded Media Laboratory (fig. 2) in which sensitive creators build "humane technology," and the Frank Gehry–designed Stata Center, a study in "collaboration [that] shouts the joy of invention."[10] In addition to the market-oriented Media Lab, MIT supports the fine arts through a visiting artists program and the program in Art, Culture, and Technology (ACT). The framework for the arts at MIT, moreover, is multimedia experience rather than student-run musical theater or classical orchestra. Aesthetic practice in these spaces is not simply decorative or expressive nor even linked to art-world markets; instead, as one recent announcement heralds, the arts evoke a "way of living" in a

10. "Spotlight: Why Shouldn't Architecture Be Fun?" MIT website, October 20, 2012. http://web.mit.edu/spotlight/stata2/.

Figure 2. The MIT Media Laboratory. (Photo: Andrew Thomas Ryan via Wikimedia Commons.)

technological society, with an overt message of political and social consciousness.[11]

Despite its aura of novelty, MIT's aesthetic commitment and its associated ideal of a training ground for a new sort of creative professional have been around for more than half a century. Indeed, it began in the heyday of MIT's identity as a servant of national defense. Both the fine arts and their commercialized brethren owe their legacy to the Media Lab's now defunct antecedent, CAVS.[12] Closely associated with its first director, György Kepes, who was a professor of architecture at MIT from 1945 to his retirement in 1974, CAVS was once to be the world's leading site for the integration of humanity in a technological era (fig. 3). It opened shop, as the story goes, in MIT's renovated Coop after Kepes called for a rejuvenation of societal vision in postwar America's interdisciplinary journal of record, *Daedalus*. "New technical tools and materials; new approaches to

11. Originally featured as "Arts at MIT: Visiting Artists," MIT website. http://arts.mit.edu/va/. The quote now appears in a more subdued form at a different URL. http://arts.mit.edu/va/artist/saraceno/#materiality/.

12. In 2009, CAVS merged with the Visual Arts Program to form the Program in Art, Culture and Technology.

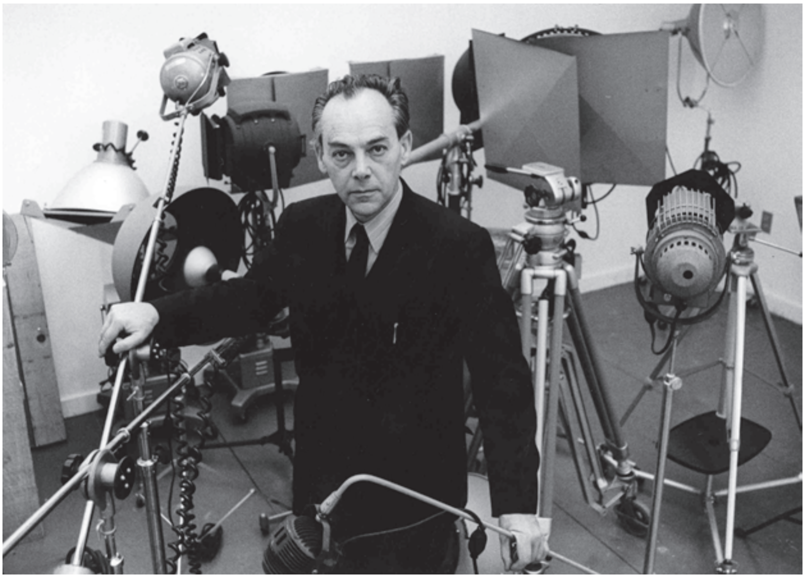

Figure 3. György Kepes (1974). (Photo: Nishan Bichajian, copyright © Massachusetts Institute of Technology.)

teamwork among creative individuals in the arts and in the sciences with different backgrounds and training; new awareness of the interplay of visual factors in the dynamic urban scene," Kepes professed, "these are the challenges to collaborative daring."[13]

This study returns to the origins of the technological arts to root out what was in it for MIT, and by so doing generates a question set for the interrogation of new-media institutions elsewhere. By approaching CAVS through the situated lens of the cultural history of science and engineering, it excavates how collaborations among artists, engineers, and scientists came to life and survived where other efforts did not. It investigates the familiar territory of Kepes, MIT's School of Architecture and Planning, and CAVS artists, but also the less familiar terrain of engineering pedagogy, sponsored research, administrators' wives, corporate executives, and New Left radicals.

Both at the height of the cold war order and in its late-1960s disruptions, art took on a range of shifting meanings among scientists and engineers that helped construct the very notion of the "technological arts." Art historians Caroline Jones and Anne Collins Goodyear have employed concepts of the "technological sublime," "tech-

13. György Kepes, "The Visual Arts and the Sciences: A Proposal for Collaboration," *Daedalus* 94:1 (1965): 117–134.

nophila," and "technophobia" to make sense of artists' embrace and subsequent rejection of technology during the cold war.[14] I will speak to these categories to further elaborate social theories of technology in the period; however, because I intend to explain why scientists, engineers, and their employers had a professional interest in art, I will introduce "aesthetic virtue" as a topos that functioned in the opposite direction. For scientists and engineers in the 1960s, engaging with the arts attained the status of a moral imperative. It fused two important process values of postwar scientific culture, *collaboration* and *creativity*, which had taken on similar significance among artists. *Collaboration* was cast as a means of capitalizing on the integration of differing knowledge domains to solve complex sociotechnical problems, and, in so doing, to bridge larger societal divisions. Above all, art was a mark of *creativity*, and as such was a universal maker of intellectual, professional, and social good that could rehabilitate the image of science and technology through the alteration of the self. Artistic metaphors and practices, however, were mobilized to reinforce contradictory ideals about the purity of knowledge and its inherent entanglements and offered alternative fashionings of technoscientific practitioners as expert leaders, as craftsmen, and as skilled contributors in a participatory democracy. United with artists in pursuit of aesthetic virtue, scientists and engineers contributed to the technological arts at MIT and beyond in a shared though discordant desire to make technology human.[15]

The institutional fusing of art/science/technology aspirations at MIT was as remarkable as the breadth of international discourse about humane technology during the cold war. CAVS came to life not just as part of a symbiotic relationship between a defense establishment looking to soften its image and artists seeking prestige and access to new tools; nor did it only emerge from a need to draw on the theory and practice of arts to answer technoscientific questions in which scientists' own approaches had failed. Neither can it be explained by the quest for a universal science of cybernetics that unified all of human activity under the aegis of design. Instead, Kepes and the myriad other participants he enrolled in his network negotiated the flexible meanings of "art," "science," "technology,"

14. Jones, *Machine in the Studio* (above, n. 4); Anne Collins Goodyear, "From Technophilia to Technophobia: The Impact of the Vietnam War on the Reception of 'Art and Technology,'" *Leonardo* 41:2 (2008): 169–173.

15. This study elaborates themes first developed in Matthew Wisnioski, *Engineers for Change: Competing Visions of Technology in 1960s America* (Cambridge, MA: MIT Press, 2012), pp. 125–128.

"creativity," "collaboration," "unity," and "innovation" in a tenuous alignment of five constituencies: 1) educators of professional architects; 2) those interested in broadening the pedagogy of MIT's scientists and engineers; 3) efforts by alumni and faculty wives to beautify and humanize the technocratic environment; 4) the desire of scientists and engineers themselves to claim the creative mantle of the arts; and 5) the new avant-garde of artists that Kepes hoped to create through disciplined exposure to science and technology. The administrative linking of these interests proved instrumental in naturalizing the idea that these groups shared common cause in the inevitable evolution of technological society; in establishing a system for credentialing professional artists in new-media fields; and in instilling a persistent ideal about the proper qualities of technoscientific labor. To reconstruct that process of institutionalization and its consequences, we need to first understand its network-builder.

The Science of Vision

"The external forces are light-agents bombarding the eye and producing changes on the retina," Kepes wrote in the months prior to the nuclear holocaust in Japan. "The internal forces constitute the dynamic tendency of the individual to restore balance after each disturbance from the outside, and thus to keep his system in relative stability."[16] In *Language of Vision*, Kepes gave meaning to his experiences of Hungarian pastoralism, of Chicago's ethereal nightscape and its darkened ghettos, and of camouflage design for the U.S. Army by seeking a universalized theory of vision. Turning both to László Moholy-Nagy and Hermann von Helmholtz, he chronicled the history of art as an optical science. In a "new world" of science, he concluded, it was the painter's task to provide visual order.

Perhaps no institution in the United States was altering modern vision as radically as MIT. Capitalizing on spectacular successes during World War II, the institution had actualized the model of a "university polarized around science."[17] MIT, of course, was not only a school for engineers and scientists, but also for architects and urban planners. Kepes came to the nation's foremost center for technical education in 1945 as an associate professor of freehand drawing, along with Alvar Aalto and a host of lesser mortals, to reinvigorate

16. György Kepes, *Language of Vision* (Chicago: Paul Theobald, 1944), p. 16.

17. Gordon Brown, "The Engineering of Science," *Technology Review* 62:2 (1959): 19–22, 48–49.

the School of Architecture and Planning, whose enrollment had plummeted under the exigencies of war.[18]

Over the next two decades, Kepes contributed to the school's re-imagination of the urban experience. He transformed the classical-drawing curriculum into "visual design" and helped to recruit Kevin Lynch, and with the aid of a multiyear grant from the Rockefeller Foundation, launched the study that produced *The Image of the City*. He invited painter Robert Preusser—his former student—to aid in undergraduate instruction. Kepes also shaped MIT's visual identity, designing brochures and donating paintings for administrators' offices.[19]

Kepes's greatest contribution to MIT, however, was as advocate and example of interdisciplinary research. By the late 1940s, "interdisciplinarity" had acquired a de rigueur quality among America's academic elite, who linked innovation amid complexity to collaborative effort and national unity.[20] At Harvard, Talcott Parsons's Department of Social Relations theorized the concept, which MIT trumpeted as the key to the Radiation Laboratory. Kepes's talent as a facilitator and synthesizer raised his stature in this milieu. In 1951, after years of friendship with senior physicists and engineers, he arranged the "New Landscape" exhibition at MIT's new Hayden Gallery, displaying natural patterns generated in the laboratory.[21] The exhibit was the seed for an edited volume that interspersed his analysis of art and science with those of physiologists, chemists, zoologists, painters, architects, engineers, poets, and physicists. He subsequently edited the seven-volume Vision and Value series, gathering international luminaries around themes like symmetry and structure.

Kepes came to represent not just the research mentality that marked him as MIT's own, but also a pillar of creative unity in an age of specialism and fragmentation. A member of the Research Society for Creative Altruism, he championed interdisciplinarity as a source

18. William W. Wurster, "School of Architecture and Planning," *Massachusetts Institute of Technology Bulletin: President's Report* 81 (1945): 138–140.

19. James Killian, foreword to György Kepes and Marjorie Supovitz, *György Kepes: The MIT Years, 1945–1977* (Cambridge, MA: MIT Press, 1978), pp. 3–4.

20. Jamie Cohen-Cole, "The Creative American: Cold War Salons, Social Science, and the Cure for Modern Society," *Isis* 100:2 (2009): 219–262; Peter Galison, "The Americanization of Unity," *Daedalus* 127:1 (1998): 45–71.

21. György Kepes, *The New Landscape in Art and Science* (Chicago: Paul Theobald, 1956); Kepes and Supovitz, *György Kepes* (above, n. 19), pp. 13–14; György Kepes, *György Kepes: Works in Review* (Boston: Museum of Science, 1973), p. 55.

of human value.[22] His books were reviewed in scientific journals, and, in turn, he elevated the scientific persona. Time-Life's book *The Scientist*, for example, began with a chapter titled "Hero—and Human Being" that included a photo essay on "A Landscape of Poetic Vision" in which Kepes analogized scientists to artists and poets.[23]

Visionary Technicians

By attempting to reconcile the "two cultures" divide before it had been named as such, Kepes's vision aligned with MIT's efforts to maintain wartime gains through pedagogical reform. In 1945, the notion of an international center for technological art, much less artistic coursework beyond the training of architects, did not exist at MIT. A student's "cultural" education was below even the standard of the American Society for Engineering Education.[24] Only two decades later, however, MIT stood as a national model for aesthetic engineering.

In 1949, the institute published the results of a two-year exploration of how its organization and pedagogy could be reformed to best train leaders for postwar technological society. Chaired by chemical engineer Warren Lewis, the Committee on Educational Survey stressed the rapid changes that MIT had experienced as a consequence of World War II. The most profound difference was in the scale of sponsored research, which by war's end exceeded its academic budget.[25] The *Report of the Committee on Educational Survey to the Faculty of the Massachusetts Institute of Technology* (also known as the Lewis report) also boasted that MIT had shed its vocational trappings; to foster professionalism, the institute needed to implement an "integral plan" that developed interdisciplinary competencies at the nexus of engineering and science, but also the humanities, social

22. See Abraham Maslow, ed., *New Knowledge and Human Values* (New York: Harper, 1959).

23. Austin H. Riesen, "Review: Structure in Art and in Science, Education of Vision, The Nature and Art of Motion by György Kepes," *Science* 149:3683 (1965): 527; Henry Margenau, David Bergamini, and the Editors of *Life*, *The Scientist* (New York: Time-Life Books, 1964), pp. 16–27.

24. "Report of the Committee on Engineering Education After the War," *Journal of Engineering Education* 34:9 (1944): 589–613. Killian made the humanities a centerpiece of his inaugural address; see James R. Killian Jr., "The Obligations and Ideals of an Institute of Technology," in *Mid-Century: The Social Implications of Scientific Progress*, ed. John Ely Burchard (Cambridge, MA: MIT Press, 1950), pp. 442–464.

25. Massachusetts Institute of Technology Committee on Educational Survey, *Report of the Committee on Educational Survey to the Faculty of the Massachusetts Institute of Technology* (Cambridge, MA: MIT Press, 1949), p. 4.

sciences, and arts.[26] The report recommended increasing humanistic-social study to 20 percent of coursework, stressed interdepartmental cooperation, and called for a new School of Humanities and Social Sciences dedicated to the interpretation of meaning and responsibility in science and technology. Such formal and informal study was intended not only to foster managerial vision, but also to mitigate engineers' status anxiety as a "culturally" deficient profession, and to improve MIT's recruiting ability at boarding schools like Andover and Exeter.

The report warned of the educational perils of sponsored research, but in the 1950s and early '60s, the practice seemed only to aid in the production of creative leaders. MIT remained the federal government's top university contractor, with budgets averaging over $100 million annually. In the military-industrial-academic nexus, graduate education took center stage, but undergraduate training also changed substantially. Gordon Brown revamped the curriculum around engineering science and incoming student quality rose. With money flowing freely, the School of Humanities and Social Sciences established itself by focusing on "the impact of technology on society" and offering some of the nation's highest salaries.[27]

Under these circumstances, growth of the visual arts became possible by appealing to art as a source of intuition and technical problem-solving. Upon becoming MIT's president in 1949, James Killian ruminated on the need for a world-class art collection and provided the impetus for the Hayden Gallery.[28] Critically, professor of architecture John Burchard—an Office of Scientific Research and Development strategist during World War II—was appointed dean of the School of Humanities and Social Sciences. Burchard was an architectural historian trained in civil engineering who had firsthand experience with goal-oriented science. He capitalized on the School of Architecture and Planning's anxiety that the attention lavished on scientific research had made it invisible by pressing his former home to aid in general education so that architecture, in turn, could enhance its institutional leverage. He also received a Carnegie Corporation grant to study the arts in technical education, appointing Bartlett Hayes Jr. to lead it. Hayes was the curator at Philips Academy

26. Ibid., pp. 26–27.

27. Wisnioski, *Engineers for Change* (above, n. 15), pp. 161–183.

28. Memorandum, James R. Killian Jr., January 5, 1949, in Records of the Office of the Dean, School of Architecture and Planning (hereafter RSAP), box 6, folder "Permanent Art Collection Committee," Institute Archives & Special Collections, MIT Libraries, Cambridge, Massachusetts.

and a popularizer whose *Layman's Guide to Modern Art* began with the adage that "[t]he modern artist, like the scientist, is a seer."[29] His report argued that science had entered a new stage: on the one hand, technological change produced Babel-like information overload; but on the other, the nation's top scientists were managing new responsibilities by finding "meaning in the way things are related, rather than in a thing for its own sake."[30] As the next generation of scientific statesmen, MIT students were doers and thus would benefit from artistic practice.[31]

Even in flush times, however, developing the arts remained a challenge. Burchard felt that the Carnegie Corporation had disavowed its study, and applications to other foundations went unfunded.[32] It was the rare student, moreover, who had time and interest for studio work. Still, art instruction began to be included in general education in 1957. Courses were offered from within architecture and planning rather than humanities and social sciences to emphasize the creative act.[33] The first "Field 10" studio course, taught by Preusser, started with thirty students, mostly engineering majors, but only twenty finished the course. Preusser argued that the arts introduced students to a "pattern of creativity" and offered a counterbalance to "inductive-quantitative learning."[34] The goal was not to copy existing styles, but rather to generate visual order. Exercises followed a progression from unstructured doodling to investigations of rhythm, pattern, texture, and color. Students were encouraged to use scientific instrumentation, such as computers, chemical processes, and magnets, as their medium.

By the early 1960s, Field 10 was a national selling point for MIT. Students exhibited their work in the Hayden Gallery, Joan Peterson Gallery, and Nashua, New Hampshire's Art and Science Museum.

29. Mary Chalmers Rathbun and Bartlett H. Hayes Jr., *Layman's Guide to Modern Art: Painting for a Scientific Age* (New York: Oxford University Press, 1954), p. 6.

30. Committee for the Study of the Visual Arts, *The Role of the Visual Arts in Modern Education: Part I of the Report of the Committee for the Study of the Visual Arts, Massachusetts Institute of Technology, 1952–53* (Cambridge, MA: MIT Press, 1964), p. 5.

31. Ibid., pp. 8, 14.

32. Memorandum, John E. Burchard to "Professor Anderson," January 28, 1955, in RSAP, box 4, folder "Visual Arts," Institute Archives & Special Collections, MIT Libraries.

33. Committee for the Study of the Visual Arts, *The Role of the Visual Arts in Modern Education* (above, n. 30), p. 2.

34. Robert Preusser, "Visual Education for Science and Engineering Students," in *Education of Vision*, ed. György Kepes (New York: George Braziller, 1965), pp. 208–219.

The studio course was the subject of numerous journalistic profiles. Where Kepes stood for the interdisciplinary heroism of the scientist in Time-Life's eyes, MIT earned an entire chapter in Time-Life's sister volume, *The Engineer*, which included a section titled "From Op Art to Oscilloscope."[35] Field 10 also was an alumni favorite, as made manifest in multiple *Technology Review* articles. Among the works reproduced for a broader public were those of future engineer-humanist Nicholas Negroponte (class of 1966).[36]

Creative Capital in the Military-Industrial Complex

MIT did not have a monopoly on aesthetic virtue among scientists and engineers; on the contrary, the concept was a national phenomenon bound up with identity politics, the meaning of creativity, and the goals of American democracy.[37] Psychologists, art historians, social theorists, and scientists themselves identified scientists and artists as society's innovators and nonconformists.[38] Their shared creativity was viewed as the attribute that allowed rational humans to rise above the conformity endemic to advanced industrial society, as well as the source of anti-authoritarian change in democratic communities.

Art was a means simultaneously of humanizing and setting apart the scientist by relating him to the artist as a font of creativity, originality, and purity. In *Science and Human Values*, for example, Jacob Bronowski argued that scientists and artists shared an underlying mechanism: "the act of creation . . . and it is the same act in original science and original art."[39] George Russell Harrison, dean of MIT's School of Science, argued that misconceptions about scientists arose when they were too quickly linked with technology. Ends did not drive the "true scientist," but instead he was "directed and conditioned by aesthetic values."[40]

35. C. C. Furnas and Joe McCarthy, *The Engineer* (New York: Time-Life Books, 1966), p. 91.

36. Jane H. Kay, "A Gallery of Visual Design," *Technology Review* 69:6 (1967): 96–97, and "Art and the Engineer," *Mechanical Engineering* 89 (1967): 48–49.

37. Wisnioski, *Engineers for Change* (above, n. 15), pp. 124–129; Matthew Wisnioski, "Centerbeam: Art of the Environment," in *A Second Modernism* (above, n. 4), pp. 185–228, esp. pp. 197–199.

38. See, for example, Myron A. Coler, ed., *Essays on Creativity in the Sciences* (New York: NYU Press, 1963).

39. Bronowski's quote was often cited during the 1950s and '60s; see Jacob Bronowski, *Science and Human Values*, rev. ed. (1956; revised edition, New York: Harper & Row, 1965).

40. George Russell Harrison, "The Scientist as an Artist," *Technology Review* 61:9 (1959): 501–504, 533–534.

For politically minded scientists, art was a vehicle to harmonious unity. In 1959, *Bulletin of the Atomic Scientists* dedicated an entire issue to science and art that was coedited by Martyl Langsdorf, artist and the wife of physicist Alexander Langsdorf and illustrator of the bulletin's doomsday clock, and Cyril Stanley Smith, then at the University of Chicago. The editors, who conceived of the issue at a New Landscape–style exhibition, appealed to "inner satisfaction" as the primary drive for artists and scientists, but also stressed universal communication.[41] In his contribution, Eugene Rabinowitch described the artist as "the most sensitive individual in society," thus the first to anticipate revolution. After a century characterized by atomization, he contended, artists and scientists were moving toward a "wider concern with mankind as a whole."[42]

Among engineers, aesthetic virtue was linked with the artist's persona, but was directed at corporate conformity and the prestige of engineering science at the expense of the "art of engineering." Engineers concerned about their profession's public status and its differentiation from science emphasized their creative affinity with the arts through the visual and artifactual character of design.[43] Textbooks cast the engineer as "an artist" who used "special tools" and an attitude of "discontent" and "nonconformity" to mold an idea into material reality while overcoming pressures of limited time and resources.[44] Mechanical engineering professor Clement Freund likewise claimed that the "artist engineer" was distinguished from the "scientific engineer" by "a special kind of intuitive judgment" under financial constraints. While the scientific engineer had done a better public-relations job, once the artist engineer was recognized, he would assume his rightful status.[45] The emphasis on aesthetic creativity undergirding theories of engineering design was especially prevalent in managerial literature, which had titles like *Company*

41. Martyl Langsdorf and Cyril Stanley Smith, "Science and Art," *Bulletin of the Atomic Scientists* 15:2 (1959): 50–51.

42. Eugene Rabinowitch, "Integral Science and Atomized Art," *Bulletin of the Atomic Scientists* 15:2 (1959): 64–67.

43. For the best expression of this belief, see Eugene S. Ferguson, *Engineering and the Mind's Eye* (Cambridge, MA: MIT Press, 1992), pp. 153–168.

44. Alvin S. Weinstein and Stanley W. Angrist, *An Introduction to the Art of Engineering* (Boston: Allyn & Bacon, 1970), pp. 1–7; Harold R. Buhl, *Creative Engineering Design* (Ames: Iowa State University Press, 1960), p. 35.

45. Clement J. Freund, "The 'Artist' Engineer," *Mechanical Engineering* 83 (1961): 38–40.

Climate and Creativity.[46] Technical journals likewise spotlighted psychological surveys of the creative individual, showing that the engineer was a "species of artist."[47] The pursuit of aesthetic virtue, moreover, generated myriad superficial appropriations; in one case, for example, a textbook formerly titled *Engineering: The Profession and Elementary Problem Analysis* (1960) became *Engineering: An Introduction to a Creative Profession* (1967), with no discernable changes save a dizzying op-art cover.[48]

Public relations for corporations and research laboratories also appealed to the arts as a way of conveying institutional soul. General Motors Research Laboratories went so far as to create its own collection of scientific images as art, which it loaned to high schools, museums, and world's fair exhibitions.[49] In similar fashion, the Los Alamos Scientific Laboratory, the leading research center for the development of nuclear weapons, recruited staff with abstract paintings inspired by scientific phenomena. One ad in the series promoted Los Alamos's interdisciplinary spirit through the Talcott Parsons–inspired axiom "from diversity comes unity," which exalted the virtue of collaboration and avoided direct reference to the laboratory's military purpose by describing how its scientists probed the universe's fundamental questions (fig. 4).[50]

Kepes, more so than any artist in America, was an evangelist for aesthetic virtue among engineers and industrial scientists. He completed a handful of corporate commissions, but was in greater demand as a public intellectual. From the late 1950s to the early '70s, he lectured to auxiliary meetings of professional societies for the wives of engineers and to advanced-theory groups at aerospace research centers alike.[51] He provided introductions to artistic collec-

46. Deutsch and Shea Inc., *Company Climate and Creativity: 105 Outstanding Authorities Present Their Views* (New York: Industrial Relations News, 1959).

47. J. H. McPherson, "How to Manage Creative Engineers," *Mechanical Engineering* 87 (1965): 32–36.

48. H. W. Leach and George C. Beakley, *Engineering: The Profession and Elementary Problem Analysis* (New York: Macmillan, 1960); George C. Beakley and H. W. Leach, *Engineering: An Introduction to a Creative Profession* (New York: Macmillan, 1967).

49. General Motors Research Laboratories, "Art for Science's Sake," *Mechanical Engineering* 86 (1964). General Motors also supplied the images for Time-Life's *The Scientist* (above, n. 23).

50. Los Alamos Scientific Laboratory, "From Diversity Comes Unity," *Mechanical Engineering* 83:12 (1961): 155.

51. Wisnioski, "Centerbeam" (above, n. 37), p. 199.

Figure 4. Los Alamos National Laboratory, "From Diversity Comes Unity." (Source: Los Alamos National Laboratory.)

tions of scientific images, such as a portfolio of *Scientific American* images reproduced on museum-quality unbound plates.[52] He reviewed regional exhibitions that followed the New Landscape pattern, including "Art in Science" at the Albany Institute of History and Art, a show that was then reproduced during the 1965 annual meeting of the American Association for the Advancement of Science.[53] Companies used examples of his work to advertise their materials, while others wanted to reproduce his images in company calendars. Kepes's paintings graced the hallways of MIT's special laboratories, and executives in Boston's technology corridor became collectors—including Leo Beranek and Robert Newman of Bolt, Beranek, and Newman, Inc.

International Centers, Local Matrons, and the Making of CAVS

If interdisciplinary collaboration was the means for achieving creative synthesis, the university center was the archetypical form for disciplining it. The center model emerged as an attempt to recreate the innovative spirit of World War II service and to ensure that government contracts were distributed across units. At MIT, sponsored research proliferated across departments in the Center for Materials Science and Engineering, but also in the social-scientific Center for International Studies.

The School of Architecture and Planning struggled to adapt to the sponsored research culture. It created the Center for Urban and Regional Studies with funding from the U.S. Department of Commerce; investigated plastics as a building technology for Monsanto Chemical Company; and sent an urban-planning team to construct a Guyanian city. The school's greatest success was the Joint Center for Urban Studies, a Ford Foundation–sponsored cooperative venture with Harvard. Nonetheless, in 1964, Lawrence Anderson argued that the School of Architecture and Planning was defined by a lack of resources and an absence of advanced inquiry. Moreover, education nationally was "intellectually backward and obsessed with the notion of the creative man guided by instinct and intuition rather than knowledge."[54] MIT thus should become a pioneer in multidisciplinary graduate research.

52. Duane Roller, "Art in Science: A Portfolio of 32 Paintings, Drawings, and Photographs from *Scientific American*," *Scientific Monthly* 80:6 (1955): 383.

53. David G. Barry, "Art and Science? Yes!" *Science* 152:3725 (1966): 1011–1012.

54. Lawrence Anderson, "Department of Architecture," *Massachusetts Institute of Technology Bulletin: President's Report* 100 (1964): 59–65.

Figure 5. Catherine “Kay” Stratton, wife of MIT president Julius Stratton. (Photo: MIT News Office.)

The Center for Advanced Visual Studies would take shape in this "center" mold, but before Kepes could pursue the arts as collaborative "advanced study," they first were given life by a more traditional—and traditionally less visible—source. Catherine "Kay" Stratton, wife of MIT president Julius Stratton, has almost as strong a claim to the title of founder of CAVS as Kepes (fig. 5). From 1959 to 1966, in the role of MIT's first lady, Stratton was a leading supporter of the arts. She established the Friends of the Arts Committee, which was composed of matrons and alumni, because she believed that original artworks had a didactic influence on students and faculty. She directed the committee to expand MIT's collection, and among it achievements was the commission of an Alexander Calder sculpture to complement the institute's new I. M. Pei tower. She also initiated an annual art sale run by women students and introduced an art-lending program.

Stratton's committee was conceived as a way of humanizing MIT through the experience of great works, but it also generated alumni and administrative support for Kepes's plans. In 1962, demand for undergraduate art offerings far exceeded supply. President Stratton asked Kay's committee to serve as an advisory council for the expansion of Field 10 in a new art department; it, in turn, pushed for the hiring of a nationally visible artist to generate alumni donations for the art collection. All parties expressed frustration at the relative paucity of funding. Early in 1963, the School of Architecture and Planning stressed Kepes's vision of a collective of fellows dedicated to advanced study as a part of its strategy to enhance its research profile.[55] And, in January 1964, President Stratton added the "center" nomenclature by identifying the Center for International Studies as a model that could stabilize MIT's multiple conceptions of aesthetic virtue:

> [The arts] have a role in the general education of undergraduates. They are playing a very important part in contributing to the broad cultural life of MIT for faculty and staff as well as for students. They play a professional role in connection with the School of Architecture, and they relate to engineering design in a way that is more than peripheral. As I believe most of you know, I have rather strong philosophical convictions about the need to offset the contemporary trend toward abstraction in so many fields of intellectual endeavor

55. Memorandum, Lawrence Anderson, "The Visual Arts in the MIT Community," March 8, 1963, in Records of the Art Committee (hereafter RAC), box 1, folder "1962–1964," Institute Archives & Special Collections, MIT Libraries.

> by an exposure to ideas and forms that are tangible and by the cultivation of visual modes of expression.[56]

The idea of a center in place, it now needed funding and a director.

By becoming the key to everyone else's normative vision, Kepes was able to actualize his own. It is in the context of the institutional opportunities opened by appealing to aesthetic virtue that one should read his famed 1965 *Daedalus* essay. Part of a special issue on "Science and Culture," with contributions from interdisciplinary theorists, Kepes outlined plans for "a closely knit work community" by praising "cooperative acts" and "unity" as a means of survival in a scientific age. He chided the abstract expressionists for withdrawing from values and basic questions. His call for a "return to fundamentals" contained a defense of purity in reaction to the "appraisers and impresarios" of the art market that resonated with physicists, who had the same complaints about government contracts. Concerned moderns had two tasks: "to advance in every field to the furthest frontiers of knowledge possible today; and to combine and communicate all such knowledge so that we gain the sense of structure, the power to see our world as an interconnected whole."[57]

In January 1965, President Stratton gave the center the green light and named Kepes its director. Citing C. P. Snow, the CAVS press release argued that collaboration could achieve the same results as in the "era of cathedral building." Roughly $200,000 was allotted to remodel the Coop, and MIT aspired to support ten fellowships of $15,000 each. CAVS's opening was delayed until 1967, however, as the Coop was converted, fellows invited, and grants attained from the Old Dominion Foundation and the Graham Foundation for Advanced Studies in the Fine Arts. In November 1967, the first artists arrived, Harold Tovish, Otto Piene, Will Garnett, and Vassilakis Takis, being joined the following year by Jack Burnham, Ted Kraynik, Wen-Ying Tsai, and Stan VanDerBeek. With Kepes's help, ad hoc individual collaborations were forged with Harold Edgerton, Norman Dahl, Louis Sutro, Ain Sonin, Walter Lewin, William Murray, Henry Kolm, and interested graduate students.

CAVS was a culmination of Kepes's life's work. As his confidence in collaboration rose, so did his ambition. He linked CAVS to the

56. Letter, President Julius Stratton to Jeptha Wade, January 8, 1964, in RAC, box 1, folder "1962–1964," Institute Archives & Special Collections, MIT Libraries.

57. Kepes, "The Visual Arts and the Sciences" (above, n. 13), pp. 117–133. For a discussion of purity and scientific culture, see David Kaiser, "Nuclear Democracy: Political Engagement, Pedagogical Reform, and Particle Physics in Postwar America," *Isis* 93:2 (2002): 229–268.

Lewis report, but argued that the center would "go much further than that and meet even deeper needs." Artists would be able to complete "epic tasks" of civil and environmental transformation. Scientists, for their part, would gain an "increase of power, a source of breadth to counterbalance the limitations that science systematically sets for itself." As a team with a common goal, artists would tackle problems on the same scale of postwar scientific and technical advances. For the first project, he directed the fellows to draw up plans for a kinetic light form in Boston Harbor as a "focal hearth" for the city.[58] "We have, in the past, had a great number of physical monuments," Kepes explained to MIT's Technology and Culture Seminar, "but the light tower would be a very different type, using technology as a kind of crescendo of confidence."[59] When the crescendo arrived, however, it was of a different sort.

Making Technology Human

By 1968, a sea change in academic and popular conceptions of technology was turning its creators into culture warriors. Accordingly, aesthetic virtue evolved into as much a defensive strategy as an aspirational one. In an environment of napalm babies and men on the moon, *technology* was *the* ascendant theme of the cold war era. In 1964, critical intellectuals—including Jacques Ellul, Lewis Mumford, and Herbert Marcuse—published the first salvos of a strain of analysis that Langdon Winner dubbed "technological politics."[60] As the Vietnam War raged and Watts burned, fear of out-of-control technology became a unifying thread for the civil rights, antiwar, and student movements.

"Technique has been extended geographically so that it covers the whole earth," Ellul admonished in his book *The Technological Society*: "It is evolving with a rapidity disconcerting not only to the man in the street but to the technician himself."[61] A small minority of scientists and engineers—themselves often readers of Ellul—indeed were disconcerted with the system in which they worked. They published underground newspapers, initiated "technology and society"

58. György Kepes, *Center for Advanced Visual Studies* (Cambridge, MA: MIT Press, n.d. [1967?]).

59. György Kepes, "The Artist's Response to the Scientific World," in *Technology and Culture in Perspective*, ed. Ilene Montana (Cambridge, MA: Church Society for College Work, 1967), pp. 35–41.

60. Langdon Winner, *Autonomous Technology: Technics-Out-of-Control as a Theme in Political Thought* (Cambridge, MA: MIT Press, 1977).

61. Jacques Ellul, *The Technological Society* (New York: Knopf, 1964), p. 78.

committees in professional societies, and even formed dissident collectives. But engineers and scientists were more likely to be roiled by the disruption of their conventions, budget contractions, and the nation's loss of progressive faith. In think tanks, employee cafeterias, and teach-ins, scientists and engineers pushed back against their critics and posited their own solutions for controlling technology. This intellectual crisis gave rise to a new genre of technology and society literature, as well as a host of activities that defy labels of *technophilia* and *technophobia*. Art and technology appeared to scientists and engineers of all stripes as a way of restoring technology as a progressive human endeavor.

Pedagogical reformers continued to emphasize the value of art for technical education, but now explicitly identified it as a way of humanizing technology. Nearly every engineering college in the United States revised its curricula, adding humanities, social sciences, and art courses. At the University of Florida, the team of engineer Gale Nevill Jr. and artist John O'Connor developed collaborative aesthetic projects (including self-destroying machines) to confront the rationalist norms of engineering students. Other technical schools, including Caltech and Stevens Institute of Technology, created artist-in-residence programs. Paul Miller of Stevens, for example, showed off fifteen student works in the journal *Engineering Education* and explained that the course would eliminate engineers' "tunnel vision."[62]

Aesthetic virtue took on even greater importance in corporate public relations directed both to a broader public and to scientists and engineers themselves. These expressions took the form of traditional print advertisements, such as an Airborne Instruments Laboratory ad that reproduced employee artwork, as well as more novel hybrids of aesthetics and social theory.[63] At Kaiser Aluminum and Chemical Corporation, for example, production editor Don Fabun compiled a masterful series of booklets that blended psychedelic arts with social theory on subjects like "You and Creativity" and "Ecology: The Man-Made Planet."[64]

62. Gale E. Nevill Jr. and John A. O'Connor, "Unbottle Your Creative Ideas: A Cooperative Venture in Engineering and Art," *Engineering Education* 63:2 (1972): 112–116; Paul F. Miller, "Art for Engineers," *Engineering Education* 62:3 (1971): 271–277. At Fairleigh Dickinson University in New Jersey, engineering professor Lee Rosenthal initiated a course for art students because he had seen their frustration with failed collaborations; see Rosenthal, "A Course in Technology for Artists," *Leonardo* 7:1 (1974): 27–29. See also Wisnioski, *Engineers for Change* (above, n. 15), p. 166.

63. Cutler Hammer, "Art at A.I.L.," *IEEE Spectrum* 4:5 (1967): 5; see also Wisnioski, "Centerbeam" (above, n. 37), pp. 197–198.

64. Don Fabun, *You and Creativity* (Beverly Hills, CA: Glencoe Press, 1969) and *Ecology: The Man-Made Planet* (Beverly Hills, CA: Glencoe Press, 1970).

Aesthetic virtue also had rhetorical force in a declining funding environment for basic science. Physicist Robert Wilson—a speaker at CAVS's inaugural symposium in 1968—used aesthetics to resolve a host of economic and political hurdles to create the Fermi National Laboratory by casting the project as a pacifist technoscientific utopia. Unlike Los Alamos and other national laboratories, Fermi Lab was open to the public, and sculptures representing scientific truths were distributed throughout its grounds.[65]

But art was not the province of any one side in this culture war. In a two-part series that traced the roots of technological art from Dada to Tovish and E.A.T., Jean Tinguely's self-destroying machine graced the cover of *IEEE Spectrum*.[66] But a few months later, another article in the world's premiere electrical engineering journal rejected such "electronic fads and shock effects," while at the same time arguing that true artist–engineer partnerships could flourish if both parties embraced classical aesthetics.[67] In 1971, the Stellite Division of the Cabot Corporation likewise displayed its new fourteen-foot-tall sculpture *Kalpa-Tarou* (Hindi for "tree of imagination") in *Mechanical Engineering*. A company vice president described the sculpture, which was built of tool bits, reflectors, and other company wares from naval ships and airplanes, as "symbolic of the imagination and creativity necessary for an industry to remain competitive in our free enterprise system. It emphasizes to us all that our goal should be to equip our children, youth, and adults with the necessary skills to compete in this highly competitive society."[68] In a similar vein, consulting-engineer-turned-public-intellectual Samuel Florman made explicit that what was at stake was the engineering profession's "claim on creativity" versus that of the counterculture.[69]

The most visible face of overtly politicized aesthetic virtue was

65. Joanna Ploeger, "The Art of Science at Fermi National Accelerator Laboratory: The Rhetoric of Aesthetics and Humanism in the National Laboratory System in the Late 1960s," *History and Technology* 18:1 (2002): 23–49. In his autobiography, Wilson wrote that "in designing an accelerator I proceed very much as I do in making a sculpture" (qtd. in ibid., p. 33).

66. Nilo Lindgren, "Art and Technology: I. Steps Toward a New Synergism," *IEEE Spectrum* 6:4 (1969): 59–68, and "Art and Technology: II. A Call for Collaboration," *IEEE Spectrum* 6:5 (1969): 46–56.

67. Gordon Friedlander, "Art and Technology: A Merger of Disciplines," *IEEE Spectrum* 6:10 (1969): 60, 68. See also Wisnioski, *Engineers for Change* (above, n. 15), p. 147.

68. "The Art of the Matter," *Mechanical Engineering* 93 (1971): 37.

69. Samuel C. Florman, "Creativity and the Anti-Technologists," in *Civil Engineers in the World Around Us*, ed. M. D. Morris (New York: American Society of Civil Engineers, 1974), pp. 20–21.

the artist–engineer collaborative E.A.T.[70] Founded by Klüver, a Ph.D.-trained electrical engineer who quit his job at AT&T's Bell Labs to pursue a "revolutionary sociological process," E.A.T. shared much in common with CAVS. The groups, however, had key differences of vision.[71] Because of its early cold war roots, CAVS was linked to the research scientist as a visionary expert dedicated to fundamental questions. Kepes used the words "engineer" and "technology" far more sparingly than "scientist" or "science." E.A.T., on the other hand, appealed to disaffected corporate engineers; Klüver's aim was social interaction on the broadest scale possible. Collaboration would alleviate fragmentation and in the long term change technology by altering its developmental processes. E.A.T. promoted itself as a participatory democracy: no one was barred from joining, and artistic talent never was claimed as a prerequisite for engineers. Klüver, moreover, was dismissive of academicism, believing that only the professional engineer working with the professional artist in a corporate context would achieve social change: companies would provide the resources, engineers the technical skill, and artists the vision.[72] E.A.T. recruited widely through booths at professional conventions, art contests, advertising, and articles in technical journals. Participating engineers represented a broad spectrum of the profession in terms of training, employment, artistic training, and motivation. More often than not, however, whether communal dropout or defense researcher, participants echoed E.A.T.'s rhetoric of humane technology and the desire to achieve "meaningful" work by pushing the limits of personal and technical imagination.

At the same time that E.A.T. was generating national press as a politically safe strategy for sociotechnical change, MIT had become the epicenter of revolt against the military-industrial complex. In 1969, approximately 80 percent of the institute's budget came from sponsored research, with the Instrumentation Laboratory and the Lincoln Laboratory, which had only marginal educational functions, accounting for over 50 percent.[73] On March 4, 1969, at the prodding of students and faculty members, regular operations shut down for

70. See Wisnioski, *Engineers for Change* (above, n. 15), pp. 139–148, 158–160.

71. For an alternative analysis, see Goodyear, "György Kepes, Billy Klüver, and American Art of the 1960s" (above, n. 4).

72. "Goals," *E.A.T. News*, November 1, 1967, p. 5.

73. Jonathan Allen, ed., *March 4: Scientists, Students, and Society* (Cambridge, MA: MIT Press, 1970); Dorothy Nelkin, *The University and Military Research: Moral Politics at MIT* (Ithaca, NY: Cornell University Press, 1972); Stuart W. Leslie, *The Cold War and American Science: The Military-Industrial-Academic Complex at MIT and Stanford* (New York: Columbia University Press, 1993), pp. 233–256.

a teach-in that gave rise to the Union of Concerned Scientists. The fall term unfolded with daily protests and threats of rebellion, culminating in the expulsion of student leader Michael Albert and the ransacking of the chairman of the corporation's office.

MIT's entrepreneurial spirit, however, translated into myriad plans for conversion from defense research to civilian needs. Scientists and engineers in the Fluid Mechanics Laboratory already had abandoned missile-reentry physics for air-pollution control. In 1969, faculty members throughout the institute petitioned for a program in Social Inquiry. Another interdisciplinary group, composed mainly of engineers, attempted to create a program for the Social Application of Technology. The School of Architecture and Planning focused on environment design. With Ford Foundation funding, the school initiated the Urban Systems Laboratory in tandem with the Sloan School and the departments of civil engineering, economics, and political science.

Given the magnitude of the controversy over the special laboratories, the arts played a marginal role in resolving MIT's problems. Nonetheless, Charles Stark Draper, who was the director of the Instrumentation Laboratory, looked for friends anywhere he might find them. In the new technological art journal *Leonardo*, he wrote that the increasing complexity of technology required "a new profession." This interdisciplinary leader would have the skills of a generalist combined with real-world experience, "imagination, creativity, self-reliance, drive and willingness to accept responsibility for overall accomplishment of results."[74]

Throughout MIT there was a shared belief that it was in a unique position to direct humane technological progress.[75] CAVS was conceived in a different frame, but the gap between "making technology human" and the *Language of Vision* was not dramatic and Kepes's evolved accordingly. "We live in a time of crisis—deep, pervasive, expanding," he wrote in a 1968 article that introduced the first fruits of the center's collaboration. "But it is also a time of enormous promise and vitality. The most creative members of the artistic community are responding to the scientific revolution with power and imagination, and are exploring its latent poetry." The scale of art, he argued, must increase to a civic level in order to meet the scale of technology. The object of his desire remained a Boston Harbor light tower, which he saw as a means of generating "festive qualities as common prop-

74. Charles Stark Draper, "Technology, Engineering, Science and Modern Education," *Leonardo* 2:2 (1969): 147–153.

75. Massachusetts Institute of Technology Commission on MIT Education, *Creative Renewal in a Time of Crisis* (Cambridge, MA: The Commission, 1970).

erty," of instilling "group identity," of controlling the "luminous accidental richness of urban life," and of building "a man-machine system so inspired as to nourish and give symbolic form to a new self esteem and dignity of man."[76]

The Panacea That Failed?

But Kepes's vision of progress as a single beam of light increasingly read like a communiqué from a bygone era. Locally and nationally, collaboration with the military-industrial complex had become suspect. In 1969, a year of strikes, moratoriums, and riots, Cambridge's counterculture, as well as many in the MIT community itself, turned against collaboration in general and the vision of CAVS in particular. In MIT's underground newspaper *Thursday*, humanities instructor William Thompson described a symposium dedicating the Coop as a cynical effort by MIT to "protect itself and beguile the artists with all the temptations at its disposal." Artists should attack injustices, but instead they were being co-opted by technocrats. This was not confined to CAVS, he concluded, but infused all of MIT's humanistic endeavors.[77]

Extending into the mid-1970s, similar recriminations echoed throughout the art world at large. E.A.T. was accused of corruption and incompetence, with the paranoid fringe claiming that it was a means of picking artists' creative minds for CIA projects.[78] The group virtually fell apart during the 1970 World Exhibition in Osaka, Japan, when it broke ties with PepsiCo, its only real corporate patron, because of Pepsi's meddling in the design and E.A.T.'s budget overruns.

CAVS fellows struggled with the shifting politics of collaboration. Kepes began deploying anti-technology rhetoric in his otherwise optimistic message. In *Arts of the Environment*, he attributed "destructive forces of a completely new kind" to the rapid accumulation of technological innovations, which nonetheless could be overcome through collaborative environmental design that maximized human experience and interaction. By seeing water-purification plants not as dirty industrial systems to be hidden from the public eye, they could be made into civic symbols of conservation.[79] For CAVS fel-

76. No mere thought experiment as later commentators would have it, Kepes hoped that the project could be realized were Boston to host America's Bicentennial; see György Kepes, "The Lost Pageantry of Nature," *Artscanada* 25 (1968): 30–40.

77. Thompson, "Art and Science" (above, n. 1).

78. Alex Gross, "Who Is Being Eaten?" *East Village Other*, March 3, 1970.

79. György Kepes, "Art and Ecological Consciousness" and "The Artist's Role in Environmental Self-Regulation," in *Arts of the Environment*, ed. György Kepes (New York: George Braziller, 1972), pp. 1–12, 167–197.

Creative 53

Jesus, another "creative"....

Creative Advertisements Inc 120E56 .. 753-4174
Creative Advtg Promotions Co 38W32 .. 564-6065
Creative Agncy Inc 295MadAv 889-4600
Creative Aids Inc 6Chrch .... WOrth 4-3950
Creative Art Cntr 1442 3Av 249-9704
Creative Art Flowers Inc 915Bway 533-3650
Creative Art Lighting Corp Imps
256GeogaAv Bklyn HYcnth 5-8720
Creative Art Prntng Co 106E19 .. GRamrcy 7-1392
Creative Art Statnry Co 520W36 ...... LO 3-7948
Creative Artists 250W57 765-1888
Creative Arts Rehabilitation Cntr Inc
18W74. 724-0500
CREATIVE BINDRY INC 215E22 679-5533
Creative Campaign Analysts 303W42 .. CI 6-5300
Creative Capital Managemt 330MadAv .. 682-2085
Creative Careers Only 527MadAv 688-2810
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CREATIVE CELL 430E56 355-6858
Creative Cntr Inc 29E61 838-1542
CREATIVE CHARTISTS DIV OF CREATIVE UTILITY SVCES INC 88Reade 267-3981
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1010Hope SpringdaleConn NYC# 597-2134
CREATIVE COLOR INC 25W45......JU 2-3841
Creative Concepts dsghrs 123E54...... 753-0241
Creative Containers Corp
175CentralAv PassaicNJ NYC# LO 3-3684
Creative Copy Assocs 527LexAv 421-2365
Creative Crafts Corp 46E11 .... OR 4-3783
Creative Custom Labs 37E28 532-7870
Creative Cut Beauty Salon
1464StNchlasAv. 781-9420
Creative Decor 77Bleekr 477-6780
Creative Designs Internatl 1RivrdlAv Bx. KI 9-4545
Creative Dimensional Prods Corp 4W40 .. 524-2161
Creative Displays Inc 1270Bway 565-0612
Creative Drapery 524W43 .... LA 4-6290
CREATIVE EAST INC 150E19 ......AL 4-8776
Creative Embroidery Co 99Sprng .... WA 5-6822
Creative Enamel 50W47 246-9661
Creative Engnrng Co 88Reade 267-3981
Creative Fabrics Inc 991 6Av .... PE 6-4253
Creative Features Inc 19E53 .... PL 5-6131
Creative Film Assocs Inc 127W96 .... AC 2-7006
Scrng&Editing Rms 723 7Av 246-3030
Creative Finishes 306E59 .... TEmpltn 2-8570
Creative Food Svce Inc 300E46 .... YU 6-5140
Creative Furs 242W30 .... LOngacr 4-8559
Creative Galry 36W57 245-7370
Creative Graphic Svce Inc 119W23 . YUkon 9-0298
Creative Group Inc The 432ParkAvS 684-5560
Creative Handbags Inc 1204Bway ...... MU 6-4790
Creative Hobbies 71W23 242-2993
Creative House Imprts OldWindyBush&
AquetongRds NewHopePa 215 862-5604
If No Answer PhiladelphiaPa 215 794-7012
Creative Hse Inc 21E40 532-5250
CREATIVE IMAGES 115W71 ....SU 7-2626
Creative Images Ltd 200W57 586-1627
Creative Imprts Inc 6E39 .... MU 3-3052
Creative Internatl Inc 132Nasau 925-5720
Creative Internatl Inc 156W44 247-7377
Creative Investor Svces Inc 550 5Av ... PL 7-3638

Creative Lamp Co 304E54 .... MU 8-3520
CREATIVE LEASING CORP 216E49 ..421-0770
Creative Leather Goods 64Fultn 964-3988
Creative Lithography Inc 207W25 .... CH 2-6257
Creative Looms Inc fbcs 231E51 ..... MU 8-2863
Creative Mailing Svce Inc
1100StewrtAv GrdnCty .... 516 ED 3-8100
Creative Managemt Assocs Ltd 555MadAv 688-2020
Creative Marketing Co 400ParkAv 752-4195
Creative Mdsng 160Varik .... YU 9-7380
Creative Metal Prods Inc fcty
68Fleet JerseyCityNJ. NYC# WO 2-1290
Creative Money Managemt 315 5Av ... MU 4-3590
Creative Monograms Inc rwlrs 83Canal. CA 6-7864
Creative Motion Picture Corp 550 5Av .. PL 7-6454
Creative Opticals Inc 35W45 .... JU 2-3020
CREATIVE PACKAGING INC 330MadAv 867-2850
Creative Paintg&Decratg Co
20EKngsbrdgRd FOrdhm 4-2000
CREATIVE PERFUMERS & FLAVORISTS INC prfums 636Bway 254-0118
Creative Placement Agncy 120E56 752-7623
CREATIVE PLAYTHINGS INC—
Retail Store 1RokfelrPlz .... JU 2-6699
Exec&Buying Office
EdinburgRd CranburyNJ NYC# WA 5-5311
Creative Polyproducts Co 42Bond ......AL 4-3037
Creative Press 749 2Av .... MU 7-7381
Creative Process Corp colr separations
64W22. CH 2-1015
Creative&Productive Ideas Inc 50Bway 943-5517
CREATIVE PROGRAMS CORP
295MadAv 889-4600
Creative Projects Inc 10E40 .... LE 2-7560
Creative Promotions 341MadAv 684-4896
Creative Research Designs 1RokfelrPlz.. JU 6-7327
Creative Research Svces Inc 220 5Av .. MU 6-6997
Creative Sampling CoInc 33Bleekr 228-0550
Creative Scope Inc 1E42 687-2570
Creative Screen Prntrs 42Bond ...... AL 4-3037
Creative Svces 1133Bway .... CH 3-6071
Creative Signs&Displays Inc 866UNPlz. 751-6320
Creative Steel Rule Die Co 24Wostr WOrth 6-4650
Creative Studio frat supls 175 5Av .. GR 5-1399
CREATIVE SURFACES INC 175 5Av ..475-0630
Creative Systms Inc
2079WntaghAv Wntagh 516 826-3325
Creative Texstyle Inc 2875Bway ...... OR 5-4257
Creative Textiles Inc crpts 295 5Av .. MU 5-5920
Creative Therapy Cntr 88-45 163 Jam .. 523-1913
Creative Tour Operators Assn Inc
777 3Av. 758-2011
Creative Travl Svce 445ParkAv 421-7272
Creative Trust The 550 5Av .... PL 7-3638
Creative Type Composition Svce The
150 5Av. 691-7000
Creative Utility Svces Inc 88Reade 267-3981
Creative Ventures Corp 866UNPlz 752-7060
Creative Visual Media Inc 138E36 .... MU 5-8236
Creative Visuals 137E36 686-3170
Creative Workshop Inc art 1376 1Av.... 988-5100
Creativision Inc 1780Bway ..... CI 5-4830
Creativity Unlimited Film Prodctns
1379LexAv. 876-7654

Figure 6. Otto Piene, "Jesus, another 'creative . . .,'" from his book *More Sky* (1973). (Source: Courtesy of MIT Press and Otto Piene.)

low and Kepes protégé Piene, art was critical to movement politics; during MIT's Vietnam moratorium, crowds marched under his forty-foot balloons. Still, Piene mocked the superficial appropriation of aesthetic virtue. His book *More Sky* included the found commentary of a phone directory listing over a hundred "creative" businesses (fig. 6).[80] He also doubted that artists willingly would abandon individual authority for teamwork, and questioned the value of speculative projects with little likelihood of success, such as the center's plans for Boston Harbor. Burnham sided wholeheartedly with the critics. The "underlying purpose" of CAVS, he later claimed, was "not primarily to do visual research or to make art, but to produce lavishly illustrated catalogues and anthologies that would impress foundations."[81]

In the early 1970s, supporters and detractors alike chronicled the implosion of the nascent technological arts.[82] Co-optation, superficiality, artistic hubris, close-mindedness, fractious beliefs about technology, and the specter of Vietnam were cited as causes for souring among artists. But more significantly, the decline was part of an economic recession in the military-industrial complex. University plans for humane technology were curtailed nationwide amid cutbacks and budget freezes. Their profits reduced, corporations also were less likely to fund art.

At MIT, Kepes foresaw the demise of CAVS. Because it was structured as a center, survival depended on a constant flow of external funding. CAVS achieved reasonable success with nonprofit foundations, but corporate support never materialized. The burden of being a visionary, moreover, was the uncertainty about what happens when you leave. CAVS thrived on Kepes's ability to foster interest among faculty and administrators, and most of the technical assistance received by the fellows came from his contacts. Perhaps most dismaying, Kepes discovered that the fellows would abandon collaboration whenever an individual commission seemed possible. From the vantage of 1972, the answer to the question "Why did MIT institutionalize the avant-garde?" was that "It did not"—either because CAVS failed to meet its utopian ambition, or because that ambition was, in fact, retrograde.

80. Otto Piene, *More Sky* (Cambridge, MA: MIT Press, 1973), pp. 25, 53.

81. Burnham, "Art and Technology" (above, n. 3), p. 240.

82. Goodyear provides an excellent account of the backlash in "From Technophilia to Technophobia" (above, n. 14), pp. 169–173.

Conclusion

To see that the faltering of Kepes's vision was a temporary nadir, we need only to open our universities' homepages nowadays or peruse their strategic plans. After a backlash in the early 1970s, the technological arts have surpassed even their cold war energy. This renaissance might be explained simply by pointing to the proliferation of technology in everyday life: in a world of "second nature," artists now universally accept that their task is to give it meaning. We might go deeper and claim that the boom is a consequence of a networked society in which technology is more accessible and user-friendly than in 1960; or analyze how late-1960s evangelists like Stewart Brand helped to make this hybrid world a reality;[83] or argue that the "humanization" of military-industrial-academic research is still the main objective—after all, MIT's current budget draws $636 million in sponsored research from the Lincoln Laboratory alone.[84]

Vital to the expansion of the technological arts today, however, is the continued pattern of multifaceted participation by technoscientific practitioners and institutions that was originally established during the cold war era. Individual scientists and engineers, universities, governments, and, increasingly, private industries have been eager to collaborate with artists for a range of motivations, from simple curiosity to corporate public relations, educational reform, profit, or a multitude of political visions. I have introduced the notion of aesthetic virtue to explain this confluence of desires. The belief that the arts, sciences, and engineering should be closely aligned, of course, is not a phenomenon unique to the post–World War II era. Cold war proponents of aesthetic virtue themselves were quick to cite debts to Leonardo da Vinci, cathedral-builders, and even the Romans. The artistic impulse for many engineers and scientists as a vaguely expressed means of overcoming alienation or finding joy in similitude, moreover, does not itself constitute a topos of aesthetic virtue; but for the era's most successful practitioners, the arts formed the core of distinct visions for attaining the good through collaborative acts of creation.

Collaboration was essential for mobilizing these visions, but also was the most volatile aspect of technological art. Existing collaborative practices in both the arts and science and engineering were

83. Fred Turner, *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism* (Chicago: University of Chicago Press, 2006).

84. Claude R. Canizares, "Sixty-Six Years of Sponsored Research," *MIT Faculty Newsletter* 193 (2007). http://web.mit.edu/fnl/volume/193/canizares.html.

important for bridging a two-cultures divide that commentators argued was unique to their time. Kepes came to the United States as part of Moholy-Nagy's effort to recreate the Bauhaus in Chicago. Piene helped to create Group Zero. E.A.T.'s artists of record—including Robert Rauschenberg and John Cage—worked together at Black Mountain College. For scientists and engineers, collaborative labor had become the postwar norm in research and development projects distributed across departments, schools, contractors, and national laboratories.

Despite the near universal embrace of interdisciplinarity, however, sustained collaboration was rare. CAVS fellows described their time at MIT as a "candy-store of information and equipment" in which they were able to get volunteers to assist on their projects. Still, in oral histories, they reminisced about friendship, but noted a lack of real teamwork.[85] Moreover, in corporate contexts, the rhetoric of the arts was effusive though actual funding was scarce. E.A.T. engineers claimed that art could be constituted as research, and that participation would result in revenue-generating spin-offs or publishable research. However, Bell Labs division director John Pierce, although sympathetic to his engineers, described E.A.T. to superiors as equivalent to a hobby like golf.[86] Most significantly, for artists during the cold war, collaboration was subject to antithetical interpretations: it was a path to unity, to new discoveries, to epic projects; but to collaborate also was to sell out, to lose creative autonomy, to be complicit in The System's destructive imperatives.

A networked history of CAVS thus is important because it insists that we approach creativity, collaboration, and the other elements of aesthetic virtue as more than a free-floating cold war zeitgeist. Unlike collaborations across the country, and unlike myriad simultaneous efforts to humanize technology at MIT, CAVS did not fold in the early 1970s; on the contrary, it expanded in a variety of directions and spawned institutions elsewhere. CAVS survived for three reasons. First, high-level science and engineering administrators—Walter Rosenblith, Beranek, and other members of the MIT Corporation—had internalized Kepes's vision and supported CAVS when it failed to secure external funding. Second, in exchange for financial stability, CAVS became a teaching unit by resurrecting the general-education duties that Kepes had severed with the founding of the center. By 1984, the number of students instructed annually

85. For example, the oral histories of David Curt Morris (tape 9), Otto Piene (tape 11), and Robert Preusser (tape 12), in Records of the Committee of the Visual Arts, box 1, Institute Archives & Special Collections, MIT Libraries, Cambridge, Massachusetts.

86. Wisnioski, *Engineers for Change* (above, n. 15), pp. 145–146.

had reached over 200. And finally, Piene, who in 1974 became the center's second director, proved to be a worthy successor who moved CAVS outside the studio into participatory, environmental art.[87]

What distinguished CAVS from its peers was its attempt to professionalize a new kind of avant-garde, first through residency and later through the establishment of a graduate degree program. These artists of the electronic age—numbering over a hundred in four decades of operation—were to be embedded partners with technoscientific practitioners. CAVS also proved highly adaptable in an evolving organization with different constituencies to be marshaled for support. However, as I have argued elsewhere, the apparent stability of this institutionalization relied upon bonds that always were contingent. While the desire to be a leading center of creativity remained constant, configurations of aesthetic virtue were never settled at MIT; indeed, in the early 1980s, disagreements about the sources and ends of artistic creativity resulted in a split between the arts as humanist critical inquiry and the arts as market-oriented, human-centered design.[88]

This combination of contradictory notions of humane technology with local politics is vital to understanding the growth and evolution of art/science/technology hybrids elsewhere. Aesthetic virtue is everywhere present in the here and now. Google, for example, holds an employee art contest.[89] Engineer reformers concerned with broadening the global and humanitarian perspective of students look to the arts as a font of creativity; one recent National Science Foundation–funded project at the University of South Florida, for example, uses the arts to "broaden students' engineering perspectives" on the one hand, and to keep broadminded students "attracted to engineering careers" on the other.[90] Similarly, engineering institutions like the University of Wisconsin's College of Engineering have published pamphlets of campus artwork to show that "engineers develop and express their creativity in many ways."[91] Moreover, in departments

87. Otto Piene, "A Five Year Plan for CAVS, 1985–1990" (1984?), in RSAP, box 15, folder "CAVS Five Year Plan," Institute Archives & Special Collections, MIT Libraries.

88. I explore the history of CAVS in the 1970s and '80s in Wisnioski, "Centerbeam" (above, n. 37), pp. 185–228.

89. Michelle Kung, "Google-y Art Wall Competition Shows Off Employees' Creativity," *Wall Street Journal Blog*, August 27, 2010. http://blogs.wsj.com/digits/2010/08/27/google-y-art-wall-competition-shows-off-employees-creativity/.

90. National Science Foundation, "Press Release 06–127: The Art of Engineering," September 11, 2006. http://www.nsf.gov/news/news_summ.jsp?cntn_id=107990.

91. College of Engineering, University of Wisconsin–Madison, *The Art of Engineering* (Madison: University of Wisconsin Press, 2001). Quotation is from http://www.engr.wisc.edu/server/welcome/artofengineering/.

of biology, chemistry, physics, and their interdisciplinary hybrids at research universities worldwide, scientific images, deliberately hung as "art," lined the walls.[92] For many, this amalgamation of interests is tied to a new postdisciplinary identity of the professional "innovator." In his 2008 treatise *ArtScience: Creativity in the Post-Google Generation*, for instance, former MIT chemical engineering student David Edwards argues that our present modernity has allowed a creative class to break free from disciplinary constraint in a style thought at "once aesthetic and scientific—intuitive and deductive, sensual and analytical, comfortable with uncertainty and able to frame a problem, embracing nature in its complexity and able to simplify nature in its essence."[93]

The general exuberance for a convergence of art and technology today is similarly built on competing claims to creativity and collaboration, on desires to refashion scientific and engineering selves, on projects to define the creative human in a technological age. Behind every official statement of "breathing the same air," however, there is a path as negotiated and compromised as that of CAVS. Kepes was important in the 1960s and is increasingly recognized today not for the accuracy of his vision, but because he normalized a hugely disparate and diverse set of activities and ambitions into institutional reality. CAVS demonstrated how to turn bricolage into inevitable convergence.

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92. See, for example, Felice Frankel, *Envisioning Science: The Design and Craft of the Scientific Image* (Cambridge, MA: MIT Press, 2002).

93. David Edwards, *ArtScience: Creativity in the Post-Google Generation* (Cambridge, MA: Harvard University Press, 2008), p. 7.