

HISTORICIZING ART AND TECHNOLOGY: FORGING A METHOD AND FIRING A CANON

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Science and technology, the handmaidens of materialism, not only tell us most of what we know about the world, they constantly alter our relationship to ourselves and to our surroundings.... If this materialism is not to become a lethal incubus, we must understand it for what it really is. Retreat into outmoded forms of idealism is no solution. Rather, new spiritual insights into the normality of materialism are needed, insights which give it proper balance in the human psyche. A small beginning is to record its effects upon one art form. This book is directed toward that task.

- Jack Burnham, *Beyond Modern Sculpture*, x.

In the early 1990s my professional life fell under the influence of some writings about art and technology: Jack Burnham's *Beyond Modern Sculpture: The Effects of Science and Technology on the Sculpture of This Century* and Roy Ascott's essays, including "Is There Love in the Telematic Embrace?"¹ I was a first-year graduate student in art history at Duke University and had planned to study a more conventional topic. But the rush of the 21st century as the very near future simultaneously bore down and uplifted me with great intensity. Recent developments in consumer technologies, including relatively powerful personal computers, user-friendly

¹ Jack Burnham, *Beyond Modern Sculpture: The Effects of Science and Technology on the Sculpture of This Century* (New York: Braziller, 1968); Roy Ascott, "Is There Love in the Telematic Embrace?" *Art Journal* 49:3 (Fall, 1990): 241-47.

software, and interactive media, including CD-ROM and perhaps more significantly, the World Wide Web, seemed to open up a new future of creative expression and exchange in which everyone could be a multimedia content-provider and thus break free from the tyranny of the culture industry. Inspired by, but skeptical of, such techno-utopian rhetoric, with Burnham and Ascott as my guides, with further illumination from the pioneering work of Frank Popper and Douglas Davis,² and under the mentorship of Kristine Stiles, I began to think more and more about the effects that science and technology were having on contemporary art and about how artists were using the ideas, methods, and tools of science and engineering to envision and create aesthetic models of the future. I also wondered what role art history might play in making sense of these developments in visual culture. Very quickly I realized that I had to study the entwined histories of art, science, and technology in order to have a clue about what was happening at the moment, much less what its future might bring.

The following discussion addresses the problem of writing a history of art that focuses on the nexus of art, science, and technology (AST). Although a fully elaborated history of AST must distinguish between science and technology with respect to their relationship to art, for simplicity's sake I shall refer to the intersection of art with either or both as AST. What follows constitutes a personal report from the trenches and a call-to-arms. Given the nascent state of the field, combined with its dynamic growth and extraordinary breadth, in some cases my arguments have forsaken subtlety in order to provoke. My foci are canonicity, methodology, and historiography, and my aim is to set out a prolegomena for future scholarship by critics, curators, art historians, and other cultural workers who

² Especially Doug Davis, *Art and the Future: A History/Prophecy of the Collaboration between Science, Technology and Art*, (New York: Praeger, 1973) and Frank Popper, *Origins and Development of Kinetic Art* (Greenwich, CT: New York Graphic Society, 1968) and *Art: Action and Participation* (London: Studio Vista, 1975).

produce, present, or otherwise try to make sense of AST.

I. Defining the Problem: Canoncity, Methodology, and Historiography

The development and use of science and technology by artists always has been, and always will be, an integral part of the art-making process. Nonetheless, the canon of western art history has not placed sufficient emphasis on the centrality of science and technology as co-conspirators, ideational sources, and/or artistic media. Bound up in this problem, there is no clearly defined method for analyzing the role of science and technology in the history of art. In the absence of an established methodology (or constellation of methods) and comprehensive history that would help clarify the interrelatedness of AST and compel revision, its exclusion or marginality will persist. As a result, many of the artists, artworks, aesthetic theories, institutions, and events that might be established as the keystones and monuments of such a revised history of art will remain relatively unknown to general audiences.

Indeed, there is no comprehensive scientific/technological history of art, as there are feminist and Marxist histories of art, for example. This leads one to wonder what a history of art written through a lens that emphasized AST would look like. What would be its monuments? How would they be related through historical narrative? What similarities and differences, continuities and discontinuities, might be mapped onto the use of technology for artistic purposes throughout the history of art? Why are there periods of fervent activity and others of apparent dormancy? In other words, how would the story go if standard survey texts, such as Janson's *History of Art* were re-written with an emphasis on the roles of science and technology on the history of art? In this regard, the sharp new two-volume set, *Art Since 1900*, written by Hal Foster, Rosalind Krauss, Yve-Alain Bois, and Benjamin Buchloh,

ignores the history of art and technology to such an extent that Billy Klüver and E.A.T. are not even mentioned. Such exclusion from a text that is destined to gain canonical status has significant, deleterious ramifications for the history of AST.

With respect to the literature in the field, Linda Dalrymple Henderson's "Writing Modern Art and Science" is, to my knowledge, the only historiographical analysis of writing about AST, perhaps because relatively little art historical attention has focused on the subject.³ More of such studies would be a valuable asset to current and future researchers as they evaluate and understand our intellectual heritage.

Leading art historians including Jonathan Crary, James Elkins, Henderson, Martin Kemp, and Barbara Maria Stafford, have contributed greatly to understanding the history of AST during the Renaissance, Baroque, and Modern periods. With respect to contemporary art, however, much of the pioneering historical, critical, and theoretical literature in English has been written by artists, including Ascott, Burnham, Critical Art Ensemble, Douglas Davis, Mary Flanagan, Alex Galloway, Eduardo Kac, Margo Lovejoy, Simon Penny, Peter Weibel, and Steve Wilson, to name just a few. Notable exceptions include the work of Jonathan Benthall, Marga Bijvoet, Charlie Gere, and Frank Popper, the media-archaeological scholarship of Oliver Grau and Erkki Huhtamo, the criticism and editorial work of Tim Druckery.⁴

³ See, Linda Dalrymple Henderson, "Writing Modern Art and Science – I. An Overview; II. Cubism, Futurism, and Ether Physics in the Early Twentieth Century" *Science in Context* (2004), 17: 423-466.

⁴ Survey texts, including Christiane Paul's *Digital Art* (London and New York: Thames and Hudson, 2003) and Rachel Greene's *Internet Art* (London and New York: Thames and Hudson, 2004), together with edited anthologies, such as Ken Jordan and Randall Packer's *Multimedia: From Wagner to Virtual Reality* (New York: Norton, 2001), Noah Wardrip-Fruin and Nick Montfort's *New Media Reader* (Cambridge, MA: MIT Press, 2003), and Judy Malloy's *Women, Art and Technology*

Curatorial practice historically has made important contributions historically, including the production of exhibitions and exhibition catalogs by Burnham, Pontus Hulten, and Jasia Reichardt, and, more recently, by Sarah Cook, Steve Dietz, Beryl Graham, John Ippolito, Christiane Paul, and Benjamin Weil, who have also made contributions to exhibition theory with respect to curating electronic media. Festivals including SIGGRAPH, ISEA, and Ars Electronica, and major exhibitions at the ZKM also have provided important forums for discourses pertaining to AST, though typically focusing more on criticism and theory than on history. Similarly, until the early 1990s, the journal *Leonardo* primarily published writings by artists and scientists, in large part because critics and historians simply did not generate much material on the subject.

Much of the influential current literature is being produced in other disciplines, such as comparative literature, film history, performance studies, and cultural studies. Complicating matters, rather than argue for the innovative theoretical positions that characterize AST's history, as embodied in works of art and articulated in artists' theoretical writings, much recent criticism, particularly outside of art history, is peppered with citations of the usual suspects: Benjamin, Barthes, Baudrillard, Latour, Derrida, Deleuze, and Virilio. Summoning such demi-gods to lend authority to an argument reifies existing structures of power and authority in academic writing – a result that conflicts with the aims of post-structuralism and deconstruction. Suzanne Stone, the psychopathic television journalist portrayed by Nicole Kidman in the film *To Die For* (1995) famously stated, “you’re nobody if you’re not on TV.” The same logic applies in academia: You’re nobody unless you’re

(Cambridge, MA: MIT Press, 2003), as well as Rudolph Frieling and Dieter Daniels's *Media Art Net 1: Survey of Media Art* (Vienna and New York: Springer, 2004) and *Media Art Net 2: Key Topics* (Vienna and New York: Springer, 2005), originally published online <<http://mediaartnet.org>>, also have helped to historicize the field, though it must be noted that of these authors and editors, only Daniels is trained as an art historian.

footnoted. The historical monuments and documents of AST will continue to be excluded from the canon of art history and intellectual history unless their theoretical contributions to critical discourses are credited. If art historians do not succeed in doing so, no one will.

One must ask: What is the voice of art history and criticism with respect to AST? What unique and valuable contributions have they made; and what contributions can they make now and in the future to historicize the subject - both in art history as well as in a broader cultural framework? Although I have more questions than answers, I hope that these provocations will spur debate and dialogue so that artists and art historians, collectively, can define the problems of our specialized field more clearly and begin to address them, if not in a systematic and concerted way, then at least in a way provides a grounds for identifying and problematizing methods and goals.

My discussion begins with an analysis of Burnham's *Beyond Modern Sculpture*, which I shall consider critically with respect to methodology and historiography. Questions pertaining to methodology and canonicity shall be further developed through self-reflections on my own attempts to historicize cybernetic, telematic, and electronic art within a larger art historical context.

II. Beyond *Beyond Modern Sculpture*: Historiography, Methodology, Teleology

Burnham began his career as an artist, first using incandescent light in 1954 and, following the model of Gyorgy Kepes, neon light in 1955. After earning a BFA and MFA in sculpture at Yale in 1959 and 1961, he became a professor of art at Northwestern. There, he continued his research on what he called *photokinetics*, or light-motion phenomena, and began writing his magnum opus, *Beyond Modern Sculpture: The Effects of Science and Technology on the*

Sculpture of This Century, (*BMS*) published in 1968. The subtitle, the author explained, was not intended to limit the subject of his inquiry so much as to identify the close parallels between the development of modern sculpture and the rationalism and materialism that characterize the scientific culture of which it is a part. (*BMS*, vii-viii)

Even in the best of circumstances, it is difficult to gauge a book's influence. In the case of *BMS*, this difficulty is compounded by several factors, including: 1) its highly polarized reception; 2) the author's subsequent mysticism in the 1970s, which undermined his academic credibility; 3) the author's disappearance from public life since the early 1980s, which stunted his ability to spawn intellectual progeny; and 4) the cyclical nature of popular sentiment towards the idea of joining art with science and technology. Regarding this latter factor, after going through at least six printings, the book fell out of print in the early 1980s, but in the late 1990s experienced a significant resurgence of critical attention amidst a rebirth of interest in AST.⁵ Despite the difficulties of ascertaining the influence of *BMS*, it is a landmark in the history of writing about art, science, and technology. As such, I believe it holds many clues into the past, present, and future of the field's historiography.

The book's preface, in particular, sheds much light on Burnham's methodology and warrants close reading for its insights into the historiography of AST. The author described a spiritual kinship with Gottfried Semper's *Der Stil in den technischen und tektonischen Künsten oder praktische Ästhetik* (1863). Semper, Burnham stated, not only established a method for interpreting art as the combined result of "purpose, material, and technique," but promoted the idea that art reflected the "economic, technical, and social

⁵ Bijvoet (1997), Shanken (1998a, 1998b, 2001, 2002), Whitelaw (1998), Penny (1999), Wardrip-Fruin and Montfort (2003) relocated *Beyond Modern Sculpture* and related writings by Burnham more centrally within contemporary discourses.

relationships" undergirding society.(viii) Burnham contrasted this methodological ethos with one spawned thirty years later by Alois Riegl, who decried Semper's theory as *Kunstmaterialismus* - a reduction of interpretation exclusively to the material conditions of art production. In its place, Riegl advocated *Kunstwollen*, or artistic volition, which remained the dominant hermeneutic until the mid-twentieth century.⁶ Drawing on Siegfried Giedion's (1962) archaeology of art historiography, Burnham explained that, despite its idealism, Riegl's *Kunstwollen* theory, updated by Wilhelm Worringer, resulted in two generations of art historians since the 1920s being "studiously taught to shun the crass manifestations of the technical milieu while probing the intentions of the modern artist" (*BMS*, ix). Many artists and art historians working in the 2000s might argue that this prejudice persists. As mentioned above, the recent survey by Foster, Krauss, Bois, and Buchloh exemplifies the continued exclusion of AST from canonical histories of art.

Despite Burnham's explicit concern with methodology and historiography, perhaps the unusual approach taken in *BMS* stems from the author's lack of specialized training as an art historian, for he was neither indoctrinated into nor beholden to any particular methodological mold. Indeed, with a combination of irony and arrogance, he stated, "my lack of success with the tools of art scholarship is in part responsible for this present book. Had the tools served their purpose, I might not have sought out others less respected" (*BMS*, ix). At this formative juncture in establishing the histories of media art, science, and technology, perhaps artists, critics, and historians would do well to purge their methodological prejudices, scour retrograde methods like Semper's and Burnham's,

⁶ Burnham notes that subsequent critics compared this idealistic theory with the mystical and metaphysical concepts of "phlogiston" and "élan vital," which he described as "spurious doctrines that employed impressive terms to cover phenomena that had no satisfactory physical explanation." (*BMS*, viii-ix)

and create synthetic, interdisciplinary approaches to analysis, interpretation, and exposition. I shall return to this proposal with respect to my own work, but first the methodology behind *BMS* shall be examined in greater depth, with particular attention to the question of teleology.

Burnham argued that science and technology have played an important role in art's increasing embodiment of the qualities of living beings. His examples traversed a vast swath of history, from the myth of Pygmalion's ancient living sculpture to the realization of automata in the 18th century, and from early 20th century vitalist sculpture to the emergence at mid-century of art incorporating cybernetics, computers, and robots. His argument wove in and out of the teleological claim that the historical unfolding of art had been driven by the underlying goal of becoming ever more life-like. Indeed, *BMS* was commonly criticized for being simultaneously too general and too deterministic. For example, in 1969, Donald Judd complained, "It's a pastiche of art survey information and misinformation. His idea of history, such as it is, is deterministic. Everyone has his hindsight place and history rolls on."⁷ Krauss, in *Passages in Modern Sculpture*, wrote, "... Burnham argues that the most fundamental ambition of sculpture, since its beginnings, is the replication of life.... But is sculpture.... necessarily 'about' the imitation, simulation, and nonbiological re-creation of life? And if it is not about that, what are we to think of Burnham's thesis?"⁸

Despite the validity of these and other critiques of *BMS*, the prescience of Burnham's thesis has been striking. Developments in techno-science such as artificial life, bottom-up models of embodied

⁷ Donald Judd, "Complaints, Part 1" *Studio International* (1969) 177 (910): 184. Cited in Janet McKenzie, "Donald Judd" *Studio International* (2004) <http://www.studio-international.co.uk/sculpture/donald_judd.htm> Cited June 30, 2005.

⁸ Rosalind Krauss, *Passages in Modern Sculpture* (Cambridge, MA: MIT Press, 1977): 209-11.

intelligence in robotics, nano-technology, and molecular biology have become important models and tools for AST research. Krauss acknowledged the material conditions of art production but did not grapple directly with science and technology, an omission, from Burnham's perspective, of the features that defined the prevailing epistemological conditions of the twentieth century. Although one cannot know with certainty the historic place of any given cultural moment within the context of large-scale cultural shifts, the conditions Burnham identified in 1968 arguably persist with greater intensity in 2000s techno-culture. He likely would not have concurred with Krauss's paraphrasing of his thesis as "sculpture... necessarily [being] 'about' the imitation, simulation, and nonbiological re-creation of life." For Burnham, the development towards an increasing embodiment of life-like qualities was not exclusive to art, but was characteristic of rationalist, materialist culture as a whole, of which art was a part. At the same time, one reasonably might be skeptical, as Burnham himself later was, of a method that identified a certain set of artistic practices as avant-garde by virtue of mapping a model of scientific progress onto them.⁹

In "A Teleological Theory of Modern Sculpture" – the final section of the final chapter of the book – Burnham explicitly established his position regarding teleology with respect to art, science, and technology. He lay the groundwork for his argument by replacing the romantic refrain, "art for art's sake," with a more enigmatic explanation of art's *raison d'être* in scientific culture: "art is what we do when we expend great time, care, and patience on an activity without knowing why." (*BMS*, 374). This apparently purposeful purposelessness set the stage for Burnham's subsequent reflections and prognostications on the crucial importance of art as a means of survival in an overly rationalized society. Indeed, like many

⁹ Willoughby Sharp, "Willoughby Sharp Interviews Jack Burnham," *Arts* 45:2 (Nov 1970): 21.

intellectuals in the 1960s, he feared that the cultural obsession with, and faith in, science and technology would lead to the demise of human civilization. For Burnham, the apocalypse would not be caused by thermonuclear war but by the ascendancy of intelligent automata and cyborgs, a fear that Sun Microsystems co-founder Bill Joy trumpeted to great fanfare in *Wired* magazine in April 2000.¹⁰ Joy's sudden awakening to this danger after years of contributing to it, art historian Kristine Stiles has noted, is "symptomatic of the problem" of a technologist "burying his head in the proverbial sand ... with utter disregard for the insights and research of his colleagues in the arts and humanities."¹¹ One can only imagine the impact that *BMS* might have had on Joy and other technologists had it been assigned reading along with electrical engineering and computer science texts in the 1970s.

Echoing McLuhan's description of art as a "distant early warning system," Burnham wrote, "Art ... may be a means for *preparing* man for physical and mental changes *which he will in time make upon himself.*" (*BMS*, 373). Having previously reflected on the "role of sculpture in shaping our destination as a post-human species" (*BMS*, 371), he speculated that the "quasi-biological nature of future art ... implies a gradual phasing out, or programmed obsolescence of all natural organic life, substituting far more efficient types of life forms for our 'inferior' and imperfect ones." (*BMS*, 376). Alternately, he mused, an "increasing general systems consciousness" may convince us that our "desire to transcend ourselves" through technology is "merely a large-scale deathwish," and that ultimately, "the outermost limits of reasoning" are not reachable by post-human technology but "fall eternally within the boundaries of life." Would it not be ironic, he asked, if "organic life and 'intelligence' [are] ... the same thing." (*BMS*, 376). This

¹⁰ Bill Joy, "Why the Future Doesn't Need Us," *Wired* 8:4 (April, 2000).

¹¹ Kristine Stiles, Rants, *Wired* 8:7 (July, 2000).

rhetorical question anticipated discussions concerning embodiment, disembodiment, and the posthuman three decades hence.¹²

Burnham did not attribute a universal, transhistorical essence to art, science, or technology. In fact, following Semper, his teleological account was rooted in the historically variable contingencies of purpose, material, and technique. Culture was malleable for him, but once certain epistemic formations took shape, they could exert great and enduring influence until their internal logic is played out or are otherwise replaced by alternative formations. For centuries, Burnham claimed, the ethos of rationalization dominated western civilization, all aspects of which, including science and art, necessarily were pulled into its undertow. *BMS* provided an account of rationalization with respect to art. Burnham's teleological master narrative may be interpreted as reflecting the enduring characteristics of that ethos. It was internally consistent in the sense that it simultaneously made a case for and exemplified the persistence of rationalized culture, including the necessity that explanatory narratives coherently progress to a univocal, ultimate conclusion. In other words, the tendency to formulate grand, totalizing narratives paralleled the rationalism and materialism of the scientific culture that framed Burnham's argument and the teleological theories that pervaded science and technology – to say nothing of art history - at the time *BMS* was written.

Burnham was at once enthralled by and apprehensive of science and technology. His greatest fear, however, was that the rationalistic and materialistic episteme - of which science and technology were symptomatic – would run rampant. Three decades later, the Sokol hoax and the ensuing "science wars" suggested that, while many humanists had adopted a much more relativistic and

¹² See, for example, N. Katherine Hayles *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago: University of Chicago Press, 1999).

non-linear approach to explain the march (not progress) of science, many scientists clung vehemently, if not antagonistically, to a more traditional and teleological notion that science progresses towards discovering the absolute truth. Burnham forecast that if human civilization persisted along that rationalistic path, it ultimately would be supplanted by technology. If, however, culture was reordered according to the principles of general systems theory (a theory credited to biologist Ludwig von Bertalanffy and highly influential on Burnham's thinking and in the humanities and social sciences), he suggested that the species might come to realize that organic life held greater bounties of intelligence and insight than any form of technology.

Burnham's entire *oeuvre* as a critic, art historian, and curator, including his books *BMS*, *Art in the Marcusean Analysis*, and *The Structure of Art*, his catalog essays and regular contributions to *Arts* magazine and *Artforum*, many of which were compiled in the volume, *The Great Western Salt Works*, and the theoretically and technically ambitious *Software* exhibition,¹³ demand a more elaborated historiographical analysis than can be offered here. The most comprehensive account of the history of AST in the 20th century, *BMS* not only provided the foundation for his other critical and theoretical work but, for the purposes at hand, represents his most unabashed championing of AST. He would not remain an advocate for long.

The seeds of Burnham's disenchantment with AST began to emerge in "The Aesthetics of Intelligent Systems,"¹⁴ and are evident in

¹³ See: *Art in the Marcusean Analysis*. State College, PA: Penn State Papers in Art Education, 1969; *The Structure of Art*. New York: George Braziller, 1971; *The Great Western Salt Works: Essays on the Meaning of Post-Formalist Art*. New York: George Braziller, 1974; *Software, Information Technology. Its New Meaning for Art*, Judith Burnham, ed. (exhibition catalogue) New York: The Jewish Museum, 1970;

¹⁴ Jack Burnham, "The Aesthetics of Intelligent Systems," in Edward Fry, ed., *On the Future of Art*, New York: The Viking Press, 1970): 95-122.

Software, despite the exhibition's explicit use of computers. His most explicit and antagonistic pronouncement, however, appeared much later, in "Art and Technology: The Panacea that Failed,"¹⁵ where he stated that art and technology were incommensurable on the most basic structural level. After writing *BMS* Burnham began forging a method that incorporated structuralism, alchemy, and kaballah. This method, applied to his research on Duchamp and conceptual art, led him to conclude that the internal logic of western art compelled it to reveal its own internal semiotic structure. Using Duchamp's *Large Glass* as a metaphor, he explained that art was stripping itself bare, "dissolving into comprehension."¹⁶ Technology contributed nothing to that process and amounted to "whipped cream" on the cake, he later noted.¹⁷ Having lost faith in the ability of technology to contribute in a meaningful way to the signifying system that, according to his theory, mediated the mythic structure of western art, in *Software* he purposely joined the nearly absent forms of conceptual art with the mechanical forms of technological non-art to "exacerbate the conflict or sense of aesthetic tension" between them.¹⁸

For all his brilliance and erudition, Burnham's methods obscured his ability to understand the broader implications of technology as an integral part of art-making. Technology was, for him, merely a means to a pre-determined end that had nothing to do with technology, per se. By shedding the surface layers he believed he could uncover a grand scheme, what he referred to as the meta-

¹⁵ Jack Burnham, "Art and Technology: The Panacea that Failed" in Kathleen Woodard, ed., *The Myths of Information: Technology and Postindustrial Culture*. Madison: Coda Press, 1980); reprinted in *Video Culture*, John Hanhardt, ed. (New York: Visual Studies Workshop Press, 1986): 232-48.

¹⁶ Willoughby Sharp, "Willoughby Sharp Interviews Jack Burnham," *Arts* 45:2 (Nov., 1970): 21.

¹⁷ Jack Burnham, Personal correspondence with the author, March 16, 2001.

¹⁸ Jack Burnham, Personal correspondence with the author, April 23, 1998.

programs, self-metaprograms, and mythic structures that explained why art unfolded and evolved as it did and would continue to do so. In *BMS*, beneath the surface he posited and found life. In *Software* and *The Structure of Art*, he attempted to uncover the structural foundations of art as a social institution. In an odd way, this self-reflexive methodological approach may be compared with and contrasted to an advanced stage of Post-Greenbergian formalism taken to a meta-level of analysis. Greenberg posited three ineluctable modalities of painting – the characteristics of flatness, frame, and facture – and valorized work that explicitly addressed these formal qualities. Burnham identified increasing vitality as the underlying principle that propelled the historical unfolding of art and valorized work that instantiated and revealed that systemic process.

While vitalism and structuralism may remain important philosophical models, their limits in explaining the underlying motivations of art's history hardly need to be rehearsed. Indeed, one of the important lessons of post-structuralism has been a suspicion, if not outright rejection, of the very idea of universalizing master-narratives, a deconstruction of what Burnham himself might have described as the mythic structure of western epistemology. His pioneering application of structuralism to art historical methodology remained one order of analysis removed from such an insight – that crucial level that distinguishes structuralism from post-structuralism. Despite this and other shortcomings, *The Structure of Art* remains a fascinating if abstruse text that begs critical reappraisal as part of a larger reconsideration of Burnham's important contributions to art history.

III. Art, Science, Technology: Towards Forging a Method and Firing a Canon

From the invention of one-point perspective and the creation of oil paint to the development of interactive virtual reality environments and telematic art, technical innovation and the use of emerging scientific ideas and technologies as thematics and media have substantial continuity throughout the history of western art. This is at once not saying very much while also making a significant claim. For one could state just as easily and correctly that various forms of sociology, economics, psychology, philosophy, along with other analytic and creative tools have been employed in artistic practice and art historical interpretation for hundreds of years. What makes my claim significant is that the discipline of art history has embraced biography, formalism, feminism, Marxism, psychoanalysis, post-structuralism, post-colonialism, and other critical apparatus as bona fide methodologies. This leads me to ask: How can this field develop a more comprehensive understanding of art and technology without appropriate methods designed to bring it into relief? What would such methods consist of? What insights might emerge into the relationship between art, science, and technology, especially during periods when they seem relatively unrelated?

The critical and historical work of the aforementioned art historians, critics, and artists, offer valuable models that could be formalized into a set methods. The history, philosophy, and sociology of science and technology, exemplified by the work of Thomas Kuhn, Andrew Feenberg, Paul Feyerabend, Douglas Kellner, Latour, and Michael Heim, offer valuable tools for interpreting developments in AST. Literary criticism has a long tradition of critically analyzing media, ranging from pioneers like Marshall McLuhan to more contemporary authors including Jay David Bolter, Hayles, Janet Murray, and Walter Ong. Emerging from various fields, cultural studies has developed synthetic methods that draw on a variety of critical approaches to analyze complex phenomena, particularly with respect to mass culture, including television, film, and mass media, as pioneered by Raymond Williams and more recently

applied by media theorist Lev Manovich to interpret screen-based multimedia. Given the increasing emphasis on inter- and transdisciplinary collaboration, social science methods from fields including anthropology and psychology, as in the work of Brigitte Steinheider, may offer important insights into the hybrid processes and processes of such research.

Art history is, by its nature, an interdisciplinary undertaking. Ultimately, no single method is sufficient to exhaust the infinite possible interpretations of a work of art. AST, moreover, is a remarkably broad field with a long history. Hence, no single method could hope to provide a comprehensive tool for analyzing a subject of such breadth and duration. Nonetheless, the field of art history would benefit by studying the methods employed by other disciplines to analyze the relationship between science, technology, and culture in general and by elaborating a methodological framework(s) designed to address the particularities of the aspect of AST in question. Such a method(s) would offer valuable insights into the historical relationship of art, science, and technology and provide a basis for understanding how that nexus, in turn, relates to other cultural forces (e.g. politics, economics, and so forth) that have shaped the unfolding of art.

In the absence of a basic method that incorporates the history, theoretical content, and practical applications of science and technology, the canon of art history exhibits an impoverished understanding of the role of both technology in the history of art-making and the contributions of artists who have been important innovators in that regard. This is a slippery slope. On the one hand, the reconstruction of a master narrative is challenging theoretically, if not ethically. Indeed, many of the distinguishing characteristics of contemporary AST would seem to challenge the epistemological foundations that legitimate grand narratives. In this respect, the canonization of AST is arguably tantamount to ensuring

its failure by its own criteria. At the same time, canonical revision that reflects the importance of technology throughout the history of art, implies a critical reconsideration and recontextualization of artists, artworks, art-making practices, and historical narratives that previously have been excluded, marginalized, or not understood to their fullest potential. In a different context, Burnham himself once remarked, “all progressive things are accomplished with the aid of the System.”¹⁹

In confronting this dilemma, I hope that the following considerations will at least help demarcate some of the critical issues that surround this problematic enterprise, with respect to the particularities of contemporary art involving emerging technologies and to the more general concern of including the study of technology as central to the history of art. I’ll begin by sharing some of my thoughts on these questions with respect to art and art history after 1900, which I shall expand with more detailed examples drawn from my own work in the field.

Although theoretical challenges to master-narratives and grand schemes constitute a valuable corrective to naturalized discursive strategies and methodological models, the problem of defining a data-set remains. The following considerations, while grossly simplified, illustrate the issue. Discourse depends on and necessitates that participants in it agree that they have a more or less coherent subject to respond to or talk about. They may disagree vehemently about certain objects, methods, and goals but there must be some common ground. Canons provide that common ground, a shared database of generally accepted objects, actors, and moments that are held together by virtue of their participation in the construction of an evolving discourse. In order to be part of the discussion, those objects, actors, and moments

¹⁹ Quoted in Grace Glueck, “Art Notes: The Cast is a Flock of Hat Blocks,” *New York Times*, December 21, 1969.

must be admitted to the canon by its gatekeepers. The primary gatekeepers are art critics, art historians, curators, dealers, and collectors and the institutions they represent: e.g. journals, the academy, museums, commercial galleries, auction houses, and collectors. Practically speaking, a canon can be only so large. While it must have sufficient examples to demonstrate its authority, its significance is predicated on a certain exclusivity. So, for each work newly admitted to it, another must be removed. The sorts of judgments that administer this gatekeeping junction cannot be separated from ideological agendas, professional ambitions, and financial investments. Support for and acceptance of a work as a canonical monument requires strenuous and subtle negotiation in order to make a case that compels other gatekeepers to concur. For the more gates an object, actor, or moment succeeds in passing through, the more securely entrenched in the canon it becomes. And, of course, the canon is neither monolithic nor set in stone.

Indeed, the canon of western art history has been modified dramatically, particularly by reconstructions mounted in the names of Marxism, feminism, multiculturalism, and post-structuralism. Janson's *History of Art, Second Edition* (1977), which I read in college in the 1980s, women artists were all but absent. The canon is, to be sure, patriarchal and authoritarian, but it is not fascistic. Rather, it has proven to be quite flexible and resilient. Its existence and status do not appear seriously threatened, in part because challenges to it have focused on remedying exclusions or altering its narrative of stylistic progression rather than dismantling the fundamental structures of power endemic to it. Such a project would demand fundamental epistemological shifts that lie beyond the domain of art history, though the field might be able to offer useful models of non-canonical schemes for creating a shared discursive database, perhaps incorporating interactive technologies to produce a non-linear narrative structure. As appealing as such a transformation might be, one can imagine the extraordinary

challenges they would pose in the classroom. More to the point, they do not provide a solution for remedying the lack of recognition and marginalization of AST. To accomplish that goal, the monuments of AST must be identified and admitted to the canon (or other discursive database.)

One approach to canonical recognition is through surveys that include specific chapters on art and technology, as in Kristine Stiles and Peter Selz, *Theories and Documents of Contemporary Art*.²⁰ Alternately, AST monuments might be woven into thematic or chronological narratives that integrate the role of science and technology more fully into the fabric of art history. Along these lines, the study of technology as a hermeneutic method must be acknowledged along with the art historian's standard methodological tool-kit. Artists and intellectuals working in this area must become involved in the process of negotiation and gatekeeping that will enable AST to gain canonical status or to enter into the discursive domain of whatever will replace it. Such involvement includes attaining positions of authority in professional organizations, funding and exhibition institutions, the academy, publishing, and so forth. In many respects, the AST clan, such that it is, has already begun to infiltrate these ranks but has a long way to go to achieve. I am not suggesting a take-over of the artworld, merely a leveling of the playing field.

IV. Methodological Examples in My Own Work

Telematic Embrace: In 1995 I presented my first paper on Ascott at the Einstein Meets Magritte conference in Brussels.²¹ I continued to

²⁰ Kristine Stiles and Peter Selz, *Theories and Documents of Contemporary Art: A Sourcebook for Artists*. Berkeley: University of California Press, 1996.

²¹ Edward A. Shanken, "Technology and Intuition: A Love Story? Roy Ascott's Telematic Embrace," in *Science and Art, the Red Book of Einstein Meets Magritte*, (Dordrecht: Kluwer Academic Publishers, 1999): 141-156.

research the artist's work and in 1997, received a contract to publish a collection of his essays. In my lengthy introduction to *Telematic Embrace: Visionary Theories of Art, Technology, and Consciousness (TE)*,²² I attempted to contextualize Ascott's work as a practitioner, theorist, and teacher within the history of art, the history of technology, and intellectual history. My text was grounded fundamentally in the history of art in order to locate Ascott's *oeuvre* within a continuity of aesthetic strategies employed in experimental art in the 20th century. For example, I framed Ascott's cybernetic work from the 1960s in the context of painterly tendencies ranging from Cezanne to Jackson Pollock, vitalist and constructivist tendencies in British art from Moore to Pasmore and Nicholson, the use of alleatory techniques and a process-oriented approach to art-making by Arp and Cage, the interactive aspects of kinetic art and happenings, and the conceptualism of Duchamp, Kosuth, and Art and Language. I considered Ascott's work with telematic art in the context of these constituents of cybernetic art, plus mail art, situationism, performance, artists' use of telecommunications, interactive video, and other experimental streams.

I attempted to dispel the commonly held belief that art merely emulates concepts that first emerged in scientific or technological contexts. I theorized that the historicization of ideas often fails to acknowledge artistic developments as an originary source because the languages of art are neither as literal nor widely spoken as the symbolic and textual languages of science and philosophy. My research suggested that ideas emerge simultaneously in various fields and that the cross-fertilization of those ideas presupposes that an underlying context must already exist in order for seeds

²² Edward A. Shanken, "From Cybernetics to Telematics: The Art, Pedagogy, and Theory of Roy Ascott" in Roy Ascott, *Telematic Embrace: Visionary Theories of Art, Technology, and Consciousness*, ed. Edward A. Shanken (Berkeley: University of California Press, 2003): 1-94.

from one field to germinate in another. In the case of Ascott's work, I argued that cybernetics could be applied to the problems of art only because there already was a significant history of artistic experimentation with process, systems, and interactive forms. Cybernetics then, provided a formalized, scientific method to describe approaches with which artists (and others) had already been experimenting. As an example, I showed how Ascott's *Change Painting*, 1959 could be interpreted on the basis of cybernetic principles, yet its creation predated his awareness of cybernetics. To be sure, the elaboration of the science of cybernetics also provided a theoretical foundation upon which related aesthetic research could build, and I demonstrated how Ascott's art practice, theory, and pedagogy systematically applied those models.

With respect to Ascott's theories of cybernetic art, I drew a parallel between the process by which ideas become historicized and the role of artists' writings in theorizing a field. In this regard, I claimed that his writings exemplified how innovative artists often established the theoretical foundations of their practice long before it was incorporated into critical, curatorial, and historical discourses. Over and above that claim, I emphasized that Ascott's writings, like those of artists associated with conceptual art, such as Kosuth and Art & Language, not only theorized his practice but were an integral part of it. Indeed, Ascott's integration of practice, theory, and pedagogy was a central theme of the introduction, as was his integration of artistic, philosophical, scientific, and non-western systems of knowledge.

Given the importance of science and technology in Ascott's work, my analysis demanded explanations of cybernetics and telematics, in terms of both their basic principles and theoretical implications for the artist's work and for art and culture in general. Key sources for the evolution of cybernetic thought included the work of Norbert Wiener, Gregory Bateson, Heinz von Foerster, and James

Lovelock. Licklider and Taylor, and Nora and Minc's *Computerization of Society*, the 1978 report to French president Valéry Giscard d'Estaing in which the term "telematics" was coined, were primary source for telematics. Moreover, diverse influences, including the metaphysical ideas of Charles Fourier, Henry Bergson, Teilhard, and Peter Russell, the structuralist and poststructuralist notions of Barthes, Foucault, and Derrida, and Confucian, Taoist, Native American, and Shamanistic traditions, were explicated in relation to Ascott's theory and practice of cybernetic and telematic art.

McLuhan's famous adage, "the medium is the message" was a point of departure for my analysis of the relationship between form and content in telematic art. I argued that "The processes by which technological media develop are inseparable from the content they embody, just as the developing content [conveyed by] ... technological media is inseparable from the formal structures that embody it." I concluded that "form, content, and process must be considered within the particular contexts of their creation and interpretation," and that telematic art "emerges as a dialogical process of interaction in which exchanges of information create bonds through shared systems of meaning and value." (*TE*, 85-6).

Related considerations of the relationship between self and others in mediated, screen-based environments, drew on Manovich's archaeology of screen culture, Michael Heim's dialectical theories of technology, and original reflections based on a literary notion of love in Lawrence Durrell's novel *Justine* and my interpretation of Duchamp's *Large Glass* in contradistinction to Ascott's. Such questions led to a discussion of responsibility with respect to media, drawing on Baudrillard's "Requiem for the Media,"²³ and further reflections on the topic by artist/theorist Eduardo Kac, media

²³ Jean Baudrillard, "Requiem for the Media" in *For a Critique of the Political Economy of the Sign*. (Telos Press, 1983, c. 1972).

historian/theorist Douglas Kellner, and film/media historian Gene Youngblood.²⁴

My analysis and interpretation of Ascott's work of the early 1960s as a proto-conceptual kindled the insight that telematic art also shared affinities with conceptual art. This intuition, reinforced by an interview with artist Carl Loeffler and in response to an essay by Penny, led to the conclusion that, like conceptual art, the meaning of telematic art, as theorized by Ascott, was embedded largely in its idea. In another context, I applied this strategy - identifying parallels across categories of practice that traditionally had been historicized as discrete and impermeable - to a more general analysis of the relationship between technology and conceptual art.²⁵

I offer these examples to demonstrate the breadth and depth of sources and methods that I drew upon in my research for *TE*. Although I certainly am more predisposed to and comfortable with some approaches than others, I did not come to the task with a predefined method but rather attempted to allow the subject of my inquiry to dictate an appropriate approach. In the case of Ascott's

²⁴ Eduardo Kac, "Aspects of the Aesthetics of Telecommunications," *Proceedings, ACM SIGGRAPH '92* (New York: Association for Computing Machinery, 1992): 47-57; Douglas Kellner, *Jean Baudrillard: From Marxism to Postmodernism and Beyond*. Cambridge: Polity Press, 1989, and "Resurrecting McLuhan? Jean Baudrillard and the Academy of Postmodernism," in Marc Raboy and Peter A. Bruck, eds., *Communication for and against Democracy*, (Montreal/New York: Black Rose Books, 1989): 131-146; Gene Youngblood, "Virtual Space: The Electronic Environments of Mobile Image" *International Synergy* 1:1 (1986): 9-20.

²⁵ See my "Art in the Information Age: Cybernetics, Software, Telematics, and the Conceptual Contributions of Art and Technology to Art History and Aesthetic Theory." Doctoral Dissertation, Duke University, 2001; and "Art in the Information Age: Technology and Conceptual Art" *SIGGRAPH 2001 Electronic Art and Animation Catalog*, (New York: ACM SIGGRAPH, 2001): 8-15.

work, which itself draws on such diverse sources, a highly synthetic method seemed necessary. With respect to the creation of a methodology for writing the history of AST, I conceive of the emergence of methodology and historical narrative as a mutual and reciprocal process, in which each functions for the other as both the cart and the horse that pulls it.

Art and Electronic Media: In 2002 I started writing a book tentatively entitled *Art and Electronic Media*. It will consist of a large-format, richly illustrated, hard-bound volume that includes a 20,000 word survey essay illustrated with 50 reference images; a works section of 180 color plates with captions of 100-150 words; a documents section consisting of 110,000 words of edited critical writings pertaining to the topic; and, in addition, artist biographies and a bibliography. In other words, the volume will present itself as canonical. However, unlike other topics in the same book series, such as Minimalism, Arte Povera, and Conceptual Art, there is no clearly defined canon of electronic art.

The opportunity and responsibility to create a canonical survey of this topic has been both euphoric and fearful. My over-riding goal has been to enable the rich genealogy of art and technology in the 20th century to be understood and *seen*, not just as a quirky and marginal activity, but as central to the history of art and visual culture since the early twentieth century. To this end, I included work of artists, engineers, and institutions from over thirty countries, attended to issues of race, gender, and sexuality, and structured the book thematically to emphasize continuities across periods, genres, and media.

While assembling this manuscript, I confronted a number of difficult questions about how to historicize the use of electronic media in and as art. The following identifies some of these issues and the following discussion will address them more or less sequentially.

1. How might various subgenres and modes of art inquiry within art and electronic media be classified and categorized?
2. What role do particular media or technical innovations play in defining these histories, as opposed to aesthetic or art historical continuities?
3. Given limited space and a finite number of illustrations, how does one balance the representation of work by artists with long careers with that of younger artists?
4. How can the diversity of artists with respect to nationality, race, gender, sexuality, and other characteristics best be represented?
5. How can a topic of such diversity be addressed in a coherent narrative of 20,000 words?

The other books in the series shared an organizational structure whereby the survey, works, and documents sections were divided into consistent subsections. *Arte Povera* was divided into subsections, structured primarily by artist or locale; *Minimalism* was structured according to chronological subsections; *Conceptual Art* was structured thematically. Organizing the book by artist was not applicable to *Art and Electronic Media*. I rejected using a chronological structure I wanted to stress how similar media and/or concepts have been used at different times for varied artistic goals. I opposed a medium-based organizational scheme for a two main reasons: 1) it would foreground technological apparatus as the driving force behind the work (a message I did not want to convey); and 2) it would fail to show how related conceptual and thematic issues have been addressed by artists using varied media. The ability to show these sorts of continuities was a top priority, so I elected to organize the book thematically, despite the difficulty of defining themes that are internally coherent and meaningful.

As I began to consider themes with which to organize the book, I also was compelled to define a database, which, as mentioned above, constitutes an essential core of any canon. In the absence of an overarching thesis and predetermined methodology, I intuited that by simultaneously formulating thematic sections and compiling a list of works, each activity would inform the other. Further, I anticipated that the process of defining and populating those sections would enable me to identify critical issues. Ultimately, I hoped that the thematic issues raised by the individual works and the sections they constituted would drive the narrative.

I made a list of some five hundred works, discovering in the process a richness in the field that previously I had not appreciated so fully. This database revealed absences in the thematic scheme, and vice-versa. The sections I initially sketched out morphed several times, coming to be defined as follows:

Coded Form and Electronic Production

Following a long artistic tradition of employing technology to generate form or produce multiple images, the emergence of computer graphics and electronic photocopying in the 1950s and 1960s, and high resolution digital photography, printing, and rapid prototyping (RP, which enables the production of three-dimensional copies) in the 1980s and 1990s, expanded the possibilities for artistic production and reproduction. Artists include Ken Knowlton, Sonia Sheridan, Michael Rees.

Motion, Light, Time

Defying the traditional conception of art as a static object, beginning in the early twentieth century artists began to introduce actual motion into their work, making explicit the continuity of consciousness in the perception of art through time and space. The use of artificial light, such as neon or laser, as an artistic medium also explicitly draws attention to the extension of art in time and

space, thereby shifting the artwork from being an illuminated object to an actual light source. Artists include Gyula Kosice, Nicholas Schöffer, Raphael Lozano Hemmer.

Networks, Surveillance, Culture Jamming

Even prior to the advent of computer networking and satellite communications, artists produced work in which the exchange, transfer, and collaborative creation of information, often involving remote participants. Public access cable, satellite transmissions, and especially the union of computers and telecommunications (often referred to as *telematics*) vastly expanded these capabilities. Artists include Roy Ascott, Julia Scher, rtmk.

Simulations and Simulacra

Simulations are copies that share many attributes with the concrete originals that they represent. By contrast, the term “simulacra” can refer to a form of similarity particular to media culture, wherein distinctions between original and copy become increasingly murky. The originals may no longer exist, may never have existed, or their significance has been dwarfed in comparison to the simulacra, which attains a level of primacy and authenticity that traditionally had been the exclusive province of the original. Artists include Myron Kreuger, Char Davies, Jeffrey Shaw.

Interactive Contexts and Electronic Environments

Art has always been implicitly interactive in the sense that it demands some manner of perceptual and cognitive interaction on the part of the viewer. Artists working with electronic media increasingly came to think of themselves as providing open-ended contexts that offered audiences infinite possibilities for the production of unpredictable meanings through creative exchanges. Artists include Le Corbusier, Keith Piper, Toshio Iwai.

Bodies, Surrogates, Emergent Systems

Artists have joined their bodies (and/or those of their audiences) with electronic media or created robots and other forms of surrogates in order to examine the cyborgian nature of human existence and to ponder what a post-human existence might consist of. Bridging the apparent divide between carbon-based organisms and silicon forms of intelligence and life, between the real and the artificial, suggesting that these distinctions are becoming increasingly blurred if not simply a social convention. Artists include Stelarc, Christa Sommerer and Laurent Mignonneau, and David Rokeby.

Communities, Collaborations, Exhibitions, Institutions

Although the history of art traditionally has celebrated a cult of individual artist geniuses, the field increasingly has recognized the importance of exhibitions, institutions, and communities in shaping the production, reception, and historicization of art. Due to its technical requirements and financial overhead art involving electronic media often demands close collaboration between artists, scientists, and engineers, and between individuals, communities, and institutions. Include BNMI, Software exhibition, Rhizome.

Thematic categories do not admit of hard and fast distinctions. Indeed, there are many works in the book that could have fit comfortably in two or more sections. For example, Sommerer and Mignonneau's *A-Volve* (1993-4) was appropriate for the sections "Simulations and Simulacra" or "Interactive Contexts and Electronic Environments," but the emphasis of this work on the creation of and corporeal interaction with artificial life forms was the factor that determined its place in the section, "Bodies, Surrogates, Emergent Systems." On the other hand, Jane Prophet's *TechnoSphere* (1994-5) also emphasized the interactive creation of artificial life forms, but to my knowledge was the first to do so using a web-based interface. As a result, this work was placed in

"Networks, Surveillance, Culture Jamming." In both these cases the placement of the work in a particular section helped to represent the diversity of practices within it and the extensive cross-over between sections. In this way, I hoped that the sections would at once hold together in their expansiveness while demonstrating their permeability, that they would be internally coherent yet interpenetrating. In some cases, decisions were based on intuition, while in others they were determined very purposely in order to achieve a more balanced representation in each section. Overall, my goal was for each section to make sense as a unit, while mutually reinforcing the other sections in order to form a coherent and comprehensive whole.

When I began the project, 180 color plates and 50 reference images seemed to be a lavish abundance. I quickly realized how even twice that number would not provide a sufficient platform for representing the scope and richness of electronic art internationally. This situation demanded making tough choices to select works that represented the diversity of the field by decade, gender, nationality, and so on, in a way that seemed fair to me. For example, how many works sufficiently represent the work of a pioneer, like Paik, with a career spanning five decades, compared to an artist working with electronics for under ten years? As suggested above in the discussion of canonical revision, for each additional illustration allotted to a pioneer, one less artist could be included in the volume. I made a decision to make the book as inclusive as possible by providing only one color plate for any given individual artist, except in the case of collaborative work. I placed no limit on black and white reference images, which I used to represent the breadth of an artists' career and to include additional artists who are not represented in the works section. In the end, over 200 artists from over thirty countries were represented. Women artists in the field - few and far between in the 1960s - came to represent a significantly larger proportion of the book, constituting

approximately one-third of the artists since 1990. Issues of race, nation, gender, and sexuality were not addressed as distinct topics; rather, this diversity was woven into the fabric of the volume.

The problem of constructing a narrative that brings together the extraordinary diversity of artistic strategies and media over a many decades was a major struggle. As a scholar, I was trained to identify a problem, establish a thesis with respect to that problem, and compile a series of arguments that draw on extant literature, primary sources, and theoretical propositions that support the thesis. The general topic of art and electronic media admits of no apparent thesis. Burnham's thesis of increasing vitality neither holds true nor offers useful insight into the subject. I began by writing separate short essays for each of the sections. My initial goal was to address the diversity of work within each section, while at the same time suggesting the cumulative effects of artistic development within a broadly defined area of inquiry. As a result, the narrative within each section often follows a chronology, but in a non-teleological way that emphasizes parallels and affinities. For example, in the section "Motion, Light, Time," I drew on Robert Mallery's theorization of "transductive art"²⁶ to identify a broad range of electronic art, including Jean Dupuy's *Heart Beat Dust* (1968), Gary Hill's *Soundings* (1979), Carsten Nicolai's *Milk* (2000), and Sachiko Kodama and Minako Takeno's *Protrude/Flow* (2001). Spanning more than three decades, all of these works transform matter and energy from one form or state to another.

Note: The first version of this paper was presented at "Historicising Digital Art" sessions at the annual meeting of the Association of Art Historians, University of London, Berkbeck College, London, UK, April 11-12, 2003.

²⁶ Robert Mallery, "Computer Sculpture: Six Levels of Cybernetics." *Artforum*, May 1969, 29-35.

Charlie Gere, Chair. Subsequent drafts were presented at the Future Technology: Media Arts and Culture Colloquium, coordinated by Ken Rinaldo at the Wexner Art Center, The Ohio State University, Columbus, Ohio, April 28, 2003 and at the MediaArtHistory organizational meeting at Villa Vigoni, Menaggio, Italy, May 28, 2004. This paper is dedicated to Roy Ascott, Jack Burnham, and Frank Popper.