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INTRODUCTION

Discussions on the advent of digital culture now occur in most disciplines in the sciences and humanities. Literary critics address digital culture's radical challenge to book culture and print literacy. Sociologists query the quality of community and the structure and shape of newly forming institutions in cyberspace. Feminists ponder whether disembodied identities will result in a liberation from the asymmetries of gender relations or in the calcified lines of privilege and power. Anthropologists and human geographers consider the dynamics of computerized civilization. Communications and media specialists discuss both an ecology and political economy of a world organized around the dissemination and reception of information; and computer scientists, medical professionals, and philosophers alike worry about the ethical consequences of digital culture. All of these discussions share a larger, common concern for understanding recent consequences of social and physical change. Yet, they all too often displace what they have in common onto a duplicated language of revolution: talk about digital culture has been invested in throwing off the past and emphasizing what is unique, radical, revolutionary.

  Discussions about digital culture assume that new computerized technologies provide such fundamental rupture from the past that there are no continuities or, worse, that they willfully obliterate the past in creating new models. Such ahistoricism is problematic be-

cause it tends to reproduce at the level of scholarship what is one of the hallmarks of digital culture—its rhetoric of newness. It is painfully obvious that this is neither the first technological revolution in human history nor an event independent from its cultural heritages and historical roots, and so a rhetoric of newness is at best a myopic one.

Current discussions fail to take into account how digital culture has come into its own. Over the course of the nineteenth century, capitalist industrialization drove a wide range of new technologies —telegraphic, telephonic, phonographic, and photographic—that remade society through tremendous social, political, and economic change and through radically reorganizing people's perceptions of time and space. These changes provided the cultural and technological basis for the twentieth century—for mass production, for modern and postmodern industrialization, and for the societies of consumption that have prevailed in the West during the twentieth century. To understand the current consequences of social and physical change—to understand digital culture—requires a philosophical and historical framework for a duration longer than the last twenty years.

The rhetoric of amnesia that surrounds current discussions of digital culture facilitates utopic as well as dystopic visions of the role of computer technologies in the twenty-first century. It provides a vision of the future that relieves anxiety over any imagined loss of control; in the celebration of revolution and uniqueness, it promises a new future rife with limitless possibilities. In its dystopian guise, the rhetoric of amnesia removes all agency from social subjects: a new technologically deterministic course of history takes the future out of our hands. In either case, the rhetoric of amnesia erases the complex interplay among the institutions—economic, juridical, and political—that selected, authorized, and deployed specific technologies over other possibilities and secured their development in highly specific ways for explicit purpose over time. The rhetoric of amnesia erases all that—the multiple relationships between culture and *techne* that have always been grounded in purpose and specific social interests. By obscuring the relationship of computer technologies to older modes of capitalist production and distribution, the status quo becomes naturalized and the material base of technology in history assumes transparency.

This is not to say that all discussions of digital culture are neglectful of history. But among the discussions that are growing at a tremendous rate of production—more than a dozen anthologies on digital culture have appeared in only the last five years—very few *think* historically or foreground the relationship of historical perspective to the current discussion. Most often, "history" stands apart and is represented by intellectuals of previous generations for their role as prophets or architects of what is to come (e.g., Marshall McLuhan's *Understanding Media* [1964] and *The Medium Is the Massage* [1967], Vannevar Bush's "As We May Think" [1945], Alan Turing's "Computing Machinery and Intelligence" [1950]). McLuhan forecasts the information society of the "global village"; Bush provides a prophecy of hypertextuality; Turing's discussion of artificial intelligence celebrates the future of disembodiment. One of the things that distinguishes these self-proclaimed visionaries from twentieth-century philosophers concerned with technology is that by popularizing the very concepts they proclaim, they changed social attitudes and values about the new technologies they were describing. In this regard, they are something of self-fulfilling prophets because they make popular the vision of society that they claim will result from new technological interventions. The history of prognostication omits dead ends and vain predictions and is ultimately history as teleology.

Another way that history often comes into play in discussions of digital culture is through the idea of remediation. That is, that new technologies, media in particular, always reinscribe what was already present in previous technologies. This works best in a history of media technologies as technics of representation with little regard to their material and institutional bases, and it has resulted in a linear history of transitions from cinema to television to hypermedia, the World Wide Web, and virtual reality. Such historical modeling suffers from two important narrowings of the field: it first reduces digitality to communications media and then reduces media technologies to their instantiation as *visual* representational forms. The latter especially ignores the status of movies, video, and the like as audio-visual representations so as to distance them from their intersection with telephonic, radio, and other communications technology industries. The result is digital culture merely as a linear history of technological representation and of visual sig-

nification. Using a teleological history of the media to understand digital culture is no corrective to the original problem of a rhetoric of amnesia—it is merely another form of amnesia.

What we need is to adopt a reflexive historical lens that attends to the dynamic of erasure itself in history writing as well as to who benefits from it. Through this approach, we may preserve a certain tension that serves both historical specificity and the relevance of the past to the present. Therefore, this volume foregrounds the very problem of how to draw historical comparisons across different technological and cultural moments. In this regard, *memory* is not cast as a simple antidote to forgetting but is a form of historical perspective in the truest sense of memory as in its Latin root *memor* or "mindful." The historical attitude of this volume accommodates multiple lines of inquiry into the social integration of new technologies by describing material and economic circumstances and by particularizing the interrelationship between machines and the formation of human subjectivity.

<div align="right">What Is Digital Culture?</div>

Everyone uses the term digital culture, but no one defines it. It is one of those key terms that in its simplest usage merely designates a society saturated by telecommunications and information networks, electronic products, and computational systems based on binary data using electronic or electromagnetic signals. Depending on where the stress falls, *digital* culture can simply designate a discrete technological preoccupation. In this sense, the term simply describes one among a plurality of subcultures (e.g., car culture, music culture, gun culture)—with its own set of enthusiasts. In its broadest usage, however, digital *culture* becomes a trope for the ethos of contemporary life. In this sense, the essential qualities of Western culture in late modernity are described in terms of the salient features of digital technology: its speed, interchangeability, mutability, and so on. The *digital* then becomes the master sign for culture of the last decade, the years since 1970, or even the span of time since World War II.

Whatever the intention of its meaning, the ubiquitous usage of the term digital culture has two important underlying assumptions: (1) community revolves around distributed communication; and

(2) efforts to increase community take the form of new devices, systems, and technologies for abetting telecommunication. Many collections about digital culture are thus really about communication and the chain of new technologies that intensify speed, efficiency, and the symbolic systems themselves through which we communicate. Timothy Druckrey's *Electronic Culture: Technology and Visual Representation* defines digital culture through the transitions from cinema, television, and video to hypermedia, virtual reality, and cyberspace; he charts a course that demonstrates how communications systems increasingly technologize human experience.[1] John Caldwell's *Electronic Media and Technoculture* purposefully wrests definitions, terms, and discussions of digital culture away from the computer and software industries and popular journalism and makes media theorists the legitimate authorities for how modern society works.[2] Likewise, Peter Lunenfeld's *The Digital Dialectic: New Essays on New Media* tries to find a way for the practice and critical theory of new media to energize each other.[3] An array of essays, but especially those in Andrew Herman and Thomas Swiss's *The World Wide Web and Contemporary Cultural Theory* and Timothy Druckrey's two collections *Ars Electronica: Facing the Future* and *Electronic Culture: Technology and Visual Representation*, look to aesthetic strategies of new media forms as the means for producing an ontological map of digital culture.[4]

The contributors to this volume sanguinely accept such orientations and organizations of digital culture but go further than mediacentric approaches. The essays herein are more concerned with what is at stake socially, politically, and ethically in the effects of digital culture. Toward this end, the definition of digital culture must also presume that digital culture is transformative of the individual and of the group. Most importantly, as a means of framing cultural experience it serves as a conduit for the confluence of power that technology, the government, and the corporation intertwine in the modern state.

In this sense, Martin Heidegger's 1949 essay, "The Question Concerning Technology," serves as an animus to the contributors' points of view.[5] Heidegger's interest in technology was neither utopic nor dystopic. He believed that technology's essence was not so much technical as instrumental in producing a mode of human existence. His concern at the time for the dangers of technology was for the ways that machines could alter social existence. Written immedi-

ately after the horrors of World War II and at the onset of what we think of as the computer age, Heidegger's essay serves as a conceptual bridge connecting the concerns of the history of technology and culture to the specifics of the digital.

The perceived threats of digital culture—from the eradication of book and print culture to the disappearance of community—often prevail in discussions that are more socially and politically committed. Volumes like *Digital Democracy: Discourse and Decision Making in the Information Age*; *On the Internet: Thinking in Action*; *Prometheus Wired: The Hope for Democracy in the Age of Network Technology*; and *Reading Digital Culture* worry about whether or not cybersociety opens or closes possibilities for a more democratic society.[6] As representatives of these approaches, influential critical theorists Mark Poster and Avital Ronell are concerned about the Internet's effects of disengagement from public life, its consequent eradication of community, and its undermining of a public sphere of informed-citizen discussion.[7] It is important to remember, however, that these issues did not simply arise in the late 1990s after the Internet became a widespread part of Western culture, but were in fact historically bound up with the Internet's origins in the cold war era.

Authors also regularly express concern about continuing oppression in digital culture, especially the ways that new technologies are used to reinscribe class disparities and exploit labor. In *Reading Digital Culture*, for example, Stanley Aronowitz's "Technology and the Future of Work" and Arthur Kroker and Michael A. Weinstein's "The Theory of the Virtual Class" are both important critical analyses of the material conditions of living in an immaterial world.[8] They move well beyond technologically deterministic narratives by grounding their histories in social, economic, and political contexts. Nevertheless, as Roy Rosenzweig's survey of recent scholarship on the history of the Internet suggests, such contexts themselves often constitute highly conflicted arenas.[9]

This volume on the one hand builds on the best of these earlier works while, on the other, seeks not to engage further polemics about digital culture's reifying and totalizing effects. Rather, the historical orientation of this volume enables a consideration of how and why technology, the government, and the corporation converged to the extent that their interconnections produce such cause for alarm.

Digital culture needs to be understood as at once an outgrowth of Enlightenment thought and an agent of its steady erosion. Western assumptions originating in the eighteenth century about the relationship between the liberal subject, technology, and the modern state continue to set the terms for talk about technology's capacity to change society. The Industrial Revolution is the technological and social upheaval against which the digital revolution is measured. In discussions of digital culture, the Enlightenment *stands* as a kind of "structuring absence."

Promises of self-determination made in the name of digital culture are implicit invocations of the Enlightenment view that individual identity is rooted in rational thought. The liberal humanist subject, conceived as a self-possessing autonomous individual capable of entering into voluntary market relations under the regulation of a social contract, represents the Enlightenment ideal of human emancipation and agency. Hence, whatever new technologies enhance the individual's rational exercise of economic and political capacities are liberatory within the terms of Enlightenment thought. By the same terms, new technologies that appear to suppress those capacities threaten the freedom of the liberal subject. Criticism about new technologies often gets expressed in the fear that the liberal subject will be forced to submit to antidemocratic corporate control.

At the same time, N. Katherine Hayles holds out a third position that does not make agency contingent on the continuity of the liberal subject. While the liberal subject has already been critiqued as something that never really existed historically but masqueraded as a universal ideal in order to serve specific political projects of domination and oppression, Hayles crystallizes a new model of subjectivity in the "posthuman."[10] Since the Enlightenment, the continuous integration of man and machine has led to a steady erosion of the notion of the "human" as a distinct individual thinking subject. Because this process blurs the line between bodily existence and intelligent machines, human identity is no longer exclusively located in individual people as such but rather is distributed across biological and technological systems.

Hayles, even in revising the categories for human subjectivity, still defines the posthuman as a historical development in relation to the

legacy of the Enlightenment. She writes: "The historical processes leading to this [transformation from 'human' to 'posthuman'] . . . were never complete transformations or sharp breaks; without exception, they reinscribed traditional ideas and assumptions even as they articulated something new. . . . 'Human' and 'posthuman' coexist in shifting configurations that vary with historically specific contexts."[11] Following Hayles's reasoning, we claim that digital culture is neither simply a rupture from Enlightenment thinking nor Enlightenment's final flowering.

By assuming the origins of digital culture in the Enlightenment, we are setting up a self-consciously Western history. More narrowly, this volume is an inquiry into the relationship between culture and technology from the point of view of the United States and, although we encompass historical connections from the Enlightenment to the present, our definition of digital culture is also contingent on a history of post–World War II computing in the United States. After World War II, three strains stemming from the Enlightenment—*techne*, the subject, and the state—converge in a new way with the development of computing. The history of computing cannot simply be made to stand in for a definition of digital culture, but it is necessary to that definition.

The origins of modern computing are to be found in the technomilitary context of World War II. The new strategic demands of the war drove massive government investment in computer technology in Germany, Britain, and the United States. With the end of the war, the buildup of apparatus, expertise, and investment for airplane and missile technology, code breaking, and other military applications extended to industrial and civilian government uses. Many of these technologies did not have to remain secret any longer.

A key figure in this transformation from wartime computer research to civilian and corporate application is Vannevar Bush. Bush, a former professor of electrical engineering at MIT and participant in the Manhattan Project, was a top advisor to President Franklin Roosevelt during the war. Even during the war, in 1944, Roosevelt was already thinking about how to apply the lessons from World War II to civilian, peacetime activities, and he asked Bush to study the problem. Six years later, Bush's recommendations led to the formation of the National Science Foundation, with Bush as its first director. By 1945, however, Bush had already popularized these con-

cerns when he asked in the *Atlantic Monthly* what social role scientists should play in the wake of their wartime involvement.[12]

Bush's *Atlantic Monthly* article, "As We May Think," specifically addresses the problem of how American scientists who had put aside institutional and other rivalries for the war effort might continue to share information. For him, the chief obstacle that lay ahead was not competition but the surfeit of information and the acceleration of scientific specialization in the wake of World War II. He offers a technological antidote in his conception of the memex, a device he had already been thinking and writing about for over a decade. As a kind of dream tool of the information age, the memex would be "a device in which an individual stores all his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility."[13] The memex, in other words, would contain no less than "the record of the race," and moreover it would preserve and organize that record with a kind of "associative" architecture that mimicked the structure of human memory.[14] Bush's thinking about the memex depends on an analogical relationship between the individual mind and larger structures, which means between organic memory and networked systems.

While Bush focused on how to optimize the technology of information storage and retrieval by modeling it on memory, the field of cybernetics simultaneously generalized the analogy between organism and machine and extended it to the widest possible range of fields of knowledge. The term *cybernetics* describes the study of communication and control in living organisms or machines, and it comes from the title of Norbert Wiener's pathbreaking 1948 book on theories of feedback control processes.[15] Wiener originally developed his ideas through their application to antiaircraft artillery control during World War II.

Under the auspices of the Josiah Macy Jr. Foundation, ten conferences on cybernetics were held between 1946 and 1953. Organized and chaired by the neurophysiologist Warren McCulloch, the Macy conferences were dedicated to a radically interdisciplinary exploration of cybernetics. Participants included the mathematicians John von Neumann, Walter Pitts, Norbert Wiener; engineers Heinz von Foerster, Claude Shannon; anthropologists Margaret Mead and Gregory Bateson; social psychologist Alex Babelas; and scholars from the fields of philosophy, semantics, and literature. Indeed, as

N. Katherine Hayles has shown, the very ability of the conference participants to communicate with one another across disciplinary boundaries depended largely on the use of metaphor: a specialist in one field could adopt a mechanism from another by associating it metaphorically with a mechanism familiar to her or his own work.[16] This form of interdisciplinary communication replicates the logic of feedback that is fundamental to cybernetics. The Macy conferences initiated the logic by which digitality could be understood as cultural.

This is not to say that the U.S. military assumed anything less than a central role in the post–World War II development of computing. Although private industries and government civilian agencies carried out important research and development, they often did so under Defense Department contracts or with an eye to the military as a reliable market. As historian Roy Rosenzweig notes, "in 1950, for example, the federal government—overwhelmingly, its military agencies—provided 75 to 80 percent of computer development funds."[17] Although companies like UNIVAC (Universal Automatic Computer) and IBM (International Business Machines) built supercomputers that were used by entities such as the U.S. Census Bureau and General Electric, they worked for a market dominated by cold war military priorities. As writer Frank Rose points out, "the computerization of society has essentially been a side effect of the computerization of war."[18]

Even the Internet, one of today's most culturally ubiquitous applications of computer technology, has its origins in U.S. cold war military defense strategies. In the 1950s the U.S. Department of Defense faced a concern about how to maintain a command-and-control network of communication in the event of a nuclear strike. Because any central authority would be an immediate enemy target, the department sought the means to establish a decentralized communications network that would be invulnerable to attack because it would be disbursed and able to continue operation even if any point it was disabled. Throughout the 1960s, government-sponsored research into such a "blast-proof" network for maintaining national security occurred at the Rand Corporation and at MIT and UCLA.[19] In 1969, ARPANET (Advanced Research Project Agency Network) began operation at UCLA: it was an infant high-speed network for transmitting data over long distances. As the federal government's ARPANET grew and expanded in the 1970s, the researchers who had

access to it used it for a purpose additional to its original intention. Rather than using it to transmit computing data, they treated it as a personal communications medium by sending long-distance personal and informational messages to their fellow researchers. Soon these workers had developed "mailing lists" for sending batches of communications to those who shared the same hobbies, side interests, and personal pastimes. The network grew rapidly because it was unlike standard corporate computer networks that depended on having similar machines. The very means that made ARPANET decentralized—that it did not depend on any one type of computer —meant that so long as any individual computer could speak the packet-switching language of the network it could become linked to the system.

At the same time, some of the university researchers who had access to ARPANET began to question and resist the government-authorized projects in which they were involved that were connected, even indirectly, to U.S. war operations. While the decentralized communication of ARPANET was designed to preserve the central authority (the "command and control") of the government in the event of nuclear war, many of ARPANET's first generation of users saw its promise for just the opposite: the dissolution of central authority in a nonhierarchical organization of society. In the climate of the Vietnam antiwar movement of the late 1960s and early 1970s and the formation of a counterculture centered at university campuses across the United States, ARPANET users began to take command of the network as a means for more grassroots, democratic participation among their peers.

By the 1980s, ARPANET became linked to other government networks at NASA, the National Science Foundation, the Department of Energy, the National Institutes of Health, and others. As the single network became a network of networks, technical advances occurred regularly so that speed, efficiency, and a conventional infrastructure all expanded into the Internet configuration that is familiar today. In 1989, ARPANET expired—a victim of its own success and seriously outdated and overpowered by its heirs. What is important here is that what rapidly became in the 1990s a cultural institution, a high-speed and high-tech communications medium, and a symbol of digital culture cannot be separated from the social, material, and economic conditions that gave rise to it and shaped its applications. Indeed, the origins of the Internet still inevitably shape today's dis-

cussions about its political valence as a communications medium. Does the Internet open up possibilities for democratic participation or further shut them down? Is it a medium of the people or an engine of corporate and governmental dominance? Although we do not mean to suggest that the only way to take up these questions is in such simple binary terms, it is important to focus on the fact that these issues did not arise only in the 1990s after the Internet had become a widespread, integral part of Western culture, but rather were always structurally part of its development.

It may have been too easy to forget that the development of computer technologies has a material and political base once leisure and entertainment, education and the workplace, and health and medicine all became dependent on digital technologies in order to function successfully. By the 1990s, digitality and the computerized technologies that employ this process were no longer a matter of augmentation or luxury but an essential infrastructure of modern society. Their widespread development and application for a home-consumer market resulted in everything from the consumption of music to the automobile to the kitchen oven as commodified products of digital technologies. Such a move was neither predetermined nor an unexpected byproduct of scientific and government research but instead a complex consequence of three decades of technological progress in miniaturization, the importation from non-Western countries of new technological advances as well as the cheap manufacturing labor that they offered, and the important U.S. "engine" of market-driven profits from the sales of consumer goods. Such political and economic conditions make one's music CD (and its player), one's car, and one's kitchen microwave more than wonders, achievements unavailable to our grandparents, and conveniences of modern everyday life in the twenty-first century. They are all steeped in the politics of their production, material bases, and technological intersection with larger cultural issues. When one goes for a ride, relaxes with a tune, or heats up a fast-food snack, one also represses the politics of the history of the relationships between machines and human subjectivity that have resulted in the present moment. This volume seeks to undo that repression: it asks what we can learn from the past that provides a philosophical and historical framework for the sets of issues being framed for the way we live today in contemporary digital culture.

The collection of essays in this book stresses four broad themes: (1) it defines digital culture in relationship to the information age but also as a political and cultural phenomenon larger and older than the information age; (2) it historicizes the digital and its antecedents in terms of multisensory effects and as somatic experience; (3) it attends to the integral interrelationship between machines and how human subjectivity has been historically formed; and (4) it particularizes technologies as dependent on their material and economic circumstances. The essays may individually bridge different disciplines from the social sciences and humanities, but they collectively have common concerns. Most of the volume's contributors wrote their essays while participants in the University of Iowa Obermann Center for Advanced Studies Summer 2000 Interdisciplinary Research Seminar. This three-week seminar, directed by Lauren Rabinovitz, brought together ten scholars from different disciplines, universities, and regions in order to study, read about, and write on the themes in this volume in an intensive learning atmosphere. Seminar fellows developed their ideas through lively exchanges with each other and through shared readings and lectures that cut across disciplinary boundaries. The result was not only a transdisciplinary approach to the subject but also a truly synthetic one that regardless of each individual topic maintains a vision of a larger coherent whole.

To assist the reader in preserving the larger, more synthetic claims and issues that motivated, animated, and linked together these discussions, the separate studies that comprise this volume have been grouped into four thematic sections or categories, including "Intellectual Histories of the Information Age," "Visual Culture, Subjectivity, and the Education of the Senses," "Materiality, Time, and the Reproduction of Sound and Motion," and "Digital Aesthetics, Social Texts, and Art Objects."

In the first section, the authors provide three case studies of the relationship between intellectuals' formative work on technology and their ideological underpinnings. They offer a snapshot intellectual history that encompasses the Enlightenment, the Romantic era, and Modernism in the first half of the twentieth century, and they lay the groundwork for the intellectual orientation of the information age that follows World War II. In the first of these studies, Laura

Rigal calls for a critical history of electricity from the Enlightenment to the present that accounts for the way that theories of electricity are embedded in the ideological and economic foundations of the state. Through a reading of Benjamin Franklin's widely circulated 1751 pamphlet, Rigal demonstrates that Franklin's model of electrical charges and discharges was not merely technical, it also was an elastic, efficient ideological mechanism for elaborating the dynamics of economic expansion and social control within the emerging federalist state. David Depew traces a history of the scientific rhetoric of the body from the Victorian era to the mid-twentieth century to show how the body as figured as a thermodynamic heat engine became replaced by an image of a kind of printout from a hydrocarbon-based computer display. He shows conclusively how the recent reception of the Human Genome Project is tied to a picture of the body as digital that is both a product of self-conscious rhetoric and a matter for concern insofar as it screens out energetic, ecologically embedded views of the body. In the third essay in this section, Ronald E. Day argues that the positivist logic of the information age has worked to erase its own history. He looks at the careers of two forgotten but important advocates for the positivist organization of information in the mid-twentieth century: Paul Otlet and Suzanne Briet. At the same time, he reexamines two famous theorists of modernity—Martin Heidegger and Walter Benjamin—as important critics of that emerging information age. By recovering both the advocates and critics of earlier information ages, we may learn how current meanings of information, knowledge, and language have a highly conflicted, less than inevitable history.

The second section, "Visual Culture, Subjectivity, and the Education of the Senses," deals exclusively with the ongoing historical relationship between technological applications in audio-visual or highly somatic experiences (often linked in the twentieth century to "entertainment") and the production of ideological states of consciousness. Using examples both from very early and very recent cinema, Lauren Rabinovitz shows how technologically futuristic movies have only addressed a *fantasy* of disembodiment while they actually emphasize physical presence and the delirium of multiple senses. They have played a regular, crucial historical role in preserving knowledge grounded in the body when radical technological transformation has prompted a crisis in visually ascer-

taining truth. The second essay in the section also treats the relationship of disembodied and embodied viewing practices with the discovery of knowledge. Judith Babbits describes how at the turn of the twentieth century progressive educators adapted stereographs in an attempt to standardize teaching techniques and to inculcate an American national culture across an increasingly diverse population. The proliferation of stereographs and the rhetorical strategies of the stereograph industry were central both to the construction of a paradigm of visual knowledge and to a modern theory of vision.

In a sly move, the last essay in the second section brings home the message that even in the world of leisure and entertainment, the relationship between the U.S. military and the postwar world of the development of computing remains integral. Sharon Ghamari-Tabrizi analyzes the curious convergence of the Pentagon and Hollywood when, in 1999, the U.S. Army gave $45 million to the University of Southern California in order to establish the Institute of Creative Technologies, a center for developing cutting-edge virtual reality military training simulations that would deliver the emotional impact of Hollywood movies. Using government documentation and defense industry publications, Ghamari-Tabrizi shows how the Pentagon became convinced that the way to improve "realism" in military simulation was to incorporate methods of "good storytelling" practiced by entertainment professionals. The Pentagon's aim was to produce an emotionally immersive experience to match the somatic immersion provided by the newest virtual reality technology.

The third section, "Materiality, Time, and the Reproduction of Sound and Motion," opens with an essay by John Durham Peters that probes the intimate connection between the study of physiology and the explosion of media technologies in the nineteenth century. Although Marshall McLuhan linked media and physiology some time ago, he neglected to pursue the connection with the historical research this essay provides—research that shows how media were fashioned precisely as "artificial portals" to the human nervous system. Through the work of the German scientist Hermann von Helmholtz and the American inventor-entrepreneur Thomas Edison, Peters examines the foundational moments in the history of sound recording. More than just an intellectual and technological history of the phonograph, this essay is also a meditation

on the ways media retroactively redefine previously accepted standards of human capacity as fragile and flawed.

In the next essay, Lisa Gitelman argues for how the material meanings of any new technology centrally contribute to the history of its social integration. Too often, materiality disappears behind the mutually reinforcing auras of transparency and inevitability. To counter this tendency, Gitelman focuses on a specific material—paper—and the historical case of the cultural and legal conflicts over the status of player piano rolls. She traces the ways that the emergence of listening habits, technical standards, new corporate structures, copyright strictures, and the like instituted a cultural hierarchy among mechanized player pianos (the hardware) and their paper rolls (the software). The "matter of piano rolls" is a precedent for the confusion over the intellectual property status occasioned by digital technologies such as eBook, e-paper, and MP3 files.

The third essay in this section shifts from a shared set of concerns regarding the materialist bases of media technologies as such to the application of those same technologies within the institution of medicine—specifically analyzing such digital medical imaging techniques as computed tomography (CT) and magnetic resonance imaging (MRI). Scott Curtis argues that while such new technologies of medical motion pictures have seemingly revolutionized the way physicians "read" the human body, the interpretation of the human body relies on a dialectic steeped in the material basis of the image—between stillness (the corpse, the medical illustration) and movement (the living human body). He illuminates the philosophical relationship between cinema and medicine by tracing its historical echo to digital medical imaging.

The final section of the book, "Digital Aesthetics, Social Texts, and Art Objects," concludes with a series of essays that examine *new* art objects that are the result of recent digital technologies. The essays consider the historical dimensions that impinge on the entire domain of any aesthetics of digital culture; they take into account the longstanding relationships among books, painting, and sculpture—art writ large—and bodies as the means to stand in for one another in a metaphorical connection between word and flesh or picture and flesh. Do these "metaphoric networks" between bodies and art texts undergo any reconfiguration once texts cease to take material form and manifest instead in the electronic forms of digital media? Do the bodies represented within them undergo a corre-

sponding transformation in embodiment? To directly address these concerns, N. Katherine Hayles closely examines two pairs of works in digital media and shows how gender as a central category of embodiment is transfigured in the creation of these new textual bodies.

In the next essay, which shifts the focus from new media art objects themselves to the discourses surrounding them from the late-1980s through the 1990s, Thomas Swiss argues that the debates on the status of electronic literature reveal a deep cultural anxiety over digitization. He illustrates how in the early years an avant-garde community of hypertext artist/authors resembled earlier modernist literary avant-gardes. The passing of this "golden age" followed the same path as many historical avant-gardes: digital literature lost its disruptive function of opposing dominant institutions of American literary culture and achieved a more central status within those institutions.

The last essay seeks to preserve an artifact of digital technology—the QuickTime movie—by isolating it from the "quickening" flow of a cinematic art that aims for the seamless reproduction of reality. Vivian Sobchack compares the phenomenological experience of QuickTime movies and Joseph Cornell's "boxed relics" sculptures from the 1930s and 1940s. By putting these objects in relation to one another, Sobchack shows how the very qualities that technicians wish to remove from QuickTime movies—their stuttering transmission, fragmentation, and miniature framing—have the aesthetic power to evoke the experience of memory and desire through an "aesthetics of absence."

The contributors to this volume propose a change in approach to current concerns about digital culture by examining historical models for the social integration of new technologies. While some of the authors emphasize those past practices that inform or provide the foundations for the present, and others explore more fully present practices (especially facets of the World Wide Web) that borrow from the past, they all treat digital culture itself as a historical phenomenon. The authors make history writing and the dynamic of erasure itself in history writing central preoccupations throughout this volume, yet they do not naively regard the elucidating effects of history here as a panacea. Rather, they focus on—and thus the volume highlights—the thorny dilemma of how to draw historical comparisons across different technological and cultural moments.

1   Timothy Druckrey, *Electronic Culture: Technology and Visual Representation* (New York: Aperture, 1996).

2   John Thornton Caldwell, ed., *Electronic Media and Technoculture* (New Brunswick: Rutgers University Press, 2000).

3   Peter Lunenfeld, *The Digital Dialectic: New Essays on New Media* (Cambridge: MIT Press, 1999).

4   Andrew Herman and Thomas Swiss, eds., *The World Wide Web and Contemporary Cultural Theory* (New York: Routledge, 2000); Timothy Druckery, ed., *Ars Electronica: Facing the Future: A Survey of Two Decades* (Cambridge: MIT Press, 1999); Druckrey, *Electronic Culture*.

5   Martin Heidegger, "The Question Concerning Technology," in *Basic Writings*, ed. David Farrell Krell (San Francisco: Harper Collins, 1977).

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13 Ibid., 106–7.

14 The ways that the memex is in fact prophetic of contemporary modes of producing, storing, and disseminating information facilitated by personal computers, hypertext, and the Internet is a point that has not been lost on numerous scholars of digital culture.

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17 Rosenzweig, "Wizards, Bureaucrats, Warriors, and Hackers," 1538.

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19 "Blast-proof" is Bruce Sterling's term. See his "Short History of the Internet," available on the Web at: http://www.library.yale.edu/div/instruct/internet/history.htm.