

THE DIALOGICS OF NEW MEDIA: VIDEO, VISUALIZATION,
AND NARRATIVE IN RED PLANET: SCIENTIFIC AND
CULTURAL ENCOUNTERS WITH MARS

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In 1997, Robert Markley was invited by a prominent colleague at another university to contribute a module about Mars to a proposed CD-ROM history of science fiction. She had received funding to develop a pilot version of this project as an on-line course: Students would pay a fee to the school for the CD-ROM or for access to its contents over the Web. The course would consist of fifteen modules, each of which would feature video interviews with one or two prominent science fiction authors, and focus on three key works. Having just begun a book about Mars in science and science fiction, Markley agreed, secured start-up funding, and began a collaboration with Michelle Kendrick and Harrison Higgs, faculty in the Program in Electronic Media and Culture at Washington State University–Vancouver. By 1998, the original history of science fiction project had collapsed: The costs of producing a set of CD-ROMs dwarfed what the university could envision as a payoff in student fees for an on-line course.¹ The Mars “module” by then had assumed a life of its own. Backed by grants from West Virginia University and Washington State University, *Red Planet: Scientific and Cultural Encounters with Mars* (Markley et al. 2001) became the first scholarly-educational DVD-ROM authored from the ground up to be published by a major university press.² The authoring process took four years and forced the authors and designers to confront both the practical problems and the theoretical complexities presented by new media technologies that continually reshaped and were reshaped by our efforts.³

Between 1997 and 2001, the rapidly changing capabilities of hardware and software redefined the values and assumptions that informed the architecture of multimedia; in turn, the resulting changes in how we perceived the relationships among text, video, animations, sound, and static images profoundly challenged traditional and chic hypertextual accounts of content and form, text and visual design. In describing in roughly chronological fashion the problems we encountered and the work-arounds we adopted, we want to develop a larger theoretical argument: “Information architecture”

and “theory” are never distinct concerns. Our experience in authoring *Red Planet* suggests that new media pose both problems—perhaps even the end of “alphabetic consciousness,” as David Porush (1998) argues—and opportunities for scholars willing and able to invest the necessary resources of time, money, and labor to help (re)define what we might call the visualization of scholarship.⁴ In this respect, *Red Planet* may serve as a case study in the ways in which “text” and “visual images” interact dialogically with the changing technologies—sound, video, and dynamic animation—that are always in the process of redefining the conceptual frameworks and practices of multimedia. Beginning in 1998, the authors did twenty or so presentations of our work in progress to academic, student, and software industry audiences, including demonstrations at the University of Oklahoma, the Mars Society, and the Smithsonian Institution. In addition, early versions of the title were used in courses at West Virginia University (science fiction) and Washington State University (Web design and multimedia authoring); responses, questions, and informal suggestions from these audiences were often incorporated in ongoing redesigns of the project. These experiences reinforced our belief that *Red Planet*’s dialogic structure has significant ramifications for understanding the complexities of educational and scholarly multimedia. Whatever the future of DVD-ROM technology, the processes of authoring *Red Planet* offered us a crash course in beginning to understand the ways in which multimedia technologies break down and reconfigure the boundaries among “scholarship,” “pedagogy,” and new media.

Our project began to take shape in a rapidly changing electronic environment. In the 1980s and early 1990s, information architecture was dominated by conceptions of hypertext in fiction, criticism, and software programs such as Jay Bolter’s and Eastgate Systems’ *StorySpace*, a program for creating hypertextual documents that could be organized in a multitude of possible ways.⁵ Committed to the belief that hypertext could reproduce spatially the associative logic (they claimed) of the ways in which the mind worked, theorists such as Richard Lanham (1993) and George Landow (1992) posited that such an associative structure enacts a postmodern “freeing” of the reader to create her own narrative(s) by combining and recombining textual (and occasionally visual) elements. These theorists argued that hypertext’s nonlinear architecture radically transformed temporal and spatial models of writing and reading. Because we read in time and therefore process information sequentially, hypertheorists argued, spatial nonlinearity implies a suspension or redefinition of a text’s temporal and narrative structure. Espen Aarseth (1997), for example, maintained that “nonlinear” texts “have

a positive distinction: the ability to vary, to produce different courses” (41–42). This definition, in effect, suggests that “linear” texts lack this desired “ability to vary”; instead, they exhibit a plodding and restrictive logic that can be read only *monologically*. It was a short step, then, for some enthusiasts in the 1980s and early 1990s to argue that hypertext actualized the poststructuralist properties of language and narrative that they gleaned from readings of Roland Barthes, Jacques Derrida, and Michel Foucault, among others. For these humanists-turned-cybergurus, hypertext seemed poised to become both template and genetic code for the digital “revolution.”

As early as 1994, however, Richard Grusin pointed out that such efforts were misguided because they misinterpreted the crucial insight of post-Saussurean theories of language: The written text was “deconstructive” long before digital media were conceived. In the same issue of *Configurations*, David Porush (1994) maintained that the archaeology of hypertext extended back to the Talmud and its dynamic models of language, interpretation, mind, and media. By recognizing that semantic meaning has never been unitary and therefore never can be reduced to mathematized metaphors of “information,” Grusin and Porush offered more theoretically sophisticated and historically accurate ways of understanding the complex relationships between text and visualization than the abstractions of hypertext. For all their claims to revolutionary sophistication, hypertext theorists modeled their conceptions of design on traditional Cartesian assumptions about space and time. “Nonlinearity,” Aarseth (1997) argues, “as an alterity of textual linearity (monosequentiality), can be seen as a topological (rather than tropological) concept, in accordance with the principles of graph theory” (43). By making graph theory a constitutive metaphor for nonlinearity, he invokes an abstract, two-dimensional model of spatial relations by presupposing that time and “meaning” can be encoded as semantic and logical “elements” within a geometric space. This implied logic renders discrete elements of both “content” (text) and “design” (image) as containers or counters that can be arranged and rearranged at will. Paradoxically, then, by insisting that hypertext allowed users to navigate among multiple narrative elements, theorists such as Lanham and Landow reinscribed a traditional model of communication theory—one at odds with the values and assumptions of a “postmodernism” that, they implied, could be identified with point-and-click interactivity. Although temporal and spatial elements can be arranged in any number of ways (well, in any number of ways within the algorithmic constraints of the code in which the software is written), what is *within* or *defined as* an “element” in a hypertext document effectively is blackboxed: Content is recast in metaphors of mathematical information. In fact, the decisions about what constitutes a textual or visual element actually

restrict these content containers to a temporal or spatial unit (the sentence, the paragraph, the photograph) that reinforces traditional assumptions about language, meaning, and design.

Before beginning work on *Red Planet*, Markley (1993, 1–33) and Kendrick (1996) had voiced very different views of language, representation, and media theory. From the start, this title in the making was guided by the authors' distrust of the metaphor of text as "information" and the biases that made visualization a poor relation to textual content. In contrast to the values and assumptions of hypertext theory, multimedia produces dialogic interactions among and within textual and visual elements, if we understand "dialogic" in the complex ways theorized in Mikhail Bahktin's theory of language. Bahktin (1981) rejects the notion of a "unitary" or an authoritative language, a one-to-one correspondence between word and thing that seeks to repress the "process of historical becoming that is characteristic of all living language" (288). For Bahktin, each utterance is historically and socioculturally located; it penetrates and is penetrated by other utterances, "entangled, shot through with shared thoughts, points of view, alien value judgments and accents" (289). Marked by internally contested relations to other utterances, each utterance competes agonistically in "a dialogically agitated and tension-filled environment of alien words, value judgments, and accents" (276). Because *all* understanding is dialogic, every utterance—whether on a printed page or in a hypertext box—is internally contested. In this regard, hypertext does *not* actualize a "latent" dialogism within a previously "linear" or "rational" language but denies or represses the dialogic nature of *all* texts to further its own claims to be doing something revolutionary.

If words are always contextual and contested, then the introduction of static images, hot links, sound files, animation, and video raises the stakes exponentially by challenging the underlying metaphors of *information* that are invoked in most discussions of multimedia. As Aarseth's (1997) invocation of graph theory suggests, the concept of "information"—and the reduction of text and image to abstract, quasi-mathematical units—invokes a simplified view of how communication occurs. Because hot-link interactivity, as Kendrick (2001) argues, is limited by the algorithmic structure of computer code, the metaphors of mapping and associative logic that dominate discussions of hypertext-based multimedia are constrained by the physical and philosophical presuppositions of mathematical modeling that privilege "message" unproblematically over "noise." These metaphors depend on a conceptual model of information theory that presupposes both the transparency of the "code" and the unitary meaning and stability of the "message."

code
|
sender—> message—> receiver

For this model to work, the sender and receiver must share an unambiguous and fully understood code; the message must be articulated precisely within the semantic and logical constraints of the code; and the receiver must be able to reproduce the sender's intentions and meaning without any transcription errors, without "noise."

In his influential critique of communication theory, Michel Serres (1982) draws on the physical properties of thermodynamics to argue that no system—physical, electronic, or thermodynamic—transmits "messages" without "noise." If you hear static on a radio, boosting the signal increases the static in proportion to the volume of the music rather than eliminating it. This noise, Serres maintains, is not an "error" that can be rectified but an essential form of mediation that defines our comprehension of the signal. Within any communication system, the binary relation between sender and receiver, who must share a "code" in order to conceive and understand the "message," is always mediated by a parasite (*le parasite* is the technical term in French for electronic noise) that mediates, interrupts, and paradoxically helps to produce "meaning." It is only *against* such noise that "meaning" can take shape: "we know of no system," Serres notes, "that functions perfectly, . . . without losses, flights, wear and tear, errors, accidents, opacity—a system whose return is one for one, where the yield is maximal" (12–13). Such "losses," "errors," and "wear and tear" within communication systems are, in important ways, analogous to the complexity defined by Bahktin's dialogic description of language: media always generate a welter of effects, ongoing constructions and reconstructions, interpretations and misinterpretations, that the sender or speaker cannot control.

Crucially, as William Paulson (1988) argues, this "noise," these competing interpretations and meanings, is precisely what we term "literature," "history," "culture." In short, Serres and Bahktin offer a means to think against the grain of those philosophical assumptions that transform complex issues in the theory and practice of multimedia to the problems of surface, interface, and transparency that guided many responses to the widespread proliferation of digital media. Rather than "freeing" a disembodied user to "create" infinite meanings in an enabling digital universe, multimedia forces users to grapple with the historical and cultural embeddedness of technologies of representation. In this regard, multimedia cannot be defined romantically as a set of frictionless interfaces or as the metaphysical abstraction "cyberspace." Multimedia must be described heuristically and materially by complex networks: of

workers, investors, programmers, producers, and consumers; of computer codes, cables, connections; of raw materials consumed to fuel ever-expanding demands for electricity; and of errors, updates, patches, and work-arounds. These interactions are both dynamic and irreducibly complex. Orchestrating static images, text, hyperlinks, audio, animation, and video dynamically does not allow us to transcend the noise of media culture, but it does allow us to turn up the volume.

The complexity of multimedia, according to Jay David Bolter and Richard Grusin (1999), can be understood as a consequence of “remediation.” Following Marshall McLuhan, they argue that all media cannibalize and subsume previous technologies of representation. Whether we enhance media to achieve unprecedented standards of visual, auditory, or sensory quality (hypermedia) or design systems that try to remain as inconspicuous as possible (transparent media), the ultimate goal is the same: to reduce noise to a minimum and thereby “to get past the limits of representation and to achieve the real” (Bolter and Grusin 1996, 313). This desire to transcend representation, however, is shaped by perceptions of “reality” derived from media with which we already are familiar. As every designer recognizes, we can describe improvements in verisimilitude *only* by judging new media against the perceived inadequacy of those media that they are designed to replace. “Each new medium,” Bolter and Grusin (1996) assert, “is justified because it fills a lack or repairs a fault in its predecessor, because it fulfills the unkept promise of an older medium [343]. . . . In each case that inadequacy is represented as a lack of immediacy” (314). Our sense of what is “new” or “revolutionary” in media—of what constitutes “immediacy”—is structured by perceptions of an always mediated reality, a reality, in other words, that is always in the process of becoming obsolete. Because multimedia is irrevocably dialogic, adding an image to a text, inserting navigation tools, enhancing rollover buttons, and, in short, enriching a mediated environment cannot eliminate noise or bring us closer to experiencing an “immediacy.” Rather, multimedia transforms and recombines local, discrete elements, remediating previous technologies of representation. Rather than transcending technology, multimedia reinforces our sense of what Kendrick (1996) terms the “technological real”: the recognition, whether implicit or explicit, that consciousness, identity, and “reality” are and always have been mediated by technology and that this mediation is always dynamic (144).

By the time we began *Red Planet* in 1997, hypertext had been superseded practically and in the public consciousness by the World Wide Web. The Web, like CD-ROMs, remediated and cannibalized hypertext documents as well as a variety of print media that redefined users’ expectations about what information architecture “should” look

like, appropriating layouts and designs from magazines, newspapers, video games, books, graphs, photographs, logos, billboards, and so on. Our expectations of verisimilitude are redefined continually by technological mediation: What looks “real” one year is second nature the next (that is, it exhibits an expected level of technological competence) and out-of-date the one following that. On the Web and in multimedia authoring more generally, technological improvements (upgrades for downloading capabilities, for example) continually up the ante in terms of users’ expectations of what is cool, cutting edge, useful, and aesthetically pleasing. But no standard of verisimilitude—pixels per screen, processing speed, RAM, storage capacity, improvements in downloading time, design modifications—can ever render media transparent. If our desire for verisimilitude on the Web and in technologies of visualization drives expanding expenditures of time, money, intellectual and manual labor, and raw materials, it also forces developers to make decisions about what constitutes marketable standards of immediacy. In authoring *Red Planet*, we were caught in an ongoing process of having to decide what we could afford in time, money, and labor to live up to our grant application claims that DVD-ROM could do what neither CD-ROM nor the Web could manage: integrate hours of high-quality video into a scholarly multimedia project and, in the process, redefine heuristically the dialogic interactions among text, image, animation, and video. At the same time, we had to engineer downward the minimum requirements of RAM, operating systems, monitor resolutions, and so on to avoid pricing our product out of a “mainstream” educational market.

From the start, we conceived of *Red Planet* as the scholarly “equivalent” of a book, that is, as a thesis-driven work of original scholarship. We confronted the challenge of producing a multimedia cross-disciplinary title that would extend beyond models of the electronic textbook or reference work yet, paradoxically, would have to remediate the very forms of digital media that were shot through with the commercialized values, assumptions, and expectations of the Web. If, as Markley (1994) and Kendrick (2001) have argued (see also Lewontin 1991; Hayles 1991, 1993), the dominant models for hypertext educational materials were commercial e-undertakings, we were faced with the question of whether a scholarly DVD-ROM could appeal to audiences beyond specialists in planetary astronomy and critics of science fiction and still claim the cultural capital of a refereed publication. Although the title would include basic scientific information about Mars—key definitions, animations of its orbital mechanics, and the basics of planetary geology—it was not limited to a specific grade level as a “teaching tool” or, for that matter, to a single discipline. We were committed to harnessing multimedia to present a historical and theoretical argument: since the time of Schiaparelli and Lowell, Mars has been a site on which scientists, science-fiction writers, readers,

and the “general public” have projected and repressed anxieties about ecological degradation on Earth. The scientific quest to find or rule out the possibility of life on the red planet, we argued, was part of a complex narrative of planetary evolution that motivated science-fiction writers since the nineteenth century to depict Mars as a “dying planet,” the contested site of radically different views of humankind’s relationship to a terrestrial environment on the verge of apocalyptic collapse.⁶

This decision to resist dumbing down the narrative to straightforward “information” of the sort that is readily available on NASA Web sites meant that, in addition to solving technical problems on a shoestring budget, the project had to distinguish itself from Web-based teaching materials so that *Red Planet* would be seen as the scholarly “equivalent” of a book, as a work of original scholarship. In contesting the default assumption that *all* electronic media had to be geared toward consumerist models of education, the four-year authoring of the DVD-ROM raised crucial questions about the financing and labor involved in a project of its size, complexity, and duration. In the absence of a mid-six-figure grant to fund the completion of *Red Planet*, the only way to compensate individuals who contributed to the authorial, artistic, and technical production of the title would come through the delayed forms of gratification that are valued and rewarded in academic institutions: publication or, for the designers, creative credit. Our insistence that *Red Planet* was *not* a CD-ROM was the result of a strategic and political decision about the ways in which all participants in the project—professors, graduate students, and undergraduates—perceived their roles within the contexts of academic labor and professional capital: If the project had been conceived of as an “instructional tool,” an electronic reference guide that collected and arranged previously published and available information, then *Red Planet* could not claim much in the way of professional recognition. Without the promise of such credit, the project never would have been completed. Treating *Red Planet* as the equivalent of a book and, for the designers, a creative work influenced our decision to seek an academic publisher rather than a commercial purveyor of software or textbooks. In turn, the dialogic form of multimedia redefined the ways in which we came to think about “scholarship” and publication credit.

On a day-to-day, task-by-task basis, the production of *Red Planet* broke down conventional barriers between “authors” and “designers,” between content and form. Most multimedia projects in the humanities and social sciences have reinscribed a division of labor between “content” and “medium.” Although there are more than a few cases of humanists becoming enthralled by Web design and CD-ROM authoring, the majority of commercial educational software treats “content” as a given, reified as “information” that has to be encoded within a programming language and designed in

such a way as to enhance its “usability.”⁷ In short, the division between textual labor (writing) and design labor (making it look good on the screen) reinforces divisions apparent elsewhere throughout the university and society as a whole between intellectual and manual work. With the exception of digital artists, those who write or patch code, who design your department’s home page, and who service your e-mail account tend not to be “regular” faculty but either persons employed specifically to troubleshoot computer and network problems or an assortment of catch-as-catch-can graduate assistants, work-study students, part-time employees, or consultants hired piecemeal by the university. In such a universe, it should be no surprise to hear (as we have) colleagues say, “I have this great idea for a DVD-ROM; I’ll write the text and give it to somebody who will do the design.” The assumptions underlying this kind of comment not only reinscribe a division of labor but reinforce conventional divisions between form and content, media and message, hired help and “authors.” Such biases are held by both humanists and designers: If a scholar produces “content,” then the design is treated as packaging; if a publisher of electronic encyclopedias or textbooks produces a multimedia version of a remediated print text, then that “content” is black-boxed.⁸ Writers write, artists design. Although professors may be encouraged to develop Web sites for courses, to set up list-servs for class discussion, most recognize that the time spent constructing such sites far outweighs any actual payback in terms of professional recognition, merit raises, and so on.⁹ After much discussion, we found that we had to adopt the semiotics of both print and multimedia to accommodate the four primary and three secondary authors on a colophon page, as well as a more detailed and elaborate credits page to indicate the kinds of contributions made to content and information architecture by the authors and other individuals.

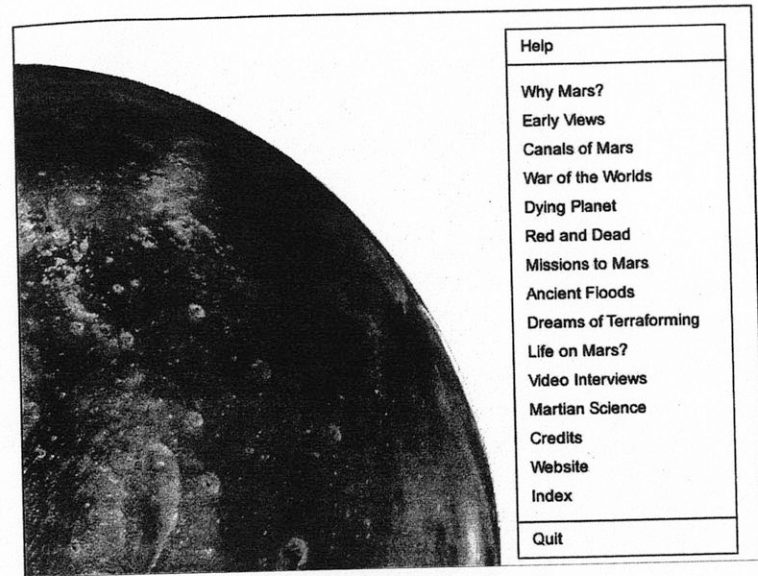
Our decision to produce *Red Planet* as a DVD-ROM had important consequences for how we conceived and continually modified its structure and design. *Red Planet* mediates self-consciously several generations (at least) of filmic and digital media: the minimalist, head-and-shoulders video inherited from television documentaries; hot-linked keywords derived from CD-ROM, and more distantly, biblical exegesis; digital artwork premised on studio collage techniques; and sophisticated animations. This ancestry carried with it a host of assumptions about how a software title should look, “feel,” and behave. The dialogic design of *Red Planet*, in this regard, takes into account the unpredictability of user needs and demands by incorporating the elements of the commercialized Internet—flexibility, layered content, and intermediality (a dialogic interlacing of formats: video, audio clips, voice-over narration, 200 pages of text, hundreds of photographs, and diagrams)—while preserving a sense of narrative coherence.

By distancing our project from the metaphors of mapping and gaming that have guided hypertext and multimedia development, we tried to avoid sacrificing narrative coherence and intellectual rigor to consumerist desires for easy access to dumbed-down information.

One way that we sought to address the danger of dumbed-down information was to emphasize that static and dynamic images play crucial roles in providing a complex introduction to Mars as a scientific and cultural artifact, even as they entice media-savvy users by hypermediating video and animation. For instance, the hyperlinked animations of orbital mechanics (opposition, conjunction, retrograde motion) illustrate key concepts that a student or educated layperson would have to know to understand why windows for launches of spacecraft to Mars occur only once every twenty-six months. But these animations contribute to the historical and conceptual narrative, demonstrating why debates about life on Mars and the appearance of scientific articles about the planet cluster during the years of “good” oppositions, when Mars approaches as close as 34 million miles to Earth. The dialogic interplay between such dynamic images and the text, in this regard, becomes essential to the conceptual and artistic design of the overarching narrative. Scientific “information” is not slighted, and users still get to watch video clips of the devil girl from Mars zapping hapless Earth males.

Given its conceptual, historical, and generic argument, we assumed that our commitment to narrative would distinguish *Red Planet* from software conceived as chunks or modules. But we soon realized that narrative itself is entwined with the notions of space and visualization as well as that of time, and the ongoing challenge we faced was to find strategies of visualization that would supplement or enhance the narrative rather than disrupt it. One of the reasons *StorySpace* was so popular for a brief time in the 1990s was that it provided a visual *space* in which to define narrative relations: Textual elements existed in boxes that could be rearranged, hyperlinked, and illustrated. Aware of the vast amount of information that had to be organized, we structured the narrative (in contrast to the remediated print technology of hypertext) in a series of chapters that run chronologically from ancient observations to recent Mars missions, including two chapters on science fiction and its significance in shaping scientific and popular perceptions of the planet. Because users are able to access our Web sites directly from the DVD-ROM, and thus updates on missions, a bibliography, continuing debates, and links to other sites, *Red Planet* would have a flexibility that a scientific study of Mars or a literary-critical analysis of science fiction about the planet would lack.

In defining the shape of this cross-disciplinary narrative, we had to come up with visual ways to direct the user: The more data and options we had to consider, the more complex such design and conceptual decisions became. For early versions, the table of

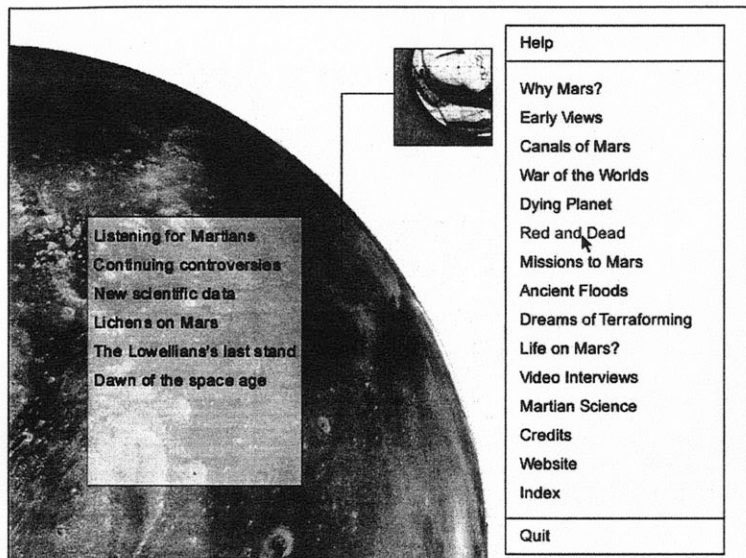


| Figure 3.1 |

Table of Contents for *Red Planet*.

contents (figure 3.1) included chapter titles; but, prompted by the Marketing Department at the University of Pennsylvania Press, we added pop-up boxes for each chapter.¹⁰ Each chapter heading features two rollover links; when a chapter is pointed to, the user sees a visual image that has an iconic relationship to the content of the chapter and a list of five to eight subheadings within the chapter: point to “Red and Dead,” for example (figure 3.2), and the subheadings appear as a rollover. The rollovers remediate self-consciously the browser design of multimedia search engines, while emphasizing visually the location of information within the historical and conceptual narrative that the chapters describe.

These kinds of composing decisions indicate how design and content questions impinge on each other. The index, for example, borrows from both the book and the Web page; it identifies relevant screens and links directly to important concepts in the

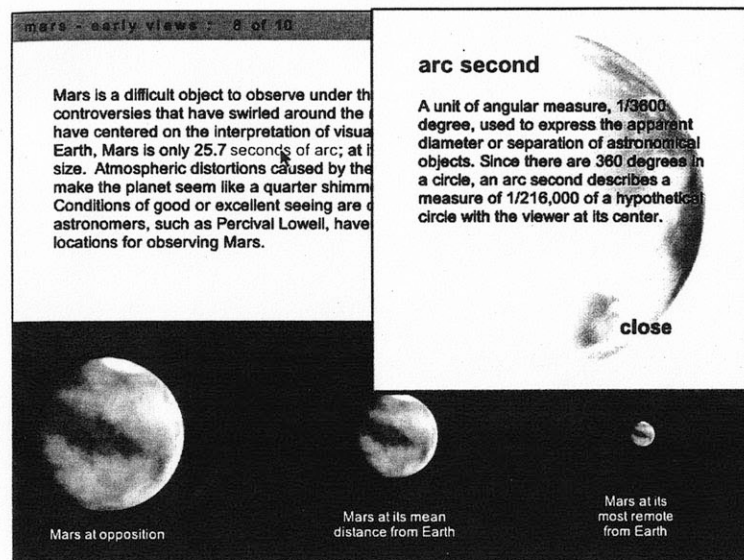


| Figure 3.2 |

A rollover reveals detail about each section.

body of the work. In a variety of contexts, then, we had to come up with intuitive visual navigation strategies. *StorySpace* handled the problem of visual design with a floating box suspended above the text boxes and carved with cryptic signs (arrows and boxes). Working ten years after *StorySpace*'s peak in popularity and having the benefit of Web-savvy users, we were able to integrate the navigation bar into the project with an easily recognizable set of tools: forward and back buttons, a button for turning off sound, and a button for returning to the main menu. Eventually, the number of hyperlinked and pop-up screens (figure 3.3), used to define scientific terms, outnumbered the pages of the main narrative.

But these links, in different ways, were not ancillary to the main narrative, not analogous to footnotes, but explorations that continually redefined the shape of the narrative. The biography of Russian science-fiction novelist Alexander Bogdanov, for



| Figure 3.3 |

Screen featuring a "pop-up" glossary definition.

example, included the kind of information about the crucial role he played in the first Russian Revolution of 1905 that would be incorporated in a scholarly book (as it is in Markley's forthcoming *Dying Planet*) but that on the DVD-ROM can be skipped, skimmed, or used as a means to redefine the contours of the narrative. A science student trying to remember what "aphelion" means may skip Bogdanov and the two major science fiction chapters completely; a cultural critic may read through the Bogdanov screens carefully, note the Key References on early twentieth-century science fiction, check the extensive bibliography on our Web site, and, clicking twice, be able to locate or purchase key books that discuss Bogdanov, such as Robert Service's (2000) biography of Lenin.

Rather than describe the individual chapters in a blow-by-blow fashion, we want to concentrate on the significance of integrating video into *Red Planet* for three reasons:

Video presented us with many of our most daunting technical and design problems; video radically alters traditional art-historical conceptions of the image; and, given the development of DSL and broadband networks, high-quality video seems likely to define the future of multimedia. In large measure, our decision to include extended video clips in the DVD-ROM meant that conceptually as well as technically, we were breaking new ground for educational or scholarly multimedia. Even in 1997, we recognized CD-ROM was destined to be replaced by DVD-ROM. A single-sided DVD holds a minimum of 4.38 GB of data, a CD-ROM about one-seventh of that. This storage capacity means that a DVD-ROM can hold several hours of high-resolution video, the equivalent of a book ninety feet thick; as significantly, DVD-ROM reads data a rate seven times faster than CD-ROM, a significant difference when one is compressing video. Video on CD-ROM is a pixilated, impressionistic oddity; on DVD-ROM, video begins to achieve something of the semiotic verisimilitude we associate with film.

The video interviews on *Red Planet*, sixty of them, are lengthy clips (up to seven minutes) playing at fifteen frames per second, with a data rate of 300 KB per second. File sizes range from 4 MB (for short segments in the introduction, "Why Mars?") to 136 MB (Robert Zubrin's description of the Mars Direct Plan).¹¹ Files of this size effectively spell the end of CD-ROM as a storage medium in a video-rich, multimedia environment. Because we were working with proprietary software (Macromedia's Director, versions 5, then 6, then 7), we were able to use video boxes, 360 × 240 pixels, much larger than those on the Web, which measure 120 × 80 pixels. The video on *Red Planet*, excluding all other multimedia features (static images, animations, text, navigation bars, sound files, and so on), takes up 2.5 GB, the storage space of three CD-ROMs. Yet DVD-ROM allows for smooth, instantly accessible video that can be viewed and navigated easily. Video offered over the Internet, on the other hand, is usually pared down to ten and sometimes seven frames per second, with a data rate of 15 KB or lower per second. Video compressed for the World Wide Web, at this stage, consists of comparatively short, choppy clips or sound bites that do not allow for the kinds of in-depth, comprehensive responses offered by interviewees on *Red Planet*.¹² Even when video clips are squeezed into such small file sizes, many Internet users grow impatient with the time it takes to download clips. Using a 56K modem, it would take almost a week to download all the data on our DVD-ROM. Although cable lines obviously handle Internet video faster and more smoothly, they are expensive: The list price of *Red Planet* is \$39.95, almost exactly the going rate in early 2002 for one month of high-speed Internet access.

From the start, we were confronted with the problem of how to integrate video interviews with NASA scientists, science-fiction authors, and cultural critics without

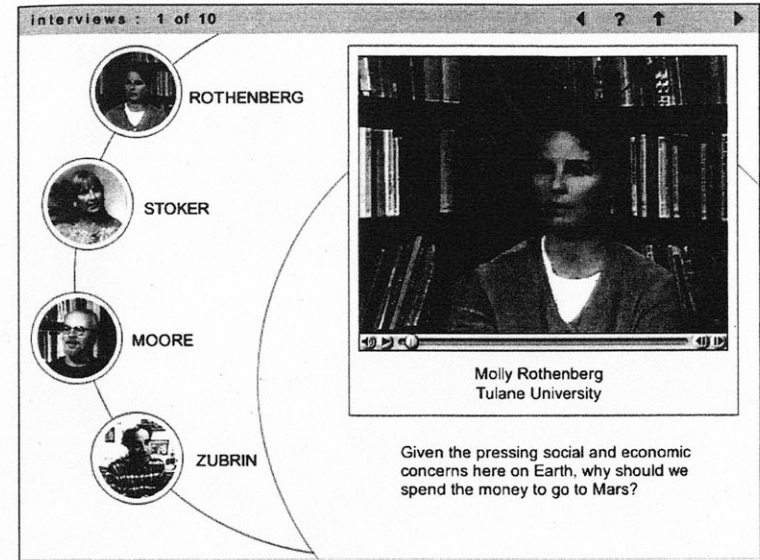
interrupting the narrative. In this respect, the integration of video into a scholarly narrative called into question the subordination of image to hypertextual metaphors of mapping and problematized the notion of a linear narrative. Static images can be scanned and downloaded easily, as anyone who has constructed a Web site since 1995 realizes; video presented us with crucial decisions to sort through in negotiating among the remediated design and conceptual conventions of visualization: hypertext buttons, BBC talking heads, clips from 1950s science-fiction movies, navigation bars, hyperlinks, static images from a variety of print and electronic sources, and so forth.¹³ In the days before video capture and editing became a standard feature on iMacs, we worked through a process of trial and error in deciding how video clips would enhance and complicate our historical and conceptual narrative. In early versions, the narrative (and voiceover) would stop; a video screen (360 × 240) would appear against a black or night sky backdrop and the talking head would talk. The video would end, and the next text and image screen would appear automatically. At this preliminary stage, the video clips functioned analogously to passages of primary material in a critical text: The previous screen introduced the "content" of the clip, the clip played, then the narrative continued. Other video clips in early versions required the user to point and click, to select an image of a talking head. The black backdrop and video screen would appear centered on the computer screen and disappear when the speaker finished. Automatically, the screen would return to the original page from which the user had linked. These video clips functioned, in this sense, by loose analogy to footnotes, "see also" entries in encyclopedias, and Web-based hyperlinks.

Our use of video, then, had a very different function from newscast or documentary sound bites. Television documentaries, for example, are limited by time and financial constraints; the clips must fit into a narrative at once entertaining and generically informational. Video must be integrated as seamlessly as possible into a medium that provides the viewer with limited options: watch, change channels, hit the mute button, or mow the lawn. In contrast, the video links that we developed were situated within a variety of spatial and temporal contexts. Because users can click on a video clip, turn it off by closing the window, replay it, or skip forward or backward in the narrative, the use of video becomes a dialogically fraught element: It enhances, disrupts, complexifies the notion of narrative itself. Significantly, it provides a visual semiotics that cannot be reduced to mere "information."

Our sense of narrative, in brief, had to adapt to the experience of having to integrate a variety of views, often radically at odds with each other, into our argument. To complicate matters, the interviews we used were conducted over a three-year period (1997–2000) at various locations (Denver; Los Angeles; Flagstaff, Arizona;

Morgantown, West Virginia; Toledo, Ohio) using different videographers and different high-end tape formats (3/4-inch, Beta, mini-dv).¹⁴ Many of the tapes eventually had to be dubbed into mini-dv, although in 1997 and 1998 we were still renting expensive decks to do our own dubbing to and capturing from 3/4-inch tape. The majority of interviews were conducted before the failure of the 1999 missions (when the Mars Climate Orbiter went off course and burned in the Martian atmosphere and the Polar lander crashed: both failures were the result of human error); before all of the 60,000 photographs were taken by the Mars Global Surveyor, some with resolutions as precise as one meter per pixel; before the paradigm-bending announcements that sedimentary layers and recent evidence of liquid erosion on the Martian surface had been photographed; and before the February 2001 article that apparently confirmed the existence of nanofossils in Martian meteorite ALH84001 (Friedman et al. 2001). The questions we posed—and could pose—in interviews changed over time, and the interviewees' responses had to be selected, edited, tweaked to filter out sound distortions, and located within the narrative.

Our theoretical concerns with dialogic nature of multimedia became particularly relevant in the arrangement of the video interview section of *Red Planet*. The gateway screens of this section (figure 3.4) include the question posed to each scientist, critic, or author and feature head shots of each interviewee. Users are able to select the video interviews they want to watch and the order in which they want to watch them. The control bars allow users to stop, speed through, and go back to any point in the interview. Unlike the chapters, there is no narrative *other* than the unscripted and often animated responses of those interviewed: Jeff Moore, Carol Stoker, Chris McKay (all from NASA-Ames), Kim Stanley Robinson (the science-fiction novelist), Molly Rothenberg (Tulane), Richard Zare (Stanford), Robert Zubrin (President of the Mars Society), and Philip James (Toledo).¹⁵ Video becomes the dominant content at this point, providing a dialogic forum through which users may investigate competing narratives about the future of Mars exploration, the benefits and dangers of terraforming another planet, and the significance of finding definitive evidence of past or future life on the red planet. It is left up to the user, with some help from the Educational Resources section, to analyze and, in effect, to *narrativize* the material. In every case, the physical appearances, voice tones, eye movements, facial expressions, and gestures of the interviewees become crucial factors in the user's process of making sense of their responses. Zubrin's enthusiasm, Rothenberg's skepticism, and Stoker's forceful justification for the continued exploration of space cannot be reduced to textual statements. The semiotic complexities of the users' responses to individuals discussing complicated scientific and sociocultural issues inflect the interviews with an immediacy, and



| Figure 3.4 |

Video interview screen: Each question is "asked" to a number of experts, and the clickable video answers grouped together on one screen.

a level of interpersonal indeterminacy, that would be lost if these experts' views were printed as a transcript or condensed to sound bites.

One of the effects of working with a DVD-ROM that uses video clips of three, four, and five minutes, then, is that the informational metaphors that dominate educational multimedia break down. One the one hand, we have known since the 1960 presidential debate that "information" includes a range of semiotic responses beyond what a text "says": Richard Nixon's five o'clock shadow, rather than his stand on civil rights, in retrospect, helped to elect John F. Kennedy. Yet despite decades of experience with Teflon presidents, media messaging, and rehearsed "debates," the default assumptions in multimedia still privilege text over (video) image. One of McLuhan's key insights—that most people respond to innovative technologies with the values, assumptions, and expectations derived from old technologies—can be illustrated by an experience we

had with *Red Planet*. At our final demonstration of an early version of the title for the University of Pennsylvania Press prior to signing a publishing contract, one member of the publications board (a professor of communications, no less) interrupted us after about ninety seconds—midway through the three short video clips that introduce the title—to declare that talking heads were *not* multimedia. After we showed him other features—hot links to Key References, definitions of scientific terms, and extended segments of video and animation—he still maintained that what we were producing was an electronic coffee table book. In effect, he discounted any informational content in the video itself, at one point suggesting that a single adverb—“he said enthusiastically”—could do the same “work” (his term) as the video clip of Richard Zare narrating the chance sequence of events and personal favors that led to his using mass laser spectroscopy to discover the nanofossils in Martian meteorite ALH84001. Finally, we clicked on the screen that includes two audio clips from the Mercury Theatre’s original 1938 broadcast of Howard Koch’s adaptation of H. G. Wells’s *War of the Worlds*. On this particular screen, no critical commentary or apparatus appears, although we later added three pages of links to display quotations from listeners who heard the broadcast and thought that Martians had indeed invaded New Jersey. “Oh,” he said, at last convinced, “now that’s multimedia.” His default assumption seemed to be that multimedia was defined not by content but by the layered remediation of prior technologies.

In less than a decade, the World Wide Web has gone through several evolutions of transmission capabilities: from Ethernet, base 10 and 100, to DSL, to the fiber-optic networks of Internet 2. If this increase in network data rates heralds a coming remediation of previous “passive” media—television, video, film—as “new” interactive or immersive technologies, it also creates significant problems for humanists. The ideology of commercial viewing has had profound influences—often negative ones—on the ways in which students, teachers, software designers, and others perceive the relation between word and static image. It is likely that the next incarnations of the Web will make video close to ubiquitous on commercial sites. The economics of video-rich multimedia production, without question, will ratchet up development and authoring costs: Standard permissions for commercial film, for example, run more than \$1,000 per minute. The vast majority of available grant money is earmarked for major supercomputing projects. The National Science Foundation initiative in Information Technology Research (NSF 00-126) in January 2001 defines three classes of projects: “Small projects” with total budgets up to \$500,000; “Group projects,” up to \$5,000,000, with annual budgets of up to \$1,000,000; and “Large projects” with total

budgets up to \$15,000,000 and annual budgets up to \$3,000,000 (National Science Foundation 2000). In such an environment, writing in and for multimedia will have to assert its “traditional” values in an increasingly competitive and commercialized marketplace of high-quality images. The challenge of DVD-ROM and Internet 2 technologies, it seems, will be to reassert the value of “content development” so that educational titles do not become ghettoized.

We want to emphasize, however, that DVD-ROM is very much a temporary storage device, one, no doubt, that will be superseded. Given the current generations of computers, it is a reliable and inexpensive medium rather than a be-all and end-all for educational multimedia. DVD-ROM does not offer a replacement for Hollywood-quality entertainment, but it stands a good chance of defining a benchmark for video quality in digital education. *Red Planet* is not, as we constantly must tell people, a disk that can play in a standard DVD player. Neither is it a model to be emulated so much as it is a historical document, a means to think through the scholarly and professional legitimation of video and visual information. “So our virtues,” says Aufidius in Shakespeare’s *Coriolanus*, “lie in th’interpretation of the time.” Visual literacy and digital technologies might not spell the end of alphabetic consciousness and scholarly argument, but they promise to redefine it, we hope, in ways that contest consumerist complacency and cyber-illiteracy. The dialogical complexity of multimedia necessarily complicates conceptions of education based on the transmission of information and, in the process, suggests other models of assessing the significance of new media besides consumer surveys and standardized test results. The irony of new media may be that the more universities and professors commit to next-generation networks, the more valuable Latour, Bakhtin, and Serres may become in contesting the naive enthusiasms that have animated too many accounts of the digital “revolution.”

The test of our dialogic description of information architecture in new media, however, may well come in the authoring of our next project, an educational DVD-ROM aimed at teaching fundamental concepts in physics to students while also emphasizing the social and cultural context of these formulas and methods. *Red Planet* has the benefit of being able to subsume cultural “content” and literary elements into a chronological narrative. In contrast, *The Gravity Project* (its working title) (Markley et al. forthcoming) is not anchored by such a narrative; in its current state, it incorporates a historical narrative—the development of theories of gravitation from Aristotle, to Descartes, to Kepler, to Newton, to Einstein—into extended explanations of basic principles that, in turn, depend heavily on videotaped experiments and interactive exercises. Remediating the textbook may not be as sexy as a leather-clad Martian

dominatrix, but our attempt to secure funding to complete this DVD-ROM may well indicate whether dialogism sells in the conservative field of science education.

Initially we experimented with a “graphlike” architecture, with a timeline along the top of the screen and scientific principles arranged vertically on the left-hand side. But this design raised questions about the relationships among a coherent narrative (the historical development of gravitational theory), the need to inculcate basic scientific principles in students’ minds, the desire to contextualize experiments and principles, and the pedagogical advantages of including extensive video clips in which historians of science describe the scientific and cultural significance of debates about the nature of gravity. As a heuristic model, we are not graphing hybrid structures into what we hope will be a coherent whole: instructional modules, each with set of first principles, experiments and exercises, and a larger historico-cultural narrative. The modules are ordered chronologically, each module beginning with a “gateway” page that gives the user four ways to approach the material.

The Gravity Project, with its four-way structure, promises to extend and remediate the experiences we have had with *Red Planet*. In particular, our organizing structure of exercises, experiments, first principles, and cultural history may dialogically disarrange themselves with each student’s potential interaction. Quite clearly, the organization we have chosen presents its own dialogic interference patterns that are always and already forcing us to question both the form and content of the DVD-ROM: How do we decide what is an experiment and what an exercise? What is a first principle and what is an important cultural context? *Red Planet*, in this respect, is only the first step in a movement toward a more dialogically organized—and hence deorganized—theory of information architecture. It preserves features that are derived from scholarly books, such as the index (figure 3.5), but redefines them so that they take advantage of web-like interactivity. Clicking on an item in the index takes the user to the relevant screen or screens, and the toolbar then offers the option of continuing within the main narrative in that section or returning to the index. At this juncture, modifying the search functions to mimic those of the Web is a possibility for titles currently in development: The ultimate decision will depend on resolving technical, conceptual, and design issues and rethinking the decisions we made in authoring *Red Planet*. For now, *The Gravity Project* is an experiment in the ongoing evolution of multimedia culture. The improvisational natures of narrative, information architecture, and the dialogics of new media guarantee that this project, like *Red Planet*, never truly will be finished. Multimedia, like its print technology ancestors, must be rather than mean.

index :		December
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| Figure 3.5 |

Index main screen: Each category reveals subcategories that can be clicked to move to the appropriate screen.

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Notes

1. The total development costs for multimedia authoring on CD-ROM in 1996 averaged \$400,000: \$100,000 for content creation and acquisition, \$200,000 for production, \$60,000 for testing, and \$40,000 for overhead and miscellaneous costs (see Rosebush 1996, 259–275). Extrapolating these costs for a hypothetical DVD five

- years later is difficult. Although the industry standard DVD-ROM holds 4.38 GB, seven times that of a CD-ROM, authoring software has become more sophisticated, and production costs, particularly for video processing, have become less expensive. A best-guess for a DVD-ROM produced *commercially* (that is, paying going labor rates of \$100 to \$300 per hour) would approach seven figures. The best source of information on DVD technology can be found at a site called Videodiscovery (2001).
2. An on-line preview of this multimedia DVD-ROM and the Mariner10: Educational Multimedia series of which it is part is available at <<http://www.mariner10.com>>.
 3. Because the seven coauthors and others contributed their labor for academic capital (merit pay, tenure and promotion, summer stipends, and travel money), estimating a total cost for producing *Red Planet* depends on how one calculates percentages of research time spent on the project. A good guess is \$250,000 (about half in grants and equipment from West Virginia and Washington State Universities). For background on theoretical issues in multimedia authoring, see Coyne 1995 and Chang, Eleftheriadis, and McClintock 1998.
 4. Multimedia titles, as we discovered, are far more labor intensive than books. Markley estimates that for every hour he spent writing his book about Mars, he spent three to five hours working on his part of the collaborative project. In addition to research writing, his tasks included everything from learning the basics of multimedia editing and videography to grant writing.
 5. There is an extensive bibliography on hypertext, cyberspace, and electronic environments. See, for representative examples, Brook and Boal 1995; Heim 1994; Laurel, 1993; Murray 1997; Ryan 2001; Stone 1996; and Woolley 1993. For examples of electronic hypertexts and virtual environments, see Laurel, Strickland, and Tow 1994; Greco 1995; Jackson 1999; and Strain and Vanhoosier-Carey 2001.
 6. This argument is extended in Markley forthcoming.
 7. As Kendrick (2001) argues, this conception of interactivity is often reduced to the operations of pointing and clicking and measures of design efficacy to consumerist models of accessing predigested nuggets of information. See also Nielsen 1999.
 8. Tellingly, the largest grants to centers in the humanities have been geared toward digitizing existing materials: Johns Hopkins University Press Project Muse, on-line journals by subscription, the e-book Center at the University of Virginia. Thousands of literary texts are available from the center that can be downloaded as books using Microsoft Reader; the translation of print to a digital medium that mimics the physical appearance of the book seems to have matured to the point where there is not a lot left to do with or to texts. On the significance of visualization, see Stafford 1996.
 9. Although materials archived on Web sites have become the center of contention about the "ownership" of electronic media, they frequently serve as glorified hand-outs. Although two of the principals on *Red Planet*, Higgs and Kendrick, teach Web design, Web sites themselves seem insufficient evidence of scholarly activity.

10. For the first two years, all production work took place in the Multimedia Application Research Studio lab at Washington State University-Vancouver. In 2000 and 2001, some additional authoring work (particularly video and Web design work) were undertaken at West Virginia University. Markley, Burgess, Daniel Tripp, Hamming, and Catherine Gouge made some two dozen trips to Vancouver or interview locations during the production process. Each trip resulted in another "version" of the title. All told, then, there were probably at least twenty provisional versions that tried, discarded, and refined a variety of design options.
11. Zubrin is president of the Mars Society and a frequent talking head on educational television. His plan for a low-cost, manned mission to the red planet is outlined in Zubrin 1996.
12. Christopher Breen (2000) recommends the following standards for digital video: CD-ROM, resolutions in pixels: 320 × 240; frames per second: 15; data rate: 100 KB per second. For the Web: 192 × 144; frames per second: 7.5; KB per second: 5.
13. Because many of the images used in *Red Planet* were from NASA and therefore in the public domain, we could draw from a substantial archive.
14. Each video shoot cost us between \$250 and \$500. In addition, travel expenses to various sites (or to have some interviewees come to us) ate up large amounts of our grant money.
15. Additional video interviews with Katherine Hayles (UCLA) and Henry Giclas (Lowell Observatory) are included in the body of the narrative.

Works Cited

- Aarseth, Espen. 1997. *Cybertext: Perspectives on Ergodic Literature*. Baltimore: Johns Hopkins University Press, 1997.
- Bakhtin, Mikhail. 1981. *The Dialogic Imagination*, trans. Michael Holquist and Caryl Emerson. Austin: University of Texas Press.
- Bolter, Jay David, and Richard Grusin. 1996. "Remediation." *Configurations* 5:308-350.
- Bolter, Jay David, and Richard Grusin. 1999. *Remediation: Understanding New Media*. Cambridge: MIT Press.
- Breen, Christopher. 2000. "How to Wrap Your iMovie." *Mac World* (December):66-70.
- Brook, James, and Iain A. Boal, eds. 1995. *Resisting the Virtual Life: The Culture and Politics of Information*. San Francisco: City Lights.
- Chang, Shih-Fu, Alexandros Eleftheriadis, and Robert McClintock. 1998. "Next Generation Content Representation, Creation, and Searching for New-Media Applications in Education." *Proceedings of the IEEE* 86:884-904.
- Coyne, Richard. 1995. *Designing Information Technology in the Postmodern Age: From Method to Metaphor*. Cambridge, MA: MIT Press.

- Cunningham, Steve, and Judson Rosebush. 1996. *Electronic Publishing on CD-ROM*. Sebastapol, CA: O'Reilly.
- Friedman, E. Imre, Jacek Wierzchos, Carmen Ascasio, and Michael Winkhofer. 2001. "Chains of Magnetite Crystals in the Meteorite ALH84001: Evidence of Biological Origin." *Proceedings of the National Academy of Sciences* 98:2176-2181.
- Greco, Diane. 1995. *Cyborg: Engineering the Body Electric*. Hypertext. Watertown, MA: Eastgate Systems.
- Grusin, Richard. 1994. "What Is an Electronic Author? Theory and the Technological Fal-lacy." *Configurations* 2:469-483.
- Hayles, Katherine. 1991. "Constrained Constructivism: Locating Scientific Inquiry in the Theater of Representation." *New Orleans Review* 18:76-85.
- Hayles, Katherine. 1993. "Virtual Bodies and Flickering Signifiers." *October* 66 (Fall):69-91.
- Heim, Michael. 1994. *The Metaphysics of Virtual Reality*. New York: Oxford University Press.
- Jackson, Shelley. 1999. *Patchwork Girl*. Hypertext. Watertown, MA: Eastgate Systems.
- Kendrick, Michelle. 1996. "Cyberspace and the Technological Real." *Virtual Reality and Its Discontents*, ed. Robert Markley, 143-160. Baltimore: Johns Hopkins University Press.
- Kendrick, Michelle. 2001. "Interactive Technology and the Remediation of the Subject of Writing." *Configurations* 9:231-251.
- Landow, George. 1992. *Hypertext: The Convergence of Contemporary Critical Theory and Tech-nology*. Baltimore: Johns Hopkins University Press.
- Lanham, Richard. 1993. *The Electric Word: Democracy, Technology, and the Arts*. Chicago: University of Chicago Press.
- Laurel, Brenda. 1993. *Computers as Theater*. Boston: Addison-Wesley.
- Laurel, Brenda, Rachel Strickland, and Rob Tow. 1994. "Placeholder: Landscape and Nar-rative in Virtual Environments." *Computer Graphics*, 28:118-126.
- Lewontin, Richard. 1991. "Facts and the Factitious in the Natural Sciences." *Critical Inquiry* 18:140-153.
- Markley, Robert. 1993. *Fallen Languages: Crises of Representation in Newtonian England, 1660-1740*. Ithaca: Cornell University Press.
- Markley, Robert. 1994. "Boundaries: Mathematics, Alienation, and the Metaphysics of Cy-berspace." *Configurations* 2:485-507.
- Markley, Robert. Forthcoming. *Dying Planet: Mars and the Anxieties of Ecology from the Canals to Terraformation*. Durham: Duke University Press.
- Markley, Robert, Harrison Higgs, Michelle Kendrick, and Helen Burgess, with Jeanne Hamming, Jeanette Okinczyc, and Daniel Tripp. 2001. *Red Planet: Scientific and Cul-tural Encounters with Mars*. DVD-ROM. Philadelphia: University of Pennsylvania Press.

- Markley, Robert, Earl Scime, Helen Burgess, Jeanne Hamming, and Daniel Tripp. Forth-coming. *The Gravity Project*. DVD-ROM. Philadelphia: University of Pennsylvania Press.
- Murray, Janet. 1997. *Hamlet on the Holodeck: The Future of Narrative in Cyberspace*. Cam-bridge: MIT Press.
- National Science Foundation. 2000. Initiative in Information Technology Research (NSF-00-126), January 2001. Available at <<http://www.nsf.gov/pubs/2001/>> (accessed De-cember 10, 2000).
- Nielsen, Jakob. 1999. *Designing Web Usability: The Practice of Simplicity*. Indianapolis: New Riders.
- Paulson, William. 1988. *The Noise of Culture: Literary Texts in a World of Information*. Ithaca: Cornell University Press.
- Porush, David. 1994. "Hacking the Brainstem: Postmodern Metaphysics and Stephenson's *Snow Crash*." *Configurations* 2:537-571.
- Porush, David. 1998. "Telepathy: Alphabetic Consciousness and the Age of Cyborg Illiter-acy." In *Virtual Futures: Cyberotics, Technology and Post-Human Pragmatism*, ed. Joan Broadhurst Dixon and Eric Cassidy, 45-64. London: Routledge.
- Ryan, Marie-Laure. 2001. *Narrative as Virtual Reality: Immersion and Interactivity in Litera-ture and Electronic Media*. Baltimore: Johns Hopkins University Press.
- Serres, Michel. 1982. *The Parasite*, trans. Lawrence Schehr. Baltimore: Johns Hopkins Uni-versity Press.
- Service, Robert. 2000. *Lenin: A Biography*. Cambridge: Harvard University Press.
- Stafford, Barbara Maria. 1996. *Good Looking: Essays on the Virtue of Images*. Cambridge: MIT Press.
- Stone, Alluquere Rosanne. 1996. *The War of Desire and Technology at the Close of the Mecha-nical Age*. Cambridge: MIT Press.
- Strain, Ellen, and Greg Vanhoosier-Carey. 2001. *Griffith in Context: A Multimedia Explora-tion of D. W. Griffith's The Birth of a Nation*. Available: <<http://www.griffith-in-context.gatech.edu/>> (accessed June 12, 2001).
- Videodiscovery. 2001. <<http://www.videodiscovery.com/vdyweb/dvd/dvdfaq.html>>, ac-cessed on May 30, 1999.
- Woolley, Benjamin. 1993. *Virtual Worlds: A Journey in Hype and Hyperreality*. London and New York: Penguin Books.
- Zubrin, Robert, with Richard Wagner. 1996. *The Case for Mars: The Plan to Settle the Red Planet and Why We Must*. New York: Free Press.