Introduction

Museums and heritage organizations have institutionalized authority to act as custodians of the past in Western societies. As such, they hold a significant part of the "intellectual capital" of our information society. The use of emerging digital technologies to activate, engage, and transform this "capital" is paralleled by shifts in the organizational and practice culture of the institutions entrusted with its care.[1] In a symbiotic relationship, cultural heritage "ecologies" also appropriate, adapt, incorporate, and transform the digital technologies they adopt. Why and how this transformation occurs in our cultural organizations requires serious investigation and is the subject of this compilation.

The renowned and much quoted media theorist Marshall McLuhan (1964) stated "we become what we behold that we shape our tools and thereafter our tools shape us." Simply put, McLuhan argued that new ways of perceiving the world, embedded in knowledge structures and societal transformations, enable the development of tools that emulate new social and theoretical ideas. Thereafter these tools, through technological innovation, have the ability to offer a range of possibilities beyond those originally imagined. Looking at the relationship between technology, cultural theory, and society from another angle, Lev Manovich (2001) rightly argues that new media is culture "encoded" in a digital form.

This anthology, international in scope, draws together thirty authors to critically analyze and theorize on themes of museums and heritage in relation to "digital culture." It is concerned not simply with the implementation of digital technologies themselves but with the relationships created within cultural complexes such as the philosophical, historical, social, artistic, biological, geographic, and the linguistic.

This book represents the first comprehensive theoretical discourse on cultural heritage and digital media since 1997. That edited collection, *The Wired Museum: Emerging Technology and Changing Paradigms*, by Katherine Jones-Garmil, followed the advent of

the museum Internet revolution and discusses the future of these institutions through a technological lens. Today, nine years since this ground-breaking publication (a period of unprecedented technical development within the field), it is timely that a more critical and theoretical appraisal—of the specific roles that museums and cultural heritage institutions play in interpretation and representation using new and emerging digital media—should be realized.

An abundance of publications have emerged in recent years that investigate critical cultural theory and global digital cultures at a meta-level. These texts[2] discuss issues regarding "virtuality," the relationships between the virtual and real, the body and machine, place, space, hypertext, cyberspace, and interactivity. A number of the works are directed specifically toward cinema and the visual arts sector and Internet cultures. Yet other issues specific to the museums and heritage sector remain, that have yet to receive significant exposure in the marketplace outside of conference circuits.[3] These include: digital cultural heritage as a political concept and practice; the representation and interpretation of cultural heritage such as digital objects (including questions of aura and debates of "virtual" versus "real"); issues of mobility and interactivity both for objects and for consumers of digital heritage; the relations between communities and heritage institutions as mediated through technologies; the reshaping of social, cultural, and political power in relation to cultural organizations made possible through communication technologies; and the visualization and interpretation of archaeological sites and historic environments, embracing both digitally based knowledge management tools and virtual reality. Necessarily, the discussion of these issues embraces other concerns common to critical digital theory such as virtual reality, cognitive science, artificial intelligence, visual art history and theory, cultural communication and learning theory, social research, information management and indigenous knowledge, cultural studies, communications, history, anthropology, museum studies, film studies, and information management.

The suite of essays in this publication is intended to serve a broad international audience. As a reference work, it provides a resource for professionals, academics, and students working in all fields of cultural heritage (including museums, libraries, galleries, archives, and archaeology) as well as education and information technology. It is envisioned that the publication will be used as a primary and a secondary text at both undergraduate and postgraduate levels. This rich compendium will also be of value to non-specialists who are interested in cultural heritage and its future interpretation.

In the last few years much of the discourse about the relation between cultural heritage and digital technology has been descriptive and introspective, focusing on projects and their technical considerations. These discussions are appearing mostly in journals arising from conferences or on respective project-based Web sites. These fora continue to make valuable contributions to the ongoing development of the sector, although they have yet to foster a body of sustained critical thinking about the meanings and implications of the apparent transformations, challenges, and possibilities posed by communications technologies. Moreover, digital heritage's standing as heritage has been a source of considerable debate over recent years. It is only recently that digital heritage has accorded status as an entity in its own right. The *UNESCO Charter on the Preservation of Digital Heritage* articulates this turn by creating a new legacy—the digital heritage: "resources of information and creative expression are increasingly produced, distributed, accessed and maintained in digital form, creating a new legacy—the digital heritage."[4] As a result, digital technology has been largely unmapped in terms of a critical theory for cultural heritage per se, and for heritage institutions.

Digital Cultural Heritage: A Critical Discourse departs from the volumes preceding it[5] with the range of timely theoretical contributions it brings to an analysis of cultural heritage and technology. The choice of authors, combining both theorists and practitioners in various disciplines pertaining to cultural heritage, moves the discussion beyond purely theory described by Peter Lunenfeld as "science fictionalized discourse" to ground these discourses in practice (1999, ix). This combination of theory and praxis lies at the foundation of this book.

Collecting organizations are vehicles for the enduring concerns of public spectacle, object preservation, shifting paradigms of knowledge and power. Digital technologies are implicated with historical transformations in language, society, and culture, and with shifting definitions of the museum. To speak of the digital is to engage simultaneously with the impressive array of virtual simulacra, instantaneous communication, ubiquitous media, global interconnectivity, and all their multifarious applications.[6] Given how important digital technologies have become in our lives, this collection of essays arose as the result of a perceived need for a sustained interchange between digital cultural theory and heritage practices. Although the cultural heritage sector acknowledges that digital technology requires institutions to face new challenges, many of these issues have not yet been fully imagined, understood, or critically explored outside of conference roundtables. The authors here consider the extent to which digital technologies are a cultural construct and how they might be used

purposefully to transform institutional cultures, methods, and, most importantly, relationships with audiences—into the future.

This book demonstrates that the idea of a technologically determined future for museums is not a debate unique to our time; it is one that has a long historical trajectory. Thoughts of technological determinism have always taken center stage when apparent ruptures and dramatic shifts in the *modus operandi* occur—thereby enabling us periods of acute observation. As Fredric Jameson argues, "radical breaks between periods do not generally involve complete changes but rather the restructuring of a certain number of elements already given" (1983, 123). Identifying and predicting the parameters for future exchange between cultural organizations and audiences, together with the operational paradigm shifts required in the face of dynamic technological change this process demands, is the task of the authors in this volume.

Given the breadth of discussion, the book has been broken into three parts. Part I: *Replicants/Object Morphologies*; Part II: *Knowledge Systems and Management—Shifting Paradigms and Models*; and Part III, which focuses upon *Virtual Cultural Heritage*. The series of chapters in part I: *Replicants/Object Morphologies* is primarily concerned with the confluence of technology and culture in the representation of art and heritage collections for both Western and Indigenous communities. As Christiane Paul argues, in her book *Digital Art*, "Technologies often tend to develop faster than the rhetoric evaluating them, and we are still in the process of developing descriptions for art using digital technologies as a medium—in social, economic, and aesthetic respects" (2003, 67). The authors in part I seek to engage with this debate in relation to the wider applications of cultural heritage.

The reproducibility and so called "immaterial" nature of digital objects and assets has induced some anxiety within the museum sector. The idea that "real" objects and works of art are under threat, exacerbated by theories of mechanical reproduction and simulation by proponents such as Walter Benjamin and more recently Jean Baudrillard, has had a persuasive effect on the way museum collections and digital objects have been viewed, used, and assigned meaning.[7] To this end these contributors critically examine and re-theorize prevailing arguments about the relationships between material and digital objects. They examine definitions and morphologies assigned to objects, art works and other cultural objects, and multimedia, in both exhibitions and digital space and speculate on how these have impacted on the role, function, and imaginative uses of digital media and digital art. The theses of these arguments rest on one overarching theme, that is, what new understandings can be brought to bear

on the relationship between digital and physical collections, art works, and on the digital object? Moreover, these commentaries challenge conventional understandings of museum representation, art, history, and culture, and their application to digital objects and Indigenous collections.

From this starting point the authors explore a number of avenues around this theme. Peter Walsh looks to older visual technologies such as photography, and the historical foundations of cultural heritage institutions, to illuminate possible meanings for digital objects. Andrea Witcomb offers new perspectives on the display of objects alongside digital media in exhibitions through an analysis of interpretive approaches and forms of narrative construction. Fiona Cameron examines the poetics and politics of the "digital" historical object, the relationship between virtual and material objects and more abstract concepts of materiality, aura and authenticity, authority, interpretation, representation, knowledge, and affect. The potential uses of augmented and virtual reality in managing, researching, and sustaining Indigenous collections is a major theme of Deidre Brown's contribution.

Authors Beryl Graham and Sarah Cook investigate the histories of digital art works and critically examine their place within physical spaces and the Internet as a means of offering new perspectives on their meaning and the challenges posed for conventional practices of curatorship and documentation. A discussion of the history and politics of art communities in networked and real-world locations forms a basis for narratives on collaborative art creation, creative content creation, and education, accessibility, and usability.

Most significantly, these chapters offer new discourses of meaning for digital objects, art works, and media within cultural heritage institutions. Discussions illuminate the political and economic implications of the use of digital media in the production of art works and in the acquisition, representation, and conservation of collections. Furthermore, they foreground transformations required in institutional mission and practice, and in relationships with audiences.

In chapter 1, *The Rise and Fall of the Post-Photographic Museum*, author Peter Walsh gives his attention to the history of the development of technology as a cultural practice. He looks to the history of the development of technology, notably photography, art, and the modern art museum in the nineteenth century to find a parallel revolution to the one currently being experienced with the introduction of new media. Walsh examines the way photography changed the manner in which art was presented, reproduced, analyzed, and evaluated and the profound impact the introduction of this

technology had on the everyday practices of museums other than the range of its collecting activities. In his celebrated essay, *The Work of Art in the Age of Mechanical Reproduction*, Walter Benjamin writes, "that which withers in the age of mechanical reproduction is the aura of the work of art." Here Walsh makes the opposite claim that the "aura" of original art works was, in fact, created by the invention and distribution of photographic technologies.

Andrea Witcomb, in *The Materiality of Virtual Technologies: A New Approach to Thinking about the Impact of Multimedia in Museums* (chapter 2), discusses the impact of digital media technologies in museum exhibitions. Witcomb argues that existing discussions tend to be based on an opposition between the virtual and the material world; the virtual is thus interpreted either as a threat or as a radical process of democratization. Here, Witcomb adopts a different viewpoint, one that begins by taking digital media technologies as material objects in their own right, thus enabling the emergence of new perceptions on the relationship between the display of objects alongside digital media elements.

Following on from this theme, *Beyond the Cult of the Replicant: Museums, Objects—Traditional Concerns, New Discourses* (chapter 3), Fiona Cameron examines prevailing debates and bifurcations used to describe and define historical collections and virtual/digital "historical" objects. Cameron illustrates how digital historical collections have been bounded by an object-centered museum culture and material culture paradigms. The author argues that the roles and uses of the digital object must also be understood as part of the broader heritage complex—an institutionalized culture of practices and ideas that is inherently political, socially and culturally circumscribed. Cameron concurs that there is a need to move away from the formalist notions of technology and materiality that make digital objects fit into the specific rubric of "replicant" that have constrained their value, meaning, and imaginative uses. This chapter rethinks the relationships between historical collections and their digital counterparts while offering new understandings of digital "historical" objects as material, representation, presence, affect, experience, and value.

Te Ahu Hiko: Digital Cultural Heritage and Indigenous Objects, People and Environments by Deidre Brown (chapter 4), examines the possible heritage applications of three-dimensional augmented and virtual reality (AR and VR) to Indigenous New Zealand Maori treasures, bodies, and landscapes. Here Brown argues that the digital landscape presents itself to Developing and Fourth World people as a new frontier ready for settlement. While generally the product of First World ideologies, Brown demonstrates

how digital media offer non-Western people the opportunity to challenge the authority of such structures and reinterpret the way in which cultural arts, artifacts, practices, and environments are managed and presented.

In *Redefining Digital Art: Disrupting Borders* (chapter 5), Beryl Graham examines current working categories for classifying digital art in physical installations and looks at how these definitions are affecting how art is shown. Graham goes on to argue that digital art as a relatively new medium is disrupting "safe" categories and shows how its particularly fluid characteristics are inherently worrisome to arts institutions. Graham uses her own working definition of digital art to examine the particular challenges of collecting, documenting, and conserving new media art in institutions.

Beginning with the working definitions of digital art first proposed by Beryl Graham in chapter 5, Sarah Cook, in *Online Activity and Offline Community: Cultural Institutions and New Media Art* (chapter 6) further refines the taxonomy of digital art with a discussion of strictly online practices—net.art, net-art, and art on the Internet. Definitions and examples, as well as established criteria, are provided. In particular the question of the necessity for collaborative art creation in an online environment is addressed through an examination of the inherent multiplicity of agendas and structures prevalent in the online world. The role that the shifting politics and economics of the Internet play in the creative process of content-generation online is the focus of Cook's discussion.

The series of chapters in part II: *Knowledge Systems, Management and Users—Shifting Paradigms and Models*, critically investigates the confluence of knowledge, learning, information management, digital technologies, and user research in the cultural heritage sector. These discussions address current imperatives and those likely to be operative in the future, pertaining to cultural heritage institutions as knowledge providers, the subject of knowledge and learning brought about by current cultural complexes, technologic possibilities, and users. As Lev Manovich argues, the shift of culture to computer-mediated forms of production, distribution, and communication "affects all stages of communication, acquisition, manipulation, storage, and distribution" (2001, 19). In the context of this discourse, prevailing themes in part II, by authors Fiona Cameron and Helena Robinson, and Harald Kraemer, address shifting epistemological paradigms, digital landscapes, and the implications for knowledge creation and the documentation of collections in museums. The histories of taxonomies, methodologies, and information standards for creation and access to knowledge are addressed by Ingrid Mason and Gavan McCarthy. Of primary concern are the polemics and politics

of digital technologies, documentation, and information standards. The authors also address notions of documentation: as discursive, as a navigational system, and as a conduit for new theoretical, conceptual, access, and learning paradigms.

Other contributors, in particular Susan Hazan, Angelina Russo and Jerry Watkins, and Ross Parry and Nadia Arbach, address more abstract issues around power and knowledge, expertise, authority, objectivity, learning and narrative construction, user/audience relationships, and notions of social inclusion and exclusion in knowledge access.

From these starting points, contributors address the topics within the various disciplines of art, history, museology, the domain of information management, and Web design. Most significantly, they offer fresh insights into traditional concerns around knowledge and cultural heritage, and challenge the authority of such structures. Furthermore they propose ways in which the aforementioned imperatives might reshape institutions, foreground new knowledge models and practices in knowledge creation, in narrative formation, in documentation, learning, and in exhibition curation.

In chapter 7, *A Crisis of Authority—New Lamps for Old*, Susan Hazan questions the role of digital media in museums and how it modifies the relationship between museums and their audiences in terms of knowledge. As traditional owners of an ideological expert system that was once perceived as the primary authority on the knowledge systems they manage, Hazan argues that museums must now face the realization that their audiences may avail themselves of such knowledge through the media and other online resources. At the same time, the educational goals and social responsibilities that have traditionally fallen within the parameters of the insular institution of the museum are being challenged from many different directions. This chapter maps out the various adjustments that museums are making, and are required to make, as they reach a critical moment in a crisis of authority.

Following on from this argument, Angelina Russo and Jerry Watkins (chapter 8) *Digital Cultural Communication: Audience and Remediation* discuss the potential for convergent new media technologies to connect cultural institutions to new audiences through community cocreation programs using a framework termed "Digital Cultural Communication." The authors argue that this connection requires more than the provision of convergent technology infrastructure: the cultural institution must also consider the audience's familiarity with new literacies, and supply and demand within the target cultural market. To establish this framework successfully, the authors pose ways in which cultural institutions can seek to expand curatorial missions from exhibitions of collections to the remediation of cultural narratives and experiences.

In *Digital Knowledgescapes—Cultural, Theoretical, Practical, and Usage Issues Facing Museum Collection Databases in a Digital Epoch*, Fiona Cameron and Helena Robinson offer new insights into ways that collections documentation and interpretation within collections databases can be reconceptualized to form new knowledge models in line with contemporary theoretical and pedagogical public access concerns, and the capabilities of emerging technological innovation. The discussion illuminates how the transformative process may occur, the nature and form of new knowledge models, how these relate to user needs, and the way they may be applied to collections documentation and information capture. To conclude, the discussion poses a tangible discourse on how these new paradigms may radically reform museum practice, for example museum policy, institutional knowledge creation and management, and staff roles and tasks.

The theme of collections documentation and emerging digital technologies is further discussed in chapter 10, *Art Is Redeemed, Mystery Is Gone: The Documentation of Contemporary Art* by Harald Kraemer. Here Kraemer examines the specific traits of contemporary art and the necessity for new documentation procedures in the context of the possibilities offered by digital technologies. He argues that the diverse prerequisites and specific demands of contemporary art involve a changed methodology of analytic access, and suggests methods for significantly extending traditional static methods of aesthetic documentation. He examines this by addressing two questions. In what respect could a renewed methodology of documentation question contemporary art meaningfully? And, what roles might the interactive possibilities of digital and multimedia technology play here?

Integral to accessing cultural heritage in a digital environment, the argument for cultural information standards and frameworks becomes a persuasive one. In chapter 11, *Cultural Information Standards—Political Territory and Rich Rewards*, Ingrid Mason examines the role of cultural information standards in providing the infrastructure for the collection, preservation, and accessing of digital cultural heritage. The significance of critically examined standards, Mason argues, is because of their role in supporting the collection and preservation of digital cultural heritage. That is, they determine what is collected (selection policies and guidelines) and kept (preservation policies and methods). To do this, Mason explores the relationships between cultural information standards and digital cultural heritage and what drives their development—the sociopolitical forces that influence cultural information standards and the benefits of virtual access to digital cultural heritage.

Moreover, Gavan McCarthy, in *Finding a Future for Digital Cultural Heritage Resources Using Contextual Information Frameworks* (chapter 12), explores the use of contextual

information frameworks as a means by which knowledge can be passed from generation to generation. Following the emergence of the Internet, the creation and curation of digital cultural heritage resources has become a major cultural force, enabling the linking and sharing of information. McCarthy argues that one of the major challenges for all those creating and curating digital cultural heritage resources is in finding a path that will enable the resources to be utilized by future generations, one that can mitigate both media redundancy and epistemic failure. This chapter extends current thinking by conceptualizing how the elements of our cultural heritage knowledge base might be managed in the future.

The following two chapters engage new models for audience research and learning in an online environment. First, *Engaged Dialogism in Virtual Space: An Exploration of Research Strategies for Virtual Museums* by Suhas Deshpande, Kati Geber, and Corey Timpson (chapter 13), proposes a new theoretical framework based on Appraisal theory and classical rhetoric for formulating an audience-centered strategy in researching the optimal performance of virtual museums. Knowledge of how varied audiences use and interpret the content contained in a virtual museum is essential for designers to plan, create, and monitor the performance in virtual space. To this end, this model provides a unique way to assess discourse and the persuasive use of language to understand audience behavior. And chapter 14, *Localized, Personalized, and Constructivist: A Space for Online Museum Learning* by Ross Parry and Nadia Arbach, examines the confluence of user-driven software, learner-centered education, and visitor-led museum provisions and their relevance to online museum learning. From the assessment of these variables, the authors argue that what emerges is a paradigm of increased personalization, localization, and constructivism characterized by a greater awareness of and responsiveness to the experiences, preferences, and contexts of the distant museum learner. To this end Parry and Arbach suggest how these types of experiences are impacting on the status, value, and role of new media within organizations, the capacity of museums to use technological innovation, and ways institutions might conceive and articulate their involvement with Web-based learning.

Part III of this anthology, *Cultural Heritage & Virtual Systems*, examines the intersection of cultural heritage research, documentation, and interpretation—as it is mediated through the techniques and modalities of virtual reality. The term "virtual cultural heritage" is generally accepted to mean: virtual reality (3D and 4D computational and computer graphics systems that support real-time, immersive, and interactive operations), employed specifically for the presentation, preservation, conservation, and documentation of natural and cultural heritage. As Bernard Fischer and

his colleagues note, in reference to the possibilities available to us through the development of techniques in virtual reality, "... cultural virtual reality ... has now come of age" (2000, 7–18). While most of the preconditions for virtual reality have been available since the 1990s, the cultural, aesthetic, sociological, and scientific implications of the use of these technologies for heritage are still being formulated. Those engaged in the practice of virtual cultural heritage (hereafter called virtual heritage) are particularly concerned with the lack of translation of the scientific principles of the discipline of archaeology to the modalities of virtual reality. Does virtual reality offer the potential to make significant contributions to "spatial understandings, human-landscape interaction patterns, temporal ordering of material remains and fragments assembly" (Sideris and Roussou 2002, 32)? Virtual heritage is often labeled "edutainment," and even the "Disnification" of culture, and as Juan Barceló states "... in most cases the use of virtual reality in archeology seems more an artistic task than an inferential process" (2000, 9–36). Further, as Athanasios Sideris and Maria Roussou point out, "we observe a growing number of VR projects related to Archaeology evolving independently while any consistency to the methodological and conceptual logic remains specific to each project and is usually self justified" (2002, 31). Indeed, these researchers go on to point out that virtual heritage, as it has developed so far, may be best suited for interpretive products for the general public rather than for valid scientific inquiry.

The authors in part III take up the challenge of articulating what it means to develop both scientific objects and interpretive products for cultural heritage using the modalities offered by virtual reality. Each are engaged in the practical business of fieldwork and data capture using the most advanced scientific tools available. They *are* concerned about the issues of registration and capture technologies, storage, longevity, transparency, and the metadata of the models they create. In keeping with the purpose of this book, the writing below reflects the theoretical issues confronting virtual heritage. These include the described "newness"[8] of technologies engaged by users in virtual travel and education, navigation as paradigm in virtual space—and the requirements for "presence" and immersion combined with cognitive science and semantics for learning in virtual environments. The creation of spatial archives with the use of mobile and augmented technologies and the affordances of hyperdocuments for defining the multifarious knowledge contained in architectural heritage spatial representations are addressed by the authors below. The use of complex systems and artificial intelligence as an aid to problem solving in archaeology demonstrates a visionary future.

Sarah Kenderdine, in *Speaking in Rama: Panoramic Vision in Cultural Heritage Visualization* (chapter 15), examines the chronological use of the panorama—to decode its sociocultural implications as it reemerges in virtual heritage. In this way the work traces the panoramic scheme "in transition" to reach an applied virtual heritage. The argument develops to demonstrate that it is the provocative tension that exists for virtual heritage as a tool for scientific and cultural visualization, the gap between the scientific requirement to reproduce rational material reality and those "sensations" produced by the illusion inherent to panoramic immersion—that intrigue visitors to the (virtual) space.

How immersive virtual spaces can be articulated as modalities for virtual heritage are the subjects of the next two chapters. Erik Champion and Bharat Dave, in *Dialing Up the Past* (chapter 16), investigate the centrality of "place" as a structuring concept for virtual heritage environments. Both "place" and "placeness" in virtual heritage require more than just a high degree of visual realism. The authors draw upon concepts from architecture, cultural geography, and theory in virtual environments (especially "presence" research), to identify a number of specific features of place-making. It is the argument of the authors that virtual heritage requires the same hermeneutic features of place.

Bernadette Flynn in *The Morphology of Space in Virtual Heritage* (chapter 17), identifies one of the core disappointments in virtual heritage, that is, that an algorithmically accurate large-scale 3D model of a cathedral or castle is taken as the hallmark of authenticity, and that the reduction of the monument or artifact to visual simulation disrupts its connection to material evidence, and thus to history. As Walter Benjamin observed in discussing the replacement of the original by the copy, art is severed from its relationship to ritual and magic—it loses its aura. Evoking the presence of the past relies on a different treatment of the space that creates cultural and social presence. Applying methods of ludology, the constraints, affordances, and challenges within the architecture of virtual reconstruction can be used to convey a direct negotiation with a specific cultural context. This can lead to the imagined "presence" of the organically social experience. In this way, Flynn demonstrates that heritage is restored not only as a spatial representation onscreen, but also as a place for habitation—as a kinaesthetic sense of presence in the past.

In chapter 18, *Toward Tangible Virtualities: Tangialities*, Slavko Milekic focuses on two characteristics of virtual environments: the absence of support for meaningful experiential interactions with virtual information, and the fact that currently the emphasis in virtual environments is placed on the quantity of information rather than its quality.

He draws on cognitive science and aspects of learning theory to propose how the designers of virtual environments can meet the challenges of supporting user interactions that contribute to information transfer and retention, and make the quality of virtually presented information meet or exceed a real life experience.

In *Ecological Cybernetics, Virtual Reality, and Virtual Heritage* (chapter 19), Maurizio Forte also investigates the cognitive attributes of virtual systems as created in virtual heritage. He maintains that in virtual heritage the risk is to enhance the amazing aesthetic features despite the lack of informative/narrative feedback and cognitive research within the virtual worlds themselves. Forte reiterates that the importance of the virtual reality systems in the applications of cultural heritage should be oriented towards the capacity to change ways and approaches of learning, and he makes the case for ecological and cybernetic approaches to investigating virtual worlds for heritage.

In chapter 20, *Geo-Storytelling: A Living Archive of Spatial Culture*, Scot Refsland, Marc Tuters, and Jim Cooley propose applications for mobile computing and virtual heritage. What is interesting about locative media in the context of virtual heritage is that it makes possible the notion of a collaborative mapping of space, and the intelligent social filtering or "narrowcasting" of that space. This has the potential to significantly impact upon the dominant modes of representation, most notably that of the linear, expository narrative.

Rodrigo Paraizo and José Ripper Kós (chapter 21), drawing on their experience of architectural heritage in Brazil, discuss different methodologies for the use of "hyperdocuments" as a basis for revealing urban heritages through electronic tools. *Urban Heritage Representations in Hyperdocuments* considers spaces that are also stages for social events; and that hyperdocuments can be powerful tools to display not only the physical urban structure but also to demonstrate the connections that create the urban spaces people dwell in.

Finally, in chapter 22, Juan Antonio Barceló, in a visionary essay presents a theory for the use of artificial intelligence in virtual heritage as a specific tool for archaeological inquiry. *Automatic Archaeology: Bridging the Gap between Virtual Reality, Artificial Intelligence, and Archaeology* moves the discussion away from interpretive virtual heritage to interdisciplinary scientific applications. In general, archaeologists are looking at exploring *how* perceptual properties (shape, size, composition, texture, location) allow us to indirectly solve the archaeological problem, and that finding the social *cause* (production, use, distribution) of what we "see" creates meaningful scientific outcomes. Artificial intelligence can make this process of "reverse engineering" easier—and an automatic method of analysis.

This anthology gathers in one place the issues pertinent to practitioners charged with the study and interpretation of cultural heritage. The volume necessarily must accommodate an expansive collection of viewpoints to reflect the multidisciplinary developments being undertaken across the world. The essays act as introductory statements, and we hope that the issues presented find resonance with readers of varying interests, to invigorate lively debates in cultural institutions and to posit new ideas for future research.

Notes

1. For example, the Internet, environments of virtual and augmented or mixed reality, mobile computers, wearable technologies, automatons, artificial intelligence, intelligent agents. For a discussion of culture and digital technologies, see Gere 2002.
2. For example, see Lunenfeld 1999, Cubitt 1998, Manovich 2001, Barrett and Redmond 1997, Herman and Swiss 2001, Miller and Slater 2000, Hillis 1999, Allen and Hecht 2001, Vince and Earnshaw 2000, and Graham 2001.
3. Museums and the Web, International Cultural Heritage Informatics Meeting, International Symposium on Virtual Reality, Archaeology and Intelligent Cultural Heritage, Computing Archaeology, Virtual Systems and Multimedia, Electronic Visualization and the Arts, to name a few of the established conferences.
4. See UNESCO 2003, n.p.
5. For examples, see Thomas and Mintz 1998 and Keene 1998. Both examples have a technical/practical orientation based on case examples and do not deal with the wider heritage field. The former deals primarily with multimedia applications in museums rather than a theoretical analysis of the Internet or other emerging digital media. The latter provides a manual for the digitization of museum collections, raising issues and challenges while positioning the discussion within the broader information economy.
6. See Gere 2002, 11.
7. See Benjamin 1968 and Baudrillard 1982.
8. Refer to MIT Press series *Media in Transition*, ed. David Thorburn, in particular Gitelman and Pingree 2003.

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