CRM

CULTURAL RESOURCE MANAGEMENT
Information for Parks, Federal Agencies, Indian Tribes, States, Local Governments, and the Private Sector

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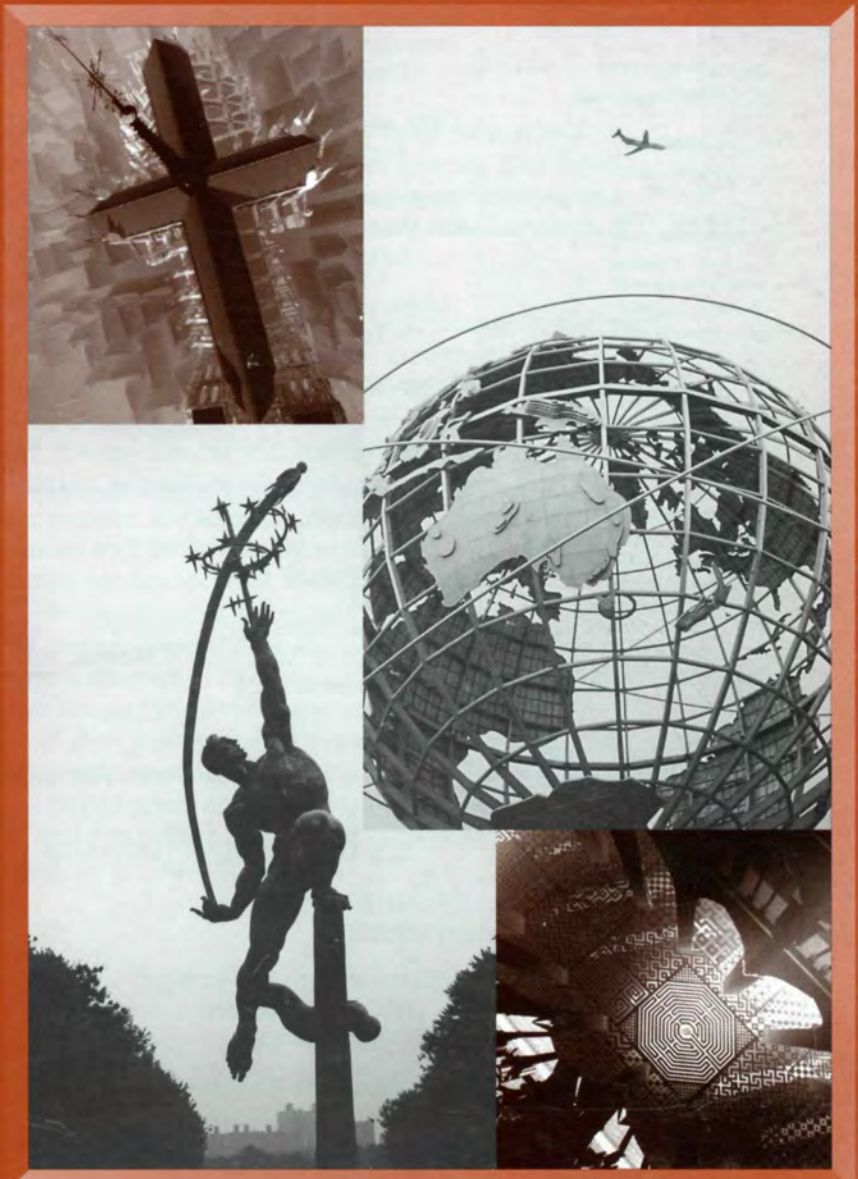
Bringing the Past into the Future

New Technologies for CRM



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Cover: Past and future meet: digital images from the Amiens Cathedral Project (upper left and lower right); the Unisphere (upper right) and the Rocket Thrower (lower left), 1964-65 New York World's Fair. Amiens images courtesy Trustees of Columbia University in the City of New York (all rights reserved); New York World's Fair images by H. Matthew Nowakowski.

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THE WHITE HOUSE

WASHINGTON

May 8, 1998

Dear Friends:

As the world and our lives move at an increasingly faster pace, it becomes ever more important to remember where we come from as a people. Our values and traditions are inexorably linked with a sense of place. In every part of our nation and around the world, we honor those places that are linked to events of the past.

The articles in this issue of *CRM* point, like a compass, toward the historic places and cultural resources in our communities and in our nation. Because they have the power to evoke in each of us a deeper understanding of our lives and of the world around us, we have come to believe strongly that one of our national goals is to ensure that our cultural resources are accessible to everyone. Computer technologies and the Internet are powerful tools to help us not only to meet that goal, but also to preserve and interpret our mutually shared history.

As a people, we cherish our historic sites. These places can make our spirits soar and remind us of life's possibilities and of our human powers to imagine and to create. In this time of great global change as we approach both a new century and the next millennium, the pace of technological change occurs at a rate far beyond the capacity for human beings to comprehend, and our historic resources become more and more important. Still, the coming of a new century and millennium presents us with a wonderful opportunity to reflect on our past and to imagine our future. In that spirit, utilizing the gifts of our new technology, let us move forward confident that we will preserve the knowledge and appreciation of our common heritage for generations to come.

Sincerely yours,

Hillary Rodham Clinton

Hillary Rodham Clinton

H. Matthew Nowakowski

Bringing the Past into the Future

Photogrammetric survey of the hominid trackway in Laetoli, Tanzania. Photo by Angelyn Bass, courtesy of the J. Paul Getty Trust (related article appears on page 40).

This issue of *CRM* will explore the effects and impacts of new technologies on cultural resource management. Why an issue devoted to new technologies? Isn't it somewhat contradictory to think about the past in terms of advances in telecommunications and computers? After all, we in cultural resource management are concerned with preserving the past for ourselves and future generations. However, many professionals are discovering that preservation and technology are not mutually exclusive, but mutually enhancing. It is one of life's ironies that technology, which races forward into an infinite and ephemeral future, is proving to be a powerful tool in conserving and recalling the pre-technological past. In many ways, technology acts like a Jules Verne-inspired time machine.

Technology is an effective and empowering tool in making the past meaningful to more and more people. And, technology offers exciting possibilities for cultural resource management:

- Archeological sites are being investigated from space shuttles and satellites.
- Planners and preservationists are using technology to model construction alternatives in historic neighborhoods.
- Visitors are accessing touch-screen databases to learn more about people and history at Civil War battlefields around the nation, at the Women in Military Service for America Memorial, in the Lower Mississippi Valley, and right in their own neighborhoods.
- Through virtual reality programming, visitors can experience the marvels of ancient Rome, Amiens Cathedral, and the White House. Far from a diversion, virtual reality is a significant interpretive tool in helping us understand the built environment.
- By combining powerful software programs like GIS and CAD, conservators and museum specialists can formulate and model interventions prior to commencing a course of treatment.
- The power of maps has resonated through the ages—today, digital maps are being used to inventory, interpret, and preserve historic districts and archeological sites.
- The power of the Internet is helping our profession expand and reach diverse audiences. On the World Wide Web, people are taking virtual tours, searching state historic archives, and investigating heritage tourism.

These are some of the technology-related developments presented here in this thematic issue of *CRM*. Cultural resource management is constantly searching for unique ways to effectively solve problems in a perpetually changing environment. Rather than exclude ourselves from recent advances in communications, multimedia, and other interpretive technologies, cultural resource professionals must strive to use them in new and innovative ways. If we accept this summons to change, we will be better equipped to face the challenges of preserving the past in the coming millennium and beyond.

Depicted on the cover is the Unisphere, 1964-65 New York World's Fair. Designated a New York City landmark, it has come to symbolize the "global village" only dreamed of in the 1960s.

H. Matthew Nowakowski <nowakowskim@ang.af.mil> is a graduate of Columbia University's Historic Preservation Program. He is a historian with the National Conference of State Historic Preservation Officers (NCSHPO) at the Air National Guard Environmental Planning Branch and guest editor of this issue of CRM.

Special thanks to the following individuals: Ron Greenberg and Antoinette Lee, both of the National Park Service, for their encouragement, advice, and unwavering support; Mark Oviatt, NCSHPO, for his assistance in producing this issue; and Captain Hank Nowakowski, for instilling in me a love of history.

Mark R. Edwards

Using Computerized Visual Simulations as a Historic Preservation Strategy

A Case Study from Columbus, Georgia

Thousands of times each year, State Historic Preservation Offices (SHPOs) carry out their consultation responsibilities with federal agencies and their applicants under Section 106 of the National Historic Preservation Act of 1966, as amended, to ensure that the effects of their undertakings to historic properties are taken into account, and, if possible, to improve the design of new construction so that it does not adversely affect historic properties. Often difficult is the task of gauging the impact of new construction within fragile historic districts, and truly comprehending the size, scale, and materials of new buildings and the effects these new design elements will have on historic properties. The historic preservation movement's design review goal is simple, but in many ways difficult to attain—how can the design of new construction be reviewed and molded to ensure that new buildings are successfully integrated, from an urban design perspective, into historic settings and communities?

Before: this aerial view shows the project site. The Muscogee Mills Complex, one of two National Historic Landmarks in the project area, is shown at the extreme left, facing the Chattahoochee River.

After: this view represents the final composite of the original "existing condition" photograph and the virtual reality image of the overall project.

While some SHPOs employ preservation architects, many are forced to rely on a rudimentary understanding of architectural documents such as renderings, plans, and elevations. To aid in the assessment process, supplemental graphic information is painstakingly produced by artists, planners, and architects which illustrates the effects of proposed construction on historic properties. Although useful, the resultant data is limited, time-consuming to produce, and expensive. Also, elements such as color, reflection, and texture are subject to interpretation and legal challenge.

New visualization options for SHPOs have been developed over the past few years. One emerging tool is visual simulation data generated through powerful computers and innovative new software, including digital photography and computer-assisted design. This case study explores the use of this tool in Columbus, Georgia, where computer-generated design materials played a vital role in ensuring that community-based historic preservation interests, as well as the SHPO,

supported quality new design within a highly significant historic district.

Second Avenue Revitalization Project

In late 1996, the Columbus Consolidated Government (CCG) negotiated a Programmatic Agreement (PA)[1] with the Georgia SHPO and the Advisory Council on Historic Preservation to assist in mitigating the effects of proposed redevelopment of a 46-acre tract along the Chattahoochee River in the historic city of Columbus, Georgia. The project area covered more than 20 historic structures. The National Park Service, the Historic Columbus Foundation (the local non-profit preservation organization), and the Columbus Board of Historic and Architectural Review (the local historic preservation commission) all participated in the consultation process and were invited to concur in the agreement. The PA contained a number of stipulations that dealt with examining the possibility of adaptively reusing historic properties as a component of new project construction, and how new construction would relate with surrounding historic buildings. The PA required the CCG to "ensure that the project design for rehabilitation, new construction, and site improvement projects in the project area is compatible with the historic and architectural qualities of the surrounding historic buildings in terms of scale, massing, color, and materials." Total System Services, Inc. (TSYS), a subsidiary of Synovus Corporation, tendered the successful bid for this 46-acre tract. The company wanted to construct a new headquarters; the massive project represents one of the largest economic development projects ever attempted in the State of Georgia.

Enhancing the Design Review Process

In 1997, TSYS unveiled its preliminary design for the corporate campus, designed by Kevin Roche/John Dinkeloo Architects. Computer-generated elevations showed the proposed design of a number of new buildings within the campus district, including two massive parking decks. Serious concerns were raised regarding the impact of the campus' overall plan on existing historic buildings, and how the proposed new construction would relate to historic buildings located at the periphery of the project area. The initial campus design plan reflected the findings of an analysis of the adaptive re-use potential of a number of buildings associated with the National Historic Landmark Muscogee Mill Complex, located to the south of the project area. This analysis concluded that the re-use of the mill was impossible, because of programmatic requirements of the new project. The initial design, therefore, included one new parking deck on the site of the Muscogee Mills Complex, and a second parking deck toward the northeast corner of the project area.

The SHPO raised many issues about the size, scale, and design of the new campus and the parking decks, and argued that additional visual simulation information would be required prior to design approval. Local preservation organizations and economic development officials concurred in the need for additional visual simulation information. Greg Clark, Chief of Economic Development for Columbus, stated that, "It is important that the campus make a statement, but also that it blends in and doesn't overwhelm the existing downtown." The SHPO assisted the CCG in locating non-profit and for-profit organizations that could create computer-generated images. In July, IMAGINE (Interactive Media Architecture Group in Education), based at the Georgia Institute of Technology in Atlanta, was chosen to produce these materials.

IMAGINE began in the early 1990s as an informal group of students and faculty researching the possibilities of integrating research and education through the development of digital tools. Early research focused on emerging technology for visualization and the impact this new technology might have on designers. According to Tolek Lesniewski, Multimedia Coordinator at Georgia Tech's College of Architecture, the Columbus virtual reality (VR) project represented the "largest composition/collage project ever attempted" by IMAGINE, and was made more difficult because of the need to merge photographic images in raster format with computer images in vector format. Under a $23,000 contract with the CCG, IMAGINE agreed to conduct six work tasks leading to the development of final VR images placed within a number of real-world photographic views.

The first step involved obtaining "existing condition" photographs from the project area, through which a number of three-dimensional reference points could be selected. This process involved taking a series of color print photographs, while carefully noting the x, y, and, z axis positions and camera focal length necessary to match the photographic perspectives and computer-generated images. The second step involved creation of a photo CD for archival purposes. Photographs were digitized at 2,400 by 3,000 pixels resolution. Using Adobe Photoshop® software, digital photographs were color corrected to erase the effects of fog and haze, and buildings scheduled for demolition were digitally edited from some views of existing areas. The third step converted the existing three-dimensional geometry of proposed construction (obtained from the project architects) and updated this geometry to reflect changes at the beginning of the project. Kinetix's Autodesk 3D Studio MAX® software was used to create this new development model. Wire frame models were then overlaid on

each photographic view to determine if there were any problems with the virtual models. This process gave the IMAGINE staff some idea where the model's silhouette would overlay existing buildings, and which elements might need to be removed. Two assumptions and decisions were made in the design process. First, it was assumed that the terrain in all views was flat, which corresponded closely to the development site, and thus would not need to be adjusted. Second, the relative depth of each picture was determined. Each photographic view was divided into a "front" and "back." For every image, IMAGINE staff could start with a background, overlay a view of new construction, and add a foreground.

Images by IMAGINE.

The fourth step undertook the process of creating renderings of the computer model for 12 selected views, at a level of detail corresponding to information obtained by the project architects. Such details as the position of the sun, color, and materials chosen for new construction, were checked for integrity. The fifth step generated 12 realistic composite images showing the new development in existing context. Because computer images appear too perfect to the human eye, this step also involved careful visual review of each image. In some cases, the edge between photographic and computer-generated images was blurred; noise was added to match the texture of photographs. Edges between images were rechecked to create seamless final pictures. The final step involved creating color hard copies for each of the 12 views selected. These views were made available to the PA signatories.

A few additional pieces of information about IMAGINE's work on this project, and its computer capabilities, may be useful to readers. This project was completed within an eight-week time period and was executed as a team effort by Mr. Tolek Lesniewski, a principal project manager (a student), and several undergraduates majoring in architecture and industrial design. The project was created within a Windows NT® operating environment using a number of computers running at 120-200 megahertz and 128 megabytes RAM. Local storage was 2-4 gigabytes per computer. Importantly, because each working image often represented up to 25 megabytes of visual information, 10 computers were networked to accelerate the time required to produce the final renderings.

Before: this is a northern view into the southernmost edge of the project site, from the perspective of a pedestrian at street level. The Muscogee Mills Complex, with its prominent smokestack, is in the center of the view.

After: this view shows a virtual reality (VR) parking structure inserted into the area along 14th Street. By examining the effects of proposed new construction on nearby historic buildings, the SHPO was able to effectively argue for changes in massing and materials.

How VR Imagery Improved Design Review

As described in the photo captions, VR imagery greatly enhanced our ability to understand the effects of proposed new construction on historic properties located on the edge of the project area. The capabilities of the technology are easily seen when comparing a "before" aerial view of the project site with the "after" view. By examining the effects of proposed new construction on surrounding historic buildings, the SHPO and local preservation organizations were able to effectively argue for changes in overall building massing, geometry,

materials, and color. For example, the SHPO and local preservation officials requested that the design of the first parking deck be changed to better match the overall volume, fenestration patterns, and materials of the Muscogee Mills Complex which it was replacing. Similar modifications resulted from an analysis of the design for a second parking deck. Taking information from the existing site, preservation officials reviewed an initial effort at design, and quickly determined that the overall size of this deck was too massive, and would create an overwhelmingly negative presence when compared to the size and scale of historic properties along Second Avenue. To address these issues, the SHPO requested that the deck's overall massing be reduced by breaking its volume into two distinct parts. The final design clearly shows these improvements. VR technology also allowed the project to be viewed from many angles, literally unveiling certain buildings hidden by later design additions.

Summary

Work in Columbus, Georgia on the TSYS project vastly improved our office's ability to comment on design development materials, allowed us to provide technical assistance at critical points to improve the overall quality of analysis, and expedited the preservation consultation process. Because the visual simulations were produced in an easy-to-understand format, collaboration among affected organizations was greatly facilitated. I believe that the use of computer visualization technology heralds the arrival of a powerful new historic preservation tool that has applicability in many other locations across the country. The use of this innovative technology will ensure that historic places and properties are better protected for this and future generations.

Because the PA called for a series of new "public benefit" products, our office believes that this technology will lead to the emergence of new interpretive and educational products. By integrating the vast number of informational sources generated through the inventory and evaluation phases of this project—including written historical data, photographic images, historical visual materials, and Historic American Engineering Record quality record data—with VR information, the many stories related to historical development of the milling industry in Columbus will be publicly presented in ways not possible a few years ago. An interdisciplinary education and interpretation team will be assembled in 1998 to begin planning for a multiplicity of products to inform the public. This effort will also examine how this information can be packaged in informational kiosks placed along the city's "River Walk" and reach a national if not international audience through a new World Wide Web site. The possibilities are exciting and limitless.

As Nicholas Negroponte, director of MIT's Media Lab pointed out in his 1996 bestseller *Being Digital*,[2] "there is just not enough digital media in the hands of executives, politicians, parents, and all those who most need to understand this radically new culture." The challenge facing many State Historic Preservation Officers, and other cultural resource managers, is how to best utilize this fast-developing technology in ways that truly improve the overall design quality of federally-assisted projects that use or affect historic resources. Given the mission of the National Park Service's National Center for Preservation Technology and Training—to promote and enhance "the preservation of prehistoric and historic resources in the United States through the advancement and dissemination of preservation technology and training"—perhaps a nationwide effort assisted by the Center to enhance the capabilities of SHPOs to fully utilize the potential of this important developing technology might be in order.

Notes

1 The Programmatic Agreement between the Georgia State Historic Preservation Office, the Columbus Consolidated Government, and the Advisory Council on Historic Preservation, was executed in December, 1996. All subsequent quotations are taken from that document.

2 Negroponte, Nicholas, *Being Digital* (New York, N.Y., Vintage Books, 1996), pg. 7.

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The author wishes to thank Richard Cloues, Jeff Durbin, Sue Edwards, and Tolek Lesniewski for their assistance in reviewing and making suggestions to improve this article.

Douglas C. Comer

Discovering Archeological Sites from Space

Using Space Shuttle Radar Data at Petra, Jordan

The popular image of Petra, which flourished from about the third century BCE to the third century CE, was probably established by the cameo appearance of one of its magnificent two-millennia-old Nabataean tombs in the Indiana Jones *Last Crusade* movie. Yet the sandstone canyon system in which Petra is located contains a wide variety of archeological sites from many different time periods. Among these are some of the earliest village sites anywhere, as well as Bronze Age, Edomite, Byzantine, and Crusader sites. With sites above ground and below, Petra provides an attractive proving ground at which to develop techniques for detecting archeological sites with radar data collected by satellites and space shuttles. What renders Petra nearly ideal for this purpose, however, is the extremely arid environment there. Certain radar bands can penetrate dry soils; vegetation that can complicate radar returns is sparse at Petra.

Technologies associated with space programs have produced cameras and multi-spectral sensors carried by satellites and space shuttles capable of producing highly informative imagery. Most recently, radar apparatus has been added to the payload of these space vehicles. Unlike optical and multi-spectral apparatus that passively senses portions of the electromagnetic spectrum, radar actively scans for target characteristics, and so provides unique categories of data. Radar is extremely sensitive to surface variations. Topographic features on the order of millimeters can be detected. Different radar wavelengths can differentiate among tree canopy, shrubs, and grasses on the basis of trunk, branch, and leaf dimension. Even ice caps, soils, and stone can be classified on the basis of surface texture. Also, radar is sensitive to dielectric characteristics that are often linked to the presence of water. Finally, longer radar wavelengths can penetrate a variety of substances, including clouds, vegetation, and dry soils. Polarizing radar waves to be transmitted and received at the same orientation enhance penetration.

Imagery enhancement and analysis software can be used to combine data generated by radar waves of different lengths and polarizations in the same image. For example, longer waves polarized for maximum penetration can provide indications of the presence or absence of water beneath vegetative cover, while shorter waves can produce data pertinent to identifying the covering vegetation in the same. Recent advances in software technology render it possible to combine optical imagery or imagery produced by multi-spectral sensors with radar imagery.

Aerial images produced by more established technologies are at present usually of higher resolution and larger scale than imagery produced from radar data. They also contain information of different sorts than that in radar imagery, which is often highly complementary to the radar data. A premise of our research is that non-radar imagery can provide the key to successful extraction of information about cultural resources from radar data. In research completed in 1997, conducted by the NPS Applied Archeology Center in collaboration with The Hashemite University in Jordan, we intended to test this premise. In particular, we wanted to

Al-Khazna, one of hundreds of spectacular tombs cut in the pink sandstone walls that surround Petra, appeared in The Last Crusade Photo by the author.

overcome limitations imposed by the 25 meter pixel size typical in images produced from radar data. We hoped to discover what cultural resources might be contained within the pixels themselves, and kinds of resources might be indicated by patterns of pixels.

NASA's Jet Propulsion Laboratory (NASA/JPL) provided radar data of Petra employed in the study. It was obtained in 1994 by the space shuttle *Endeavour*, which carried space imaging radar/synthetic aperture (SIR-C/X-SAR) apparatus. Instruments carried by previous SIR missions and other satellites, spacecraft, and aircraft, including commercial ones, also commonly employ the same radar bands and polarizations.

Essential steps in the enhancement and analysis were orthocorrecting (removing distortion) and georeferencing (fitting imagery to a standard coordinate system) SIR-C/X-SAR radar imagery, and coregistering this imagery with orthocorrected, georeferenced larger scale, higher resolution of other types.

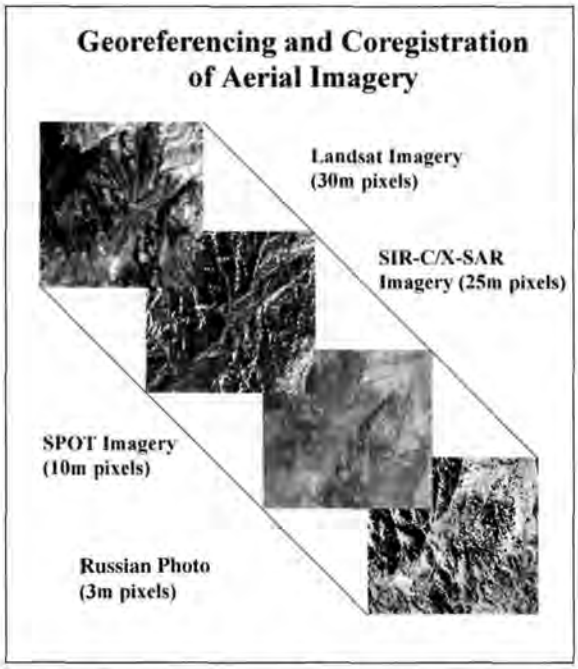
First, ground control points were established at features visible in radar imagery, and visible in other imagery to be georeferenced, including: Russian satellite photographs (with pixels of three meters); SPOT multi-spectral imagery; LANDSAT multi-spectral imagery; B/W photographic stereo pairs of 1:10,000, 1:25,000, and 1:30,000 scale; and tethered balloon photographs of about 1:500 to 1:1,000 scale.

Establishing real world coordinates for points visible in all aerial imagery with a global positioning system (GPS). Photo by the author.

Control points were established to less than half-meter accuracy by use of a global positioning system (GPS). These points provided the information required by computer software to reduce image distortion; that is, to orthocorrect imagery. Recorded as real world coordinates and therefore common to all images, the points could be used to georeference and then coregister all images. Images were in this way "stacked" one atop the other, so that a given point in one image corresponded to the same point in another. Images were entered as themes into a geographical information system (GIS). Computer-enhanced radar, LANDSAT, and SPOT were entered into the GIS as themes, as were the GPS locations of archeological sites and features observed in the field and recorded by other researchers. Imagery could be stacked and viewed; numerous areas of potential interest were observed. Some of these examined on the ground proved to be:

- **Natural landforms of relevance to archeological sites and features**: A bright band that runs from north to south through the radar imagery of the Petra area was at first attributed to a road. It was later observed—in other sorts of aerial imagery and on the ground—that a line of major springs occurred along this band, which may represent a geological fault. The line of springs no doubt influenced the location of human occupation sites in the region. A circa 6,500 BCE village site, Beidha, is found near the band, which also is at an elevation at which wild emmer wheat grows. Beidha is among the sites where cereal crops were first cultivated. Radar images highlight other aspects of the topography that made specific locations suitable for ancient constructions. Flat areas in the sandstone canyon system that contained the ancient trading city of Petra were at a premium, and were used for agriculture or as building sites.
- **Landforms altered by human occupation**: Among those found at Petra were an apparent Byzantine structural complex built alongside the flattened top of a high hill. An ancient pathway could be seen in radar imagery running from the eastern edge of the canyon system to the center of Petra. Locations where dams were constructed in steep-sided streambeds ("wadis") could also be ascertained in some imagery.
- **Archeological sites and features themselves**: One site identified in merged radar and optical imagery was located just outside the famous "Siq" (narrow sandstone canyon) that was the primary entrance to the city of Petra. The terrain and configuration of walls at the site suggest a stopping place for caravans prior to

"Stacking," or coregistering, aerial images that have been georeferenced and orthocorrected. A given location can thereby be found in each image. Digital image by K. Joly.



their entry to the city. Of particular note were distinctive pixels which were observed on the ground to be associated with a certain sort of archeological feature. These features were variously blocks of rooms, water management devices (especially dams across narrow wadis), or cisterns, but in all cases could be described as open subterranean chambers, generally angular in plan.

In the coming year, we plan to test the statistical association of specific feature characteristics with the coloration of pixels in imagery created by assigning primary colors to three different radar band polarizations. Correlations will also be sought with measures of the strength of received radar waves of different lengths and polarizations.

Such correlations, if found, will enable direct detection of small archeological sites and features with radar data. Many, perhaps most, such sites and features are in remote areas or hidden by vegetation or soil. It is probable that only aerial radar, or another, yet undiscovered, means by which to probe large areas at a time, can be used to find them before they come to light through development, looting, or erosion.

Aerial radar image of the research area. The bright vertical band near the center corresponds to a line of springs, and is probably a geological fault. Viewed at different scales, areas, patterns, and even individual image pixels of certain colors denote landforms of archeological interest and archeological features and sites themselves. Digital image by K. Joly.

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funded by the J.M. Kaplan Fund. He collaborated in this research with Dr. Talal Akasheh, Dean of Research and Graduate Studies, The Hashemite University, Jordan. ERDAS Corporation provided support for the project by contributing imagery enhancement and analysis software. Ashtech Corporation provided use of GPS equipment at a reduced rate. NASA/JPL supplied radar data at no charge.

Amy E. Facca

CRM and the WWW

The World Wide Web presents significant opportunities for cultural resource managers by enabling distribution of information to diverse and new constituencies; allowing electronic publication of timely news regarding critical legislation and organizational information; and by encouraging communication and collaboration among peers through e-mail and listservs. To assist managers in capitalizing on these new and expanding opportunities, this article will provide an overview of existing cultural resource management Web sites, describe the range of information available, identify the characteristics of successful Web sites, and suggest ways the Web can be used to further organizational missions.

Some Web sites focus on architecture: Cameron Newham is attempting to photograph every building listed in Pevsner's *Buildings of England*.

For those unfamiliar with the Web, information is located by conducting key word searches, typing in known Web addresses, following links at sites called up by searches, or through electronic resource directories. The two most prominent cultural resource management-related directories are Internet Resources for Heritage Conservation, Historic Preservation and Archaeology (National Center for Preservation Technology and Training) and PreserveNet (Cornell University). Cyburbia, Dan Tasman's planning-related directory, is another good starting point.

Some idea of the Web's growth was provided in the January 6, 1998 issue of *PC Magazine*, which reported that more than 42 million of approximately 100 million US households owned personal computers, and of these households, approximately 18 million were connected to the Web—five times the number of households online in 1995. IBM has estimated that by 2001, 550 million people will have access to the Web. Since 1995, America Online® nearly doubled its subscriber base to 11 million users. Most people can now access the Web via home-based computers or in their office, at school, or through friends and relatives. Many public libraries offer Web access. With the introduction of high-speed telephone lines and faster modems, the current rate of growth will continue.

Ian Evans' "World of Old Houses" is an extensive Web-based guide to caring for and restoring old houses.

To put these statistics in the context of cultural resource management, *Preservation* magazine recently reported that the National Trust for Historic Preservation's Web site is getting approximately 80,000 visitors a week. Since 1995, Web sites have been established by many government agencies and private organizations concerned with cultural resource management, including UNESCO and ICOMOS, as well as the Advisory Council, National Park Service (NPS), National Preservation Institute, and Preservation Action. These sites provide a wide range of program, reference, support, and contact information to professionals, while offering information to other constituencies such as tourists and educators. The NPS National Register site includes information on teaching and heritage tourism. The National Trust's site provides extensive information to the casual visitor; specialized information is available to members with passwords. Features include a preservation timeline, action items, member e-mail directory, listserv, and a database of publications.

State-level cultural resource management sites have been developed by state historic preservation offices (SHPOs) and statewide preservation organizations. As of January 1998, approximately 36 out of 50 (or 72%) of SHPOs had Web sites; 10 statewide preservation organizations also had sites. The following are some SHPO Web site highlights: the Alabama site includes an illustrated list of threatened historic properties for sale; Connecticut's site includes its quarterly newsletter and links to state-owned historic sites; Florida includes press releases, links, employment opportunities, departmental publications, state history and facts, and a detailed schedule of training programs; North Carolina lists county summaries of historic preservation activities and resources; and, Kansas has links to census data, "cool things," publications, and a "behind-the-scenes tour." State-level sites are excellent tools for educating the public and raising awareness of cultural resources.

At the local level, Web sites are being developed by municipal governments and historic preservation organizations, museums, historical and archeological societies, main street organizations, and business improvement districts. These sites typically contain information on local resources and preservation efforts; many feature "virtual tours" of historic districts, rehab project reports, design guidelines, and information designed to promote local resources. Web sites have been or are being developed by professional organizations such as the Society of Architectural Historians, the AIA, and conservation organizations. There are commercial sites established by a range of consultants, craftspeople, and suppliers. Special interest sites abound: for example, Anthony Cohen's, "The Walk to Canada: Tracing the Underground Railroad" site offers an excellent example of how Web sites can make cultural resources come alive. Some sites focus on historic house museums, such as the Monticello Web site.

The growth of the Web has enabled us to locate and download CRM legislation; search the National Register and HABS/HAER databases; find employment, internship, and grant opportunities; review program information; conduct library catalog searches; and, communicate with distant colleagues. As with traditional library resources, careful users must evaluate the reliability of Web-based information. The most effective and useful Web sites have the following characteristics in common:

- They provide a site index and are easily navigable; they are not graphics intensive.
- They are continually updated and improved.
- They provide pertinent contact information.
- They focus on a wide and diverse audience, not just CRM professionals.
- They make preservation relevant for the average person.
- They make connections and integrate issues such as conservation, transportation, fundraising, etc.

While the majority of cultural resource sites use the Web mainly for publication of program information, some organizations are beginning to utilize the more dynamic character of the Web. In the near future, cultural resource sites will offer distance learning opportunities, facilitated discussion groups on local issues, promotion of action items and daily updates such as the ISTEA Reauthorization site, and teleconferencing. Although some of the most technologically sophisticated sites were expensive to develop, it is fairly easy to learn the programming language (HTML) used to create Web pages. In short, by introducing new audiences to cultural resource issues, facilitating remote communication between peers, reducing the cost of information distribution, and significantly expanding the range of easily accessible information, the World Wide Web is an increasingly powerful educational and promotional tool.

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The author's list of relevant WWW resources is presented on the back cover of this issue.

Edie Ramey and Jannette Wesley

Amoeba—NPS Technical Information on the Web

The Technical Information Center (TIC), Denver Service Center (DSC) is the oldest and largest information system in the National Park Service (NPS). TIC contains materials from all over the NPS including drawings and documents on the infrastructure of the NPS dating back to the 1800s. Parks and regions routinely send copies of materials to TIC for microfilming and inclusion in the TIC database; the collection exceeds 800,000 drawn images and a larger number of document images.

TIC is the only service wide collection in the NPS that houses technical information images in an organized, easily retrievable manner. The collection contains such important documents as the original drawings for Ellis Island, a 1930s vegetation map of the Great Smoky Mountains, and images of Alcatraz and ships in San Francisco Harbor (these drawings were borrowed from the museum there, filmed and returned). Just as we have ensured during the past 28 years that an institutional technical memory of our park infrastructures has been preserved, we need to ensure that the new electronic files/memory are preserved; by preserving these, a new age of self-delivery of information will result.

The Amoeba Project is a document and imaging project being conducted by TIC. The vision for Amoeba is that it will be the central repository/single point-of-access for NPS-wide data stored in Denver. Increasingly, there has been a demand by the public and the NPS to make these documents readily available. In order to move toward an integration of electronic files and images (i.e., CAD files linked with drawing image, GIS files linked with map images, word-processed files linked with document images), the TIC system was converted to Lotus Notes® in December 1997. An Intranet (local area network) server has been setup. This allows TIC to publish data to the Internet while linking scanned images and electronic documents to database entries. Denver-based NPS employees, parks, and members of the general public will soon be able to view these documents with Web browser software, print copies of drawings, and conduct research. TIC is used by park personnel, central office personnel, and the public to accomplish the following:

- Identify NPS plans for use as models or standards for new projects and resource management.
- Develop descriptions of the cultural and natural context of a site.
- Obtain information to assist in disaster recovery
- Preserve legal documents.
- Increase public understanding of NPS resources.
- Provide research materials for scholars and writers.
- Furnish historical information to readers of history.

Our scanning and database conversion is a major undertaking in making TIC's wealth of information available to greater audiences across the nation.

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"Links to the Past"

"Links to the Past," the area of the National Park Service (NPS) "ParkNet" Web site focusing on cultural resources, was launched only three years ago. In that short time, we have assembled the most comprehensive collection of information on NPS cultural resources service-wide. And we are constantly expanding. We have over 7,500 HTML documents, many other documents in PDF format (e.g., *CRM* magazine), and countless graphics. We created many features unique to the Web utilizing its graphic and navigating tools. More than 2,000 users visit our site every day; many come back frequently. We have received a number of Web awards and have been mentioned in many articles about the Web, particularly for our excellent content and useful features.

All of this is due to the ingenuity, creativity, enthusiasm, and perseverance of numerous NPS staff, especially the Cultural Resources Web team. It has not always been easy; we have hit many bumps along the way. To date, we have gone through two major phases of activity and are entering our third. These phases are described below to illustrate opportunities taken, challenges faced, and benefits received.

Phase I: Floundering in a New Medium

In January 1995, the NPS Director decided to enter the information superhighway. One team was formed to consider an overall NPS Web site (Handly 1995), and another for cultural resources. National Parks Week, beginning March 31, 1995, was the launch date.

The Cultural Resources team, made up of disciplinary specialists from eight divisions, had numerous questions at the start: What kinds of information should go up on a Web site? How will our site be organized? Who will visit and use it? Who will do the work? Who knows Web-related programming? What does it mean that a Web site doesn't have a beginning and an end like a publication? Is the Web merely a fad?

Three years ago there was little guidance available to answer these questions (Andrews et al. 1995). Relatively few staff had hands-on Web experience. The current plethora of books about the Web did not exist. The group floundered at times, but began making decisions—some with forethought, some reactionary. We organized the site by topic (e.g., Historic Places, Archeology, Grants-in-Aid) recognizable to the general public. "Public" was defined as the range of people with access to the Web. We agreed on a site name, "Links to the Past," to evoke the relationship between historic preservation and the Web's linking capabilities. The homepage and identifying headers were designed with an eye to editorial coherency. As the deadline neared, many offices contributed documents and reports written for other media, using the notion that a Web site was a container for existing materials. Other offices reworked their materials into manageable segments and developed new materials, allowing visitors to follow their interests via links. Technical experts converted myriad documents (HTML coding applications did not exist), uploaded them into the organizational schema, and tested the site. We met the deadline. Members of the first team were satisfied and most went back to their "real" work.

But the Web was about change and Web users demanded updated and new materials. Site maintenance became an issue. By late summer, 1995, a new team, consisting of representatives from each program office, was formalized to maintain the site and look to its future. It is still only inter-programmatic team in the NPS National Center for Cultural Resource Stewardship and Partnerships.

Phase II: Finding a New Vision

We created a vision and long-term goals for the site, set a policy for contributors, and provided Web training. In the fall of 1995, an unexpected opportunity arose: one-time funding to redesign the overall NPS Web site. Award-winning Web sites were reviewed to determine current trends in Web design and publishing. The attention-grabbing magazine model, a one-screen homepage with departments and changing features, was chosen, and the design firm, Interactive Bureau, was hired to realize our vision. Another deadline was set to inaugurate the redesigned site: National Parks Week in March 1996.

The Web team began reorganizing "Links to the Past" from this exciting design perspective by asking more informed questions. Who exactly is our audience? How do we effectively inform the public about their heritage—the millions of cultural resources that the NPS protects and manages? What organizational categories and names are relevant to our audience(s)?

We recognized four key audiences: the public, including educators and children; professional colleagues; NPS staff; and Congress and other government offices. We acknowledged that our programs cater to different combinations of these audiences, but that the Web could also help us reach new audiences. After carefully considering the range of materials we might post to our site, we

confirmed a decision made in Phase I: provide direct access to our products. We set such a course with the following table of contents:

- "Collected Heritage" (later changed to "Discover") including major databases (i.e., the National Archeological Database <www.cr.nps.gov/aad/nadb.htm>, the National Register Information System <www.cr.nps.gov/nrishome.htm>), and other collections (i.e., significant NPS museum objects in "Treasures of the Nation" <www.cr.nps.gov/csd/treasures.html>; HABS/HAER collections <www.cr.nps.gov/hab-shaer/collectn.htm>);
- "Help Yourself" to grant programs (i.e., the National Maritime Heritage Grants Program <www.cr.nps.gov/history/maritime/grants.htm>, Tribal Preservation Grants <www2.cr.nps.gov/tribal/grants.html>), tax credit information, and key contact groups (i.e., the State Historic Preservation Offices <www2.cr.nps.gov/shpo/>);
- "Tools for Teachers" including educational programs and activities for teachers (i.e., "Teaching with Historic Places" <www.cr.nps.gov/nr/twhp/home.html>) and for students (i.e., "The Great American Landmarks Adventure" <www2.cr.nps.gov/pad/adventure/landmark.htm>); and,
- "Get Involved" with opportunities to tour historic areas, restore old buildings, participate in archeological excavations, save Civil War battlefields, and seasonal employment.

We also introduced other significant site areas: a temporary feature space for a cultural resource topic, such as "Ancient Architects of the Mississippi" <www.cr.nps.gov/aad/feature.htm>; "Publications"; "Laws" relevant to historic preservation; "Programs" to introduce each program; and, "America's Album" to provide a graphic exhibit about what the programs do. With this reorganization set, Interactive Bureau created design templates reflecting the image of the NPS, and we met the new deadline through the efforts of many.

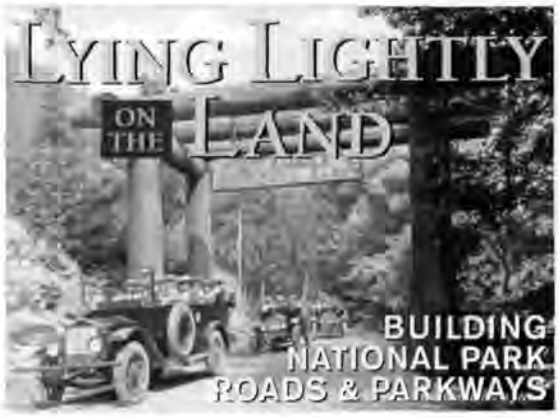
Again, change was and is inevitable. However, we had grasped the strengths and weaknesses of the Web in relation to our diverse audience and the different values they place on our materials. These understandings have proved to be critical for long-term planning and management as we continue to modify and add to our Web site.

Phase III: Looking to the Future

"Links to the Past," our one-stop shopping locale for cultural resources activities, projects, and products, is providing significant benefits to the NPS. We inform and educate Americans and the world in a cost-efficient way. In fact, we impact more people than ever before and more than in any other medium. We also now better understand ourselves as we set up and maintain Web links between our many programs, parks, and products.

With a positive outlook to the future, however, comes new management and maintenance challenges. During the 1996 site redesign, the goal was to create a unified NPS presence on the Web. In response we have used a carefully planned homepage, common templates, logos, palettes, and fonts to define "Links to the Past," bind our dispersed parts into a unified whole, and be a significant part of "ParkNet." Yet, the Web also encourages individuality and creativity.

Another challenge is the growing enormity of our site and maintaining efficient access to its varied materials. What began as a dynamic "electronic brochure" must now be transformed into a powerful application for the public and NPS alike. The best strategy to manage our creativity and productivity requires a combination of technology and human ingenuity. On the human creativity side, we must encourage the evolving talents of our Web team and program staff and advocate for staffing a dedicated Web editorial group. We must also continue to utilize the unique advantages of the Web. The Museum Management Program, for example, manages millions of interesting museum objects



Left, a recent "Links to the Past" Web site feature designed by Mark Oviatt for HABS/HAER.

Right, original Web site design as delivered from Interactive Bureau in 1996. Screen capture by Mark Oviatt.

Links to the Past Highlights

For those with research needs, we have:

- indexed our site by keywords <www.cr.nps.gov/sitindex.htm>;
- begun to put up and index *CRM* magazine's 20 years of back issues <www.cr.nps.gov/crm/>;
- created a search tool to find relevant NPS publications on cultural resources topics <www.cr.nps.gov/linkpubs.htm>;
- provided e-mail access to some 50 NPS historians to help with research questions in "Ask a Historian" <www.cr.nps.gov/history/askhist.htm>; and,
- summarized important information, such as the museum collections housed in NPS parks and regional centers <www.cr.nps.gov/csd/collections/parkprof.html>.

For education, we have:

- provided summary information on the over 50 "Teaching with Historic Places" lesson plans available <www.cr.nps.gov/nr/twhp/>;
- provided an Outline of the Prehistory and History of the Southeast <www.cr.nps.gov/seac/outline.htm>; and
- archived all past features which are great educational tools <www.cr.nps.gov/pastfeat.htm>.

Cultural resources have economic value to numerous communities, so we have:

- provided access to information on state archeology events <www.cr.nps.gov/aad/statearc.htm>;
- featured travel itineraries of selected cities and areas that utilize dynamic maps of sites listed in the National Register of Historic Places <www.cr.nps.gov/nr/tourism.html>; and
- encouraged thematically-oriented travel sites, such as the "Golden Crescent" of south Georgia and North Florida <www.cr.nps.gov/goldcres/>.

Many people value cultural resources for eliciting connections between the past and the present, so we have:

- featured an exhibit of museum objects from Gettysburg National Military Park that were used in daily Civil War camp life as well as today <www.cr.nps.gov/csd/gettex/>;
- provided historical and cultural perspectives relevant today along the Lower Mississippi River Valley <www.cr.nps.gov/delta/>; and,
- helped people explore their heritage through databases such as the Civil War Soldiers System <www.itd.nps.gov/cwss/>.
- featured the development of road systems in the parks, now taken for granted, through postcards in "Lying Lightly on the Land" <www.cr.nps.gov/habshaer/lll/lying.htm>

and archival documents in parks and centers, but has not been able to widely showcase them. The Web allows us to produce exhibits, such as "Camp Life: Civil War Collections from Gettysburg NHB" that are viewed by thousands of people worldwide. Our most widely used publications, such as the *Preservation Briefs* and *CRM*, are now available to a much wider audience than ever possible in paper. Also, we are now able to assemble all the NPS Web projects and products on a topic into one coherent and dynamic presentation, such as "Shared History: Celebrating African American History & Culture."

On the technology side, we must continue to mold our site into an institution of information exchange and education by dismissing its former technical novelty and focusing on its useful tools. This involves quantifying user visits and gaining an understanding of user interests by better application of user statistics, user surveys, and demographic data. We also must test and take advantage of new cataloging and indexing software applications. Thousands of links need to be continually tested, addresses changed, and facts checked.

In the end, a rich Web site depends on great content and a unique perspective on information flow, not on software. The sheer volume and diversity of our materials dictates that we move to a three-dimensional approach. This means using core pages, not homepages, as focal points for accessing various parts of our site, including new sections on heritage tourism and museum exhibits, a central clearinghouse for publications, diverse programmatic services, and park resources. Where once we had hierarchical lists, we are beginning to construct dynamic spheres of intersecting information—an electronic Venn diagram of sorts.

We expect to continue to learn and work hard as we move through phase III, perhaps even go through another site redesign. It has all been worth it, however, mostly because we are able to inform and educate much larger and more diverse audiences about cultural resources in the national parks than ever before. An added benefit has been the increasing use of our site by NPS staff across the country to help with daily work, learn more about what each other does, and begin work on new Web projects.

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Daniel Julien and Stephanie Modlin

Texas Historic Sites Atlas

Historic Site Information on the WWW

Texas' historical records are scattered almost as widely as the sites they document—thousands of site forms and photographs are warehoused in museums, libraries, and archives across the state. To improve access to historic site documentation and facilitate historic preservation, the Texas Historical Commission (THC) recently compiled these records in a single, Internet-accessible database and mapping system, called the Texas Historic Sites Atlas <www.thc.state.tx.us/atlas>. The Atlas documents more than 220,000 historic and prehistoric sites, and can dynamically plot site locations on a variety of digital base maps. Most importantly, the Atlas delivers these maps, site records, and photos to planners, preservation professionals, and the public through the World Wide Web.

Screen captures by the authors.

To make the Atlas an authoritative preservation tool, the THC collaborated with universities and local preservation groups to collect Texas' historic site records, regardless of record date or origin. Atlas data sources include 166 unique site forms from more than 17 state repositories and community archives, as well as the THC's in-house files. Collecting this information was the first priority of the Atlas development staff; it proved to be the longest and most expensive task of this $1.5 million ISTEA-funded project.

A county search form. You can select multiple site types to generate lists of a county's historic resources.

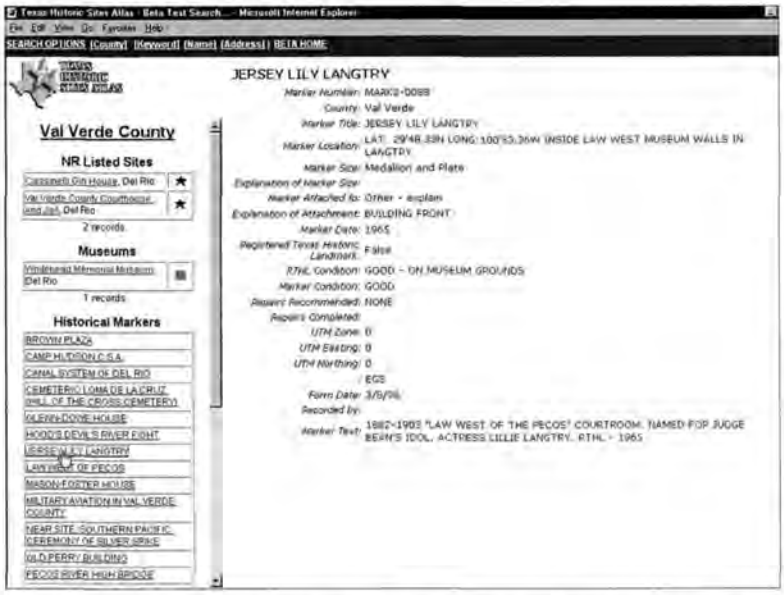
Our approach to data collection was simply to reproduce whatever documentation each archive had to offer. To preserve the recorder's observations, we chose not to standardize or modify the data to fit a single template. Instead, we created data sets and data-entry applications to match the fields on each archived form we encountered and transcribed the information directly from the original records. This approach made data entry much faster, easier, and less expensive. We also took advantage of information already available in a computerized format, such as National Register data. This information was combined with property descriptions from the THC's National Register Division files. To save time, our data-entry team scanned and converted these property narratives to text using optical character recognition (OCR) software. We also obtained thousands of historic resource survey files in database format from cultural resource management firms in Texas. The Texas Forestry Museum supplied us with a database of 4,000 historic sawmill records, and the Texas Department of Transportation provided databases of historic bridges, roadside parks, and Depression-era structures.

Some sets of data now in the Atlas have never before been available in electronic format. Archeological site data entry was performed under contract by the Texas Archeological Research Laboratory (TARL) at the University of Texas, which curates archeological records, maps, and artifacts. Archeological data collection involved transcribing data from site forms, scanning accompanying sketch maps, and digitizing site locations from USGS quadrangles. Site locations were recorded as coordinates in database tables, rather than digitized directly into a GIS map layer.

Data collection at the THC proceeded concurrently with the TARL contract; a team of data-entry workers transcribed National Register survey cards, Historical Marker files, and other records in the THC archives. They also scanned photos of most historic sites. These images were saved as JPEG or GIF format files at low resolution: this kept the individual file size to a minimum. An experienced operator could pull, scan, and re-file 100 images per hour.

The initial data collection phase lasted almost two years; this was the most expensive task of the project. The archeological data-entry contract with TARL cost approximately $500,000; we spent an additional $120,000 to employ data-entry workers at the THC. In comparison, computer hardware and software expenditures have totaled $140,000. Data-entry costs for each archeological site form was $5.94; for marker files and property

The results of a map request (right). The site you select is plotted at the center of the map, and the area displayed can be zoomed or panned left and right by clicking the buttons at the top of the screen. The Atlas currently plots historic site locations on county highway maps developed by TxDOT. In the future, more detailed topographic base maps will be available.



The full-screen results of a site form request (above). Both the maps and the site form data are displayed on the right side of the screen, while the search results remain on the left.

survey cards, $3.67 per form. Digitizing site locations from more than 4,400 USGS quadrangles cost $4.00 a map; scanned images cost $0.93.

Hosting this data requires technical expertise and substantial hardware. At the present time, Atlas resides on two networked computers, a Web server running Microsoft Internet Information Server 3.0®, and a database server running Microsoft SQL Server 6.5.® The database server has approximately 15 GB of storage (currently being upgraded to 90 GB). The Atlas Web site contains a variety of forms to obtain historic site information. These forms launch CGI scripts (written in Perl) which query the database server; the user receives the formatted results. Most scripts return a list of sites satisfying the search criteria. The user can then choose to view the complete site form data or a map of the site vicinity. Users can also click a digital map interface to select a county or smaller area for close examination.

To manage the mapping data, we use MGE®, a Geographic Information System (GIS) package from Intergraph. Another Intergraph product, GeoMedia Web Map®, generates and delivers historic site location maps over the Web. For base maps, we were able to use county highway maps produced by TxDOT. However, because these digital maps were created for paper map production, the data required a great deal of manipulation to make it suitable for use in our system.

An important phase of Atlas development was building the user interface; this included designing Web pages, writing scripts for database queries, and configuring mapping software. Last year, we went online with a beta test site. This gave us time to troubleshoot and record user comments and suggestions. More than 1,000 people registered to test the Atlas, and in one typical week our test site handled 117 user sessions, 227 user queries, and 102 requests for historic site maps. Due to legal concerns, the public version of the Atlas does not include access to archeological site records. Archeological data users must be granted a password-controlled account to gain access to the data.

The official announcement of the Texas Historic Sites Atlas is slated for spring 1998. We will continue to add new data sets and modify the user interface to enable more sophisticated types of database queries. We plan to improve the base map data by adding digital versions of quadrangle maps, called Digital Raster Graphics (DRG) files, recently completed by the USGS. Whether Atlas users search our records for entertainment, education, or historic preservation, they can browse Texas history—without ever leaving home.

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William Moss, Daniel Simoneau, and Benoît Fiset

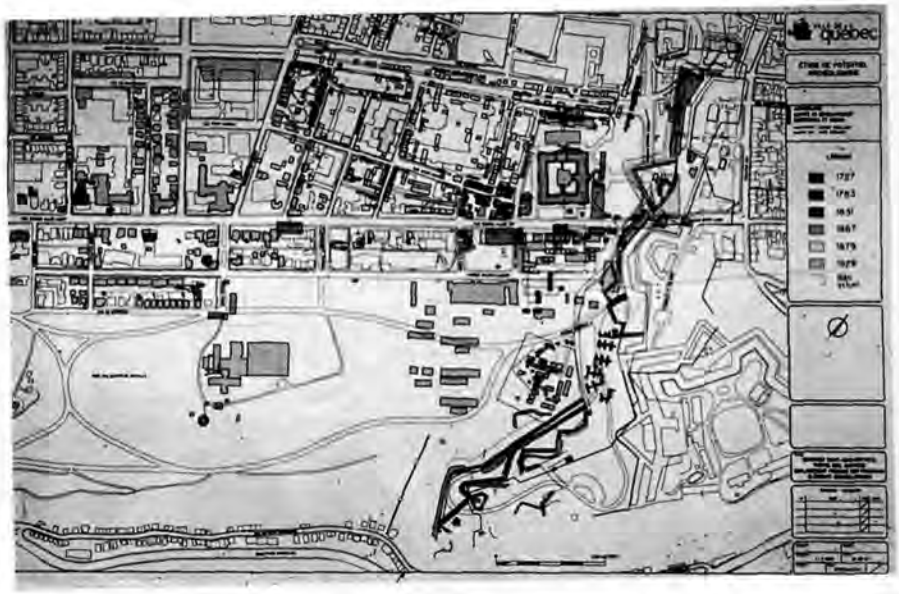
Archeology, GIS, and Urban Planning in Québec City

The initial control of archeological resources in Québec City was concentrated within the city's Historic District, listed as a UNESCO World Heritage site in 1989. Paper-based management tools assuring the protection of the city's archeological sites were consequently restricted to this territory. By the mid-1990s, the City and its partner, the provincial Culture and Communications Department, had extended their authority to all parts of the municipal territory.[1] The management tools developed to integrate historic-period archeological sites into the urban planning process were developed as a geographic information system (GIS). The new system is designed to identify potential sites[2] as part of the mitigation process and to formulate development strategies in the daily operations of a municipal urban planning department.

A major characteristic of the system is the method in which four computerized processes are integrated. Image correction software (Microstation Descartes 2.1®) is used to adjust scanned historic plans to the geodetic base plan of the modern city.[3] Efforts have concentrated on three approximate scales: plans covering the municipal territory (approximately 1: 20,000); an intermediate neighborhood level scale (approximately 1: 4,000); and, large scale plans at the site level (1: 250 or greater). The individual components of scanned and corrected plans are redrawn as geographically-referenced shapes with CAD software (Microstation 95®). Each shape must be numbered and indexed to cross-reference it to the third component, an alphanumeric database (Microsoft Access 2.0®) containing two general types of information. The first of these, a classification of the individual components of each historical plan, is essentially descriptive and serves as a research tool. The latter, primarily a management tool, synthesizes this information and consigns the archeologist's observations and comments. The use of mapping software (MapInfo 4.01®) capable of integrating cartographic and alphanumeric data constitutes the final component of the system. This software plays a dual role serving both as a graphic interface and as a communications tool to produce edited plans. Thus, it is possible to obtain information either geographically by selecting the desired part of the territory from the current geodetic base plan or thematically by querying the database. Results obtained by either one of these procedures can be electronically stored or printed as hard copy.

Another characteristic of the system is the intensive use of historical cartography. This is possible in an administrative and military center such as Québec City where numerous high-quality maps have been produced since the city's founding in 1608. The system is designed to be used in conjunction with

Historic plans are scanned and adjusted to the contemporary geodetic city plan with the use of image-correcting software. This adjustment will correct errors posterior to the plan's production, such as optical distortion during the photographing of an archived plan, but will not correct errors made by the original surveyor or draughtsperson. Seen here is a section of Chaussegros de Léry's 1727 plan of the Parliament Hill district. Photo by Robert Greffard, Ville de Québec.



Once adjusted, the content of the historic plan is redrawn as a series of geographically-referenced shapes indexed to a database describing each individual element. This map is part of the Parliament Hill district management plan. Drawing by Lise Grenier, Ville de Québec. Photo by Robert Greffard, Ville de Québec.

the city's built-heritage database which provides contextual information and site-specific data for individual properties. The system can be combined with other data available on the city's corporate GIS system, such as utility distribution networks, road networks, or the park system. Conversely, the system is quite efficient as a communications tool. Data can be readily inserted into technical specifications for planning and engineering projects or rapidly edited to transmit selected information to other players in the planning process: professionals within the municipal administration, elected officials, other agencies, or rate-payers and property owners.

The system has been used in several contexts and at every possible scale with considerable success. Striking examples include the development of a management plan for the Parliament Hill district in the Upper Town and the mitigation of a sewer construction project in the Lower Town's waterfront.[4] The system is open-ended; it is meant to be utilized in conjunction with new projects, whatever their scale or specific needs. Its use is cumulative and every new project expands the content of the general system and enriches our knowledge of the city's archeological heritage. This represents a considerable advantage over paper-based systems which are exceptionally difficult to modify or to expand upon in the face of new demands.

One point has become evident in all cases where the system has been employed: this is a tool designed to be used by qualified archeologists with proficient knowledge of the cultural resource area. For example, the analysis of the content of historic maps requires an excellent knowledge of the history and geography of the territory to select and accurately interpret plans. Professional expertise is also required in order to formulate appropriate recommendations and to ensure they are effectively applied in the specific operational context.

The flexibility, precision, and cost-effectiveness of the system have, none-the-less, proven its usefulness as both a management and research tool. In light of this, its use has been extended to the Historic District and, once completed, will cover all of the municipal territory. All current projects, managerial, mitigative, or research-oriented, both use and enrich the archeological heritage GIS.

Notes

1. PLURAM, Inc., *Étude de potentiel archéologique et analyse des composantes architecturales du Vieux-Québec* (Québec: Ville de Québec, Service d'urbanisme, Division du Vieux-Québec et du patrimoine, 1984).
2. A separate system, not described here, was developed for the Amerindian palaeohistoric occupation of the territory.
3. Sue Smith, "Future Tools for Managing the Past." *Microstation World* 2, no. 3, (1996): 32-35.
4. The management plan developed for the Parliament Hill district of the City is the most comprehensive example of the standardization of this information. See, Serge Rouleau and William Moss, "*Évaluation du potentiel archéologique du quartier Saint-Jean-Baptiste, partie sud*" (Québec: Ville de Québec, Service du centre de développement économique et urbain, Division design et patrimoine, 1998).

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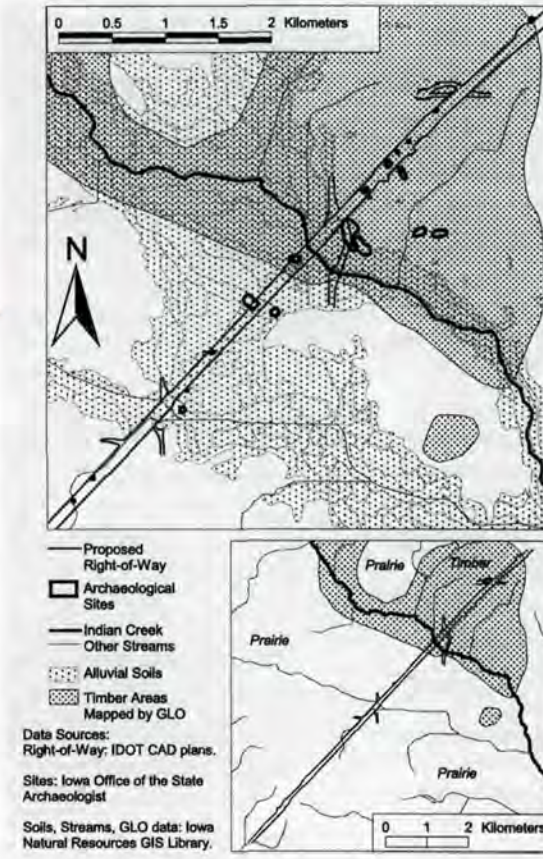
Daniel Simoneau is project archeologist for the City of Québec.

Benoît Fiset is GIS technician for the City of Québec.

Joe Alan Artz, Shesh Mathur, and John F. Doershuk

Past Landscapes, Future Roads

GIS, Archeology, and Highway Planning In Iowa



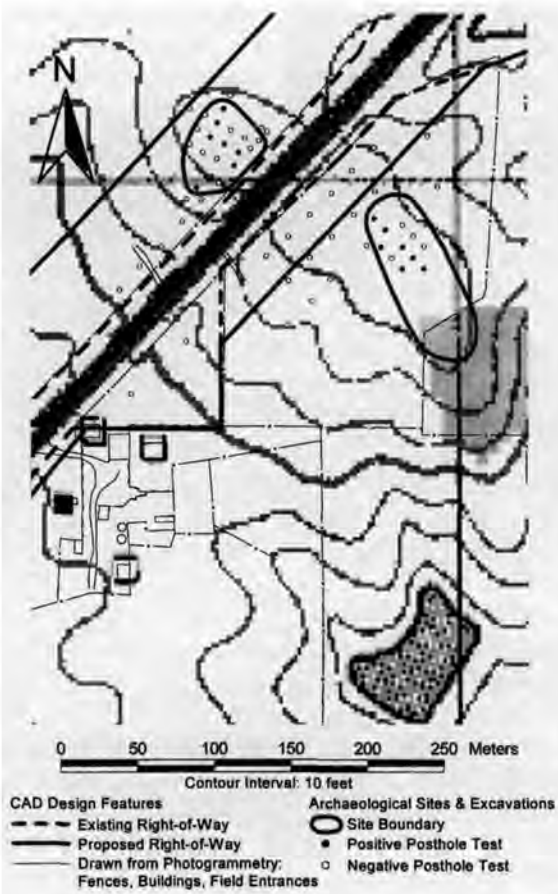
This map shows the proposed highway corridor in relation to historic map data on natural vegetation, and modern soils data. The small map at lower right shows the entire corridor. The top map shows the northeast half of the corridor, where all but one of the prehistoric sites recorded by the project are found.

Archeologists in cultural resource management often find themselves in the paradoxical, if not anachronistic, situation of visualizing the effects of future development on past landscapes. In considering the natural and cultural environmental contexts of past occupations, archeologists work with many kinds of maps, including topographic quadrangles, soil surveys, aerial photographs, and historic survey plats. In considering the effects of future development on cultural resources, archeologists often rely on client-provided plans that show the spatial extent of a proposed undertaking. The Iowa Department of Transportation (IDOT), for example, routinely provides its cultural resource consultants with plans that show where a given undertaking will be built.

Determining the location of a specific archeological site on such a variety of maps can be a daunting task using traditional tools such as an engineer's scale. Fortunately, the ability to work with spatial data at various scales is greatly facilitated by computer technology: computer-assisted drafting (CAD) and geographic information systems (GIS) hold great promise for spatial data integration in archeology. CAD is basically a drawing tool in which drawing elements are organized into thematic layers. Layers are assigned different colors, line weights, line styles, or marker symbols to facilitate their identification. Layers can be on or off as needed to reduce visual clutter. GIS software combines the drawing capabilities of CAD with the analytical capabilities of a relational database; GIS not only displays spatial data on maps but also maintains a database of information about mapped features. The database can be queried and the results can be mapped. In a GIS, mapped features are georeferenced, i.e., assigned coordinates that identify them to a specific location on the earth's surface. The user specifies coordinate systems, such as degrees of latitude/longitude or coordinates of the Universal Transverse Mercator (UTM) system.

Recently, the University of Iowa Highway Archaeology Program, under contract to IDOT, surveyed a proposed construction corridor along an existing highway. ArcView®, a software package developed by ESRI, Inc., was used to develop a GIS for the project that incorporated the following map data sources:

- CAD files provided by IDOT. The files are electronic drawings depicting various construction features, such as rights-of-way, property lines, culverts, bridges, pavements, medians, ditches, water bodies, fences, tree lines, and buildings drawn from aerial photographs.
- Digital representations of 7.5 min. quadrangle maps obtained from the USGS <mcmcweb.er.usgs.gov/>.
- Digital maps showing streams and native vegetation obtained from the Iowa Natural Resources GIS library <www.igsb.uiowa.edu/nrgis/gishome.htm>.
- A digital map of soils in the project area obtained from the Natural Resource Conservation Service <www.ia.nrcs.usda.gov/soils/iowa_soils.html>.
- Field notes used to plot site boundaries and excavation locations. These locations, recorded in the field, were digitized on-screen using CAD files as a backdrop.



In this "snapshot view" of one portion of a transportation archeology GIS, CAD design and photogrammetry data, provided by the Iowa Department of Transportation, are layered atop a digital raster graphic (DRG) of a 7.5 minute quadrangle map. Layers for archeological site boundaries and excavations are also shown, with excavations coded to indicate which yielded artifacts. DRGs are scanned at a minimum resolution of 250 dots per inch. At scales smaller than ca. 1:5000, individual pixels (small squares comprising the raster image), each measuring ca. 2.3 m on a side, become visible.

By bringing these data sources together in a GIS, any variety of maps can be prepared showing the location of the project corridor and archeological sites in relation to features of the cultural and natural environment. At relatively small scales, the location of specific sites in relation to the proposed corridor are easily visualized. At larger scales, the relation of the project area to features of the natural environment can be examined. In the map image, for example, the proposed construction right-of-way from the CAD files is superimposed on a map showing two layers of environmental data. The "alluvial soils" layer was created from the soil survey map; the "timber areas" layer was created from a digitized 1:1200 survey plat showing vegetation cover as mapped by the General Land Office in 1846.

As shown in 1846, forest formed a narrow belt along Indian Creek and extended into the uplands northeast of the valley. Most of the valley, however, and a large expanse of upland south of the valley was prairie (inset map). Of the 136 hectares occupied by the proposed project corridor, about 36%, or 49 hectares, was forested at the time of the General Land Office survey. The forested zone, however, contains 11 of 18 prehistoric sites recorded by the project, a density of 2.2 sites per 10 ha. In contrast, only seven sites were found in the prairie zone, a density of only 0.8 sites per 10 ha.

Digital images by the authors.

Sites in the forested zone in the northeast half of the project area tended to yield more abundant and diverse artifact assemblages, suggesting profound functional differences in prehistoric utilization of the two broadly defined "ecozones."

This simple ecological comparison does not begin to exhaust the analytical sophistication possible with a GIS. It does, however illustrate the technology's ability to help visualize and quantify spatial data. Readily available GIS technology enables archeologists to bring together geographic data from various media produced at various scales, including CAD drawings. Incorporating CAD designs as part of a cultural resources GIS facilitates visualizing and analyzing project effects and communicating these results to regulators, planners, and engineers. CRM surveys are usually conducted in the preliminary stages of project planning. CAD plans available at the time of survey often represent an early stage in a dynamic planning and design process. Design modifications made after the initial survey is completed often require review and reassessment to determine whether initial CRM recommendations still apply, and to determine whether a supplemental survey is needed.

The effects of proposed design changes on cultural resources can be immediately determined if information on known site locations and previously surveyed areas is incorporated as a layer in the engineer's CAD designs. By exporting a GIS data layer to a CAD file format, cultural resource locations can be added directly to the engineering CAD plans. Alternatively, the archeologist can review proposed design changes by adding client-provided CAD files to an existing cultural resources GIS. GIS promises to become an important tool in all stages of CRM, with the software providing a dynamic interface for sharing information among archeologists, planners, designers, and regulators.

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Diane Favro with Dean Abernathy

A Columnar Experience

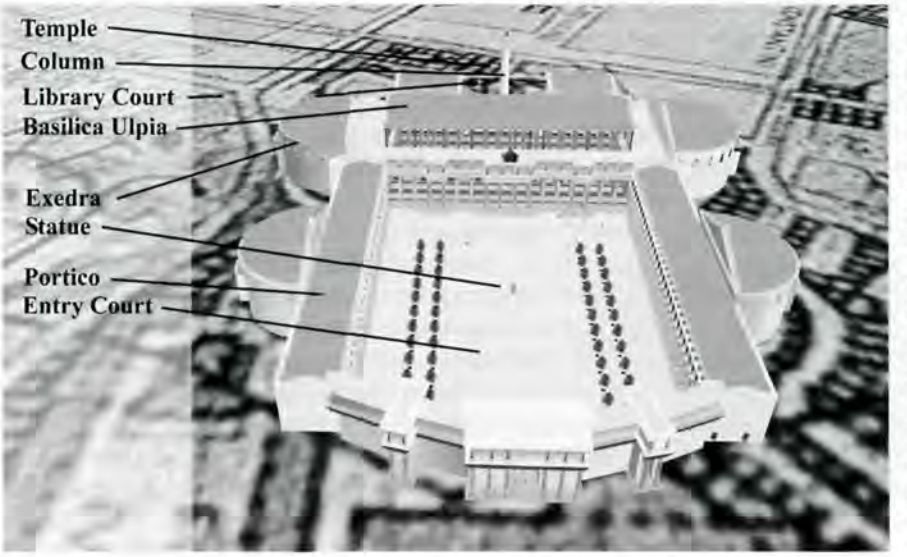
Virtual Reality of Trajan's Column

In early second century AD, the emperor Trajan erected a towering column in the center of Rome covered with reliefs depicting his successful military campaigns in Dacia. Still standing, this monument has generated more publications than almost any other Roman building.[1] Most research has focused on the engaging sculptures. In contrast, the Column's physical context remains problematic. Only a few segments of the surrounding complex have survived from antiquity. In order to study the Column in its original setting, historians must use representational reconstructions. Until now, these took the form of two-dimensional static drawings or three-dimensional scaled physical models. The nature of these tools naturally influenced how and what researchers evaluated. Static reconstruction drawings encouraged the examination of set views, architectural style, and other visual issues. Miniature physical models promoted the study of massing and topography. Today, a new analytical tool is generating a fresh range of questions and inquiries: computer-based virtual reality (VR) modeling.

First developed for use in military flight simulations, VR models allow users to move through three-dimensional spaces in real time. Architectural historians are now taking advantage of VR technology to create highly accurate, interactive historic reconstructions to recreate the experience of being in, and moving through, past environments. In marked contrast to drawings and physical models, VR models are endlessly adaptable and can be linked with a wide range of applications. Using virtual "labs," architectural historians, like scientists, can control and repeat a range of experiments. They can evaluate virtual models under different climactic conditions, test the validity of alternative reconstructions, analyze viewing angles, explore lighting issues, display a building's evolution over time, study artworks *in situ*, calibrate the sequencing of spaces, and examine use patterns by including interactive figures. They can hyperlink models to diverse textual information while creating expansive historical environments.

A team from UCLA and the Getty Trust has produced a VR model of Trajan's Forum based upon the extensive research by Professor James Packer.[2] The model is on the uSim urban simulation system, an interactive virtual reality system with real-time kinetic and sound capabilities.[3] Currently, the Getty/UCLA model is being used to show the original context for ancient sculptures at the opening exhibition of the new J. Paul Getty Museum. Under development are the creation of various educational applications for the model, as well as continued historical research. For our first study, we have used the Getty/UCLA model to analyze the recreated, animated experience of visitors to Trajan's Forum in the early second century AD.

Individual emperors created five Imperial Fora in the center of ancient Rome. Trajan's was the last and largest, dedicated in AD 112. The next year, the emperor dedicated the sculpted Column. This magnificent monument rising 100 Roman feet (29.7 meters) stood in a relatively small courtyard between two libraries located behind the large Basilica Ulpia. At Trajan's death in 117, he was made a god; his ashes were placed in the Column's base. The incomplete physi-



Overview of the Getty/UCLA Trajan's Forum Model showing the siting in Rome, orientation, central plaza, side porticos, exedrae, central equestrian statue, Basilica Ulpia, Library court, Column, and Temple of Trajan.

View from the southern entrance of Trajan's Forum along the main axis toward the equestrian statue, the triumphal chariot over the main entrance to the Basilica Ulpia, and the statue of Trajan atop the Column.

cal remains of the surrounding structures, the seductive modern appearance of Trajan's Column, as well as the limitations of available tools, have led scholars to mention, but not emphasize, the original setting. Using VR technology, we can now recreate the impact of the Column on ancient viewers.

Let's take a virtual walk through the Getty/UCLA VR model of Trajan's Forum.[4] We enter the Forum from the city center on the southeast. Our glance is first drawn to the great equestrian statue of Trajan prancing in the center of a vast paved plaza. This sculpture, known from representations on coins, emphasized the emperor's role as a soldier in peacetime and established a sight line along the Forum's main architectural axis. Behind the statue rises the great Basilica Ulpia. Over the central door we again see Trajan, this time as a victorious soldier galloping toward us in a magnificent six-horse chariot. Far in the distance, a shimmering gilded figure of the deified Trajan hovers above and beyond the Basilica. This tripartite hierarchy of civilian soldier, triumphal general, and god remains in view until we reach the middle of the plaza, when the looming façade of the Basilica Ulpia blocks sight of Trajan atop the Column. Nevertheless, the powerful visual alignment remains strongly in mind as we walk around the equestrian statue. Entering the main entrance of the Basilica Ulpia, we confront a powerful perpendicular axis directing our glance to the left and right, yet as we turn to look down the vast Basilica, our attention is captured by a tantalizing glimpse of the Column through the open upper colonnade. Anxious to get closer to the enticing reliefs, we search for an exit. With surprise, we see that there is no door on the Basilica's northwest wall opposite the main entrance. Instead, we have a choice of two rather small, innocuous doors on either side of the main axis. Passing through one, we enter the porticoed Library Court. After the enormous plaza and Basilica, this court seems small. The sense of intimacy is further enhanced by the large Column base dominating the space. The intimate scale and sculpted armor on the base spark associations with Roman funeral monuments. Our eyes are soon drawn upward at a raking angle to the reliefs on the Column. The rising slope of the carved spiral narrative draws us in a counterclockwise direction around the Column, reenacting the choreography of many Roman rituals, including those at funerals. Circling the base, we come to the door on the southeast side. If we are literate Romans, we can read the inscription over the portal telling us that a hill was removed to make way for the Column. Craning our necks upward, we search in vain for sight of Trajan's statue crowning the shaft. The close angle prevents any glimpse of the sculpted god, yet after walking through the Forum we know well he hovers overhead.

The recreated experience of moving through Trajan's Forum reveals the ideas behind the design. The ancient architect created a strong visual axis, and underscored its importance by forcing pedestrians to deviate from this line. Ancient observers saw representations in a sequence that recalled Trajan's progression in real life from leader in peacetime to victorious soldier. After his death, Trajan alone continued along the main axis, passing in death through the solid Basilica wall into the Column base, and finally rising by apotheosis up the Column to the divine realm. By forcing pedestrians to move through the side doors into the Library Court, the design reinforced the significance of the axis as a metaphor for Trajan's path to divinity. The constriction of the Library Court underscored the funerary program, supporting the idea that the Column was planned as Trajan's tomb from its inception. Overall, the VR model helps to confirm that the sensorial experience of environments was a major consideration in the design and iconographical programming of Roman buildings.

The experiential analysis of Trajan's Column represents merely one of the many research applications for VR historic models. Such models allow researchers to uncover issues for further investigation, identify locations for future excavation, and

Oblique view of Trajan's Column in the Library Court as seen entering from the Basilica Ulpia.

encourage collaboration across disciplines. Unfortunately, the creation of accurate historic virtual reality models like that of Trajan's Forum is time-consuming and costly. On the positive side, once a model is built it can be continually updated and used for a wide variety of applications. For example, reconstruction models can be placed in viewing terminals at actual sites to allow visitors to experience the environment in different eras. VR models can be incorporated into promotional and didactic materials presented on videos, CD-ROMs, or fully interactive Internet connections. By moving through a recreated environment, viewers from all over the world become engaged in, and with, the past more strongly than with other delivery systems. Like all instruments, however, visualization systems privilege certain aspects over others. We must remember that computers are tools, not substitutes for thinking. Judicious use requires that the researchers and modelers have specific experiments in mind, rather than creating models merely because the technology makes it possible.[5] Caveats aside, this single experiential experiment centered on the Column of Trajan underscores the value of virtual reality models for teaching us about even the most studied of monuments. After moving through the virtual Forum of Trajan and viewing the Column, we can understand more fully why Cassiodorus wrote in the sixth century, "The Forum of Trajan is a wonder to look upon, even after continual viewing" (Variae, 7.6.1).

VR models created jointly by the J. Paul Getty Trust and UCLA.

Notes

1 Over the last decade an average of three significant research publications each year have examined Trajan's Column. Several major exhibitions and colloquia focused solely on this monument.

2 Professor James E. Packer's meticulous research on Trajan's Forum culminated in the impressive book, *The Forum of Trajan in Rome: A Study of the Monuments* (Berkeley: University of California Press, 1997). The VR model was produced in the uSim Lab at UCLA under the direction of William Jepson and Diane Favro, with Bernard Frischer as consultant; the primary modelers were Dean Abernathy and Lisa Snyder. An alternative virtual reconstruction of the Basilica Ulpia is currently in development by Infobyte based upon the research of Professors Carla Maria Amici and Lucrezia Ungaro.

3 The uSim (Urban Simulation System) was developed at the Center for Computing at UCLA under the directorship of William Jepson. This system is capable of creating a complex virtual reality model encompassing entire urban environments which can then be used for interactive fly-, drive-, and walk-through demonstrations allowing the viewer to scale elegantly between distant urban views and close-up images of building details.

4 The following is a verbal description of the most likely path for a first visitor to the Forum. However, since the VR model allows the user to control movement in real-time, many other paths are possible.

5 In addition to an experiential analysis of Trajan's Column, we conducted several other experiments using the Getty/UCLA model, always beginning with a specific hypothesis. For example, we plotted the shadows cast by the Column to determine if it was conceived as a gnomon; the results were negative.

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Special praise and thanks must go to the J. Paul Getty Trust; UCLA's School of the Arts and Architecture, and College of Letters and Sciences; the Creative Kids Educational Foundation; and, the uSim Lab for their commitment to the creation of historical virtual reality models and related educational applications.

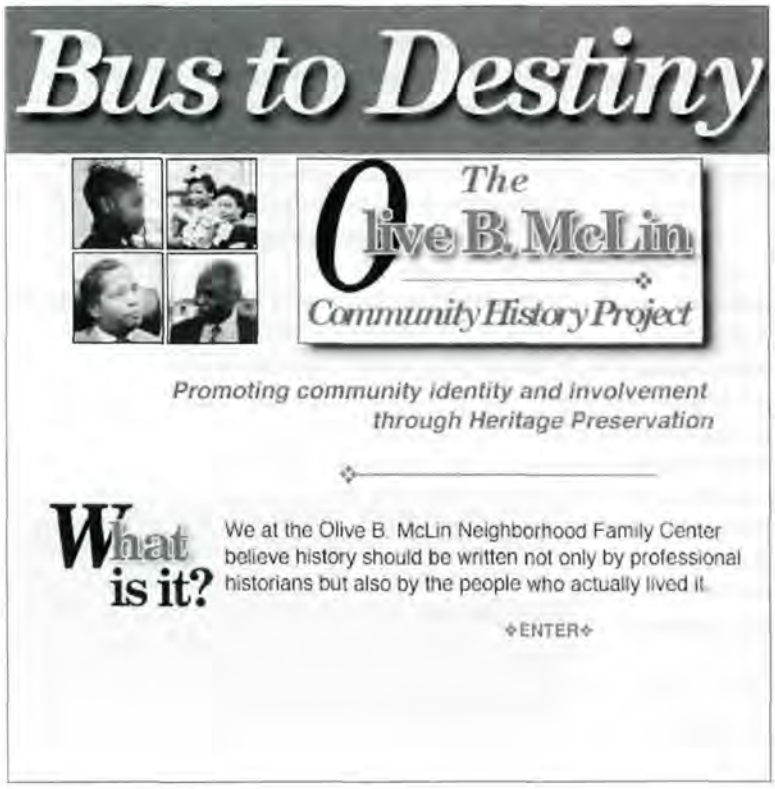
Eric Chrisp and Jay Sokolovsky

"Bus to Destiny"
Locals Teaching Local History

"If the people of any race have no record of their past...that race becomes a drone in the community and is treated as a nonentity....We should learn to record our doings, or we will be unprepared for the future examination and remain a nonentity in the great universe in which we live."

Samuel DeBow and Edward Pitter 1927, as quoted in Taylor 1994:2

This is a story of collaboration among an African-American community, two African-American owned multimedia companies, and faculty and students at the University of South Florida in St. Petersburg. A two-year effort is culminating in the creation of a CD-ROM, entitled "Bus to Destiny," which captures aspects of the community's history. Originally envisioned as a way to preserve important cultural resources, the CD-ROM concept has been expanded to function as a digital museum, a powerful tool for engaging youth, and a model for a Web page that will extend the project's reach.



The "Bus to Destiny" Web site opening page flashes several photos before resolving to an integration-era school bus. Web site and screen capture by Rochelle Lavin.

The Olive B. McLin Community History Archive Project counters stereotypes of what some communities are able to afford, or likely to value. We believe our experience challenges traditional notions of community development and shows that multimedia humanities projects can have significant impact if the collaboration is honest and the locus of control remains in the community.

The story begins in the south-central area of St. Petersburg, Florida. Like many historically black urban areas, this neighborhood has been neglected in favor of downtown development, severed by interstate construction, and affected by lack of economic opportunity and high crime. Only a few blocks from the St. Petersburg Campus of the University of South Florida, the neighborhood became the focus of growing university attention in the form of an urban initiative. Relationships have been building among faculty members, community developers, and residents over the past decade.

In 1996, we were introduced to the organizers of the Olive B. McLin Neighborhood Family Center (NFC). It seemed an ideal place to start a community development project because the center's namesake was a local educator and historical figure in her own right. The NFC saw the project as a way to stimulate involvement in the center and as a means to bolster pride—two important ingredients for self-determination in community development. The archive was partially modeled after a long-standing community history project at the Intertribal Friendship House in Oakland, California. The cornerstone of this new archive is a small collection of 40 oral histories collected by graduate student Eric Chrisp, assisted by youth and adult volunteers whom he trained. Over 45 volunteers have been involved in the project, collectively logging at least 60 hours per month. By training community members to collect oral histories, we put the tools of documenting and controlling cultural resources in the hands of the community itself. The process energized our young volunteers; they gained an opportunity to see a connection to their history missing in public schools.

We found that relationships between the university and the community had to be built one person at a time. To facilitate resident involvement, we established a Community Advisory Board (CAB) and planned a community history day to showcase the multimedia history archive. Monthly meetings with the CAB proved critical in discovering how to best use computer-based technologies.

It was initially thought that a professor of anthropology and a graduate student could easily build the CD-ROM with university-based technology. After further study, we concluded that it was unrealistic for us to produce anything more than a

mere electronic catalog of historical tidbits. We sought help from two African-American multimedia contractors in the local area. One, a specialist in CD-ROM production, combines digital skills with 15 years of television production and experience teaching public school kids poetry and music. The other is a journalist with experience designing and maintaining Web pages for a major newspaper. Working with these contractors allowed us to collaborate with individuals who could add their own cultural experience to the exacting technical needs of our efforts. Also, we wanted this historical resource project to help promote neighborhood economic development.

One of our challenges is to offer computer technologies that communities can actually learn from and access. The project's CD-ROM is being produced using the Tool Book II® software package which allows easy integration of images, video, audio, and interactive lessons and games. Producing video on the typical home computer is the greatest challenge; ours utilizes MPEG1 compression with 256 colors and 16-bit format. Since most home computer users access the Internet with low speed modems, the issue with Web production is to judiciously use high-tech bells and whistles so that a Web site is brought to users' screens before they lose interest. For example, our Web site uses an animated GIF file of historical local photos within a simple but quite elegant design—you can view it at: <www.gate.net/~lavanon/mclin/>. While our site contains a multitude of graphic images, there is seldom more than one per screen and each page is kept to less than 40 kilobytes of space. Conceptually, the CD-ROM and Web site are designed to interest viewers in local history and then entice them to explore the many layers of text, visuals, and sound within.

To assist residents in recording their own history, we developed a handbook for training community members. The youth, however, were more responsive to individualized attention; regular meetings were held to train teens on a range of information collecting techniques. They were given the opportunity to use their skills through a weekend program called the "History is Now Expedition." On one expedition, teens interviewed, videotaped, and photographed a jazz musician and music teacher who had been a World War II Tuskegee Airman. The interview took place in front of the former Manhattan Casino, a segregation-era nightclub frequented by jazz geniuses such as Count Basie. Later, the teens helped select sound bites and images to be included on the CD-ROM and Web page.

The Web extends the reach of the project by advertising upcoming events and hyperlinking to related Web sites such as the local Council of Neighborhood Organizations. A community history chat room provides a place for users to swap stories of local lore. The Web site will also provide a testing ground for materials which can be transferred to future copies of the CD-ROM. The CAB will regularly review the work of a team of youth trained by the Web page contractor to write basic HTML code. These teens will soon showcase their own efforts at cultural resource management.

The first edition of the CD-ROM will be available in June 1998. It will include a virtual heritage trail, a quiz game on local heroes, several photo exhibits, family and oral histories, and a guide to collecting local history. The technology of both the CD-ROM and the Web offers a distinct advantage over history books by linking keywords through "hot spots." When users view our "Heros of Our Heritage" photographic exhibit over the Internet, they can instantly leap to more information about a given photograph. The CD will be distributed free to St. Petersburg's community centers, public museums, and city libraries.

This ongoing CD-ROM and Web project forms a flexible platform for passing heritage between generations and meeting the needs of a community actively engaged in reshaping its public image. A cutting-edge technology is being utilized in a community which has historically been denied equal representation. It is often said in this community, "We can't know where we're going if we don't know where we've been." This community is now entering the technology-based future with a greater means of preserving its past.

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The authors wish to acknowledge generous funding from the Florida Humanities Council, the City of St. Petersburg, the *St. Petersburg Times*, the O.B. McLin, J.B. Sanderlin, and Enoch Davis Community and Family centers.

Julie Fix

The Civil War Explorer
A Multimedia Exhibit

The challenge for an interpreter of history is to make connections. Interpreters need to show visitors the relationship not only between the events of the past and the processes that shaped them, but also between the past and its relevance to their own lives. It is particularly vital to make these links when interpreting the Civil War. There is a phenomenon common at Civil War battlefields that historian Edward T. Linenthal calls the "golden mist of American valor."* This phenomenon, which began immediately after the Civil War, is the idea that both sides, North and South, were composed of brave Americans fighting honorably for their separate visions of freedom. Divisive issues such as slavery and states' rights are pushed to the side; battlefields become places to honor American courage and dedication to duty. There is a darker side to this phenomenon: a tendency to glorify war and to celebrate violence. Monuments erected to honor only battlefield soldiers tend to ignore the history of those people equally affected by war: women, civilians, and minorities. Education and interpretation programs can mitigate this effect and tell the rest of the story.

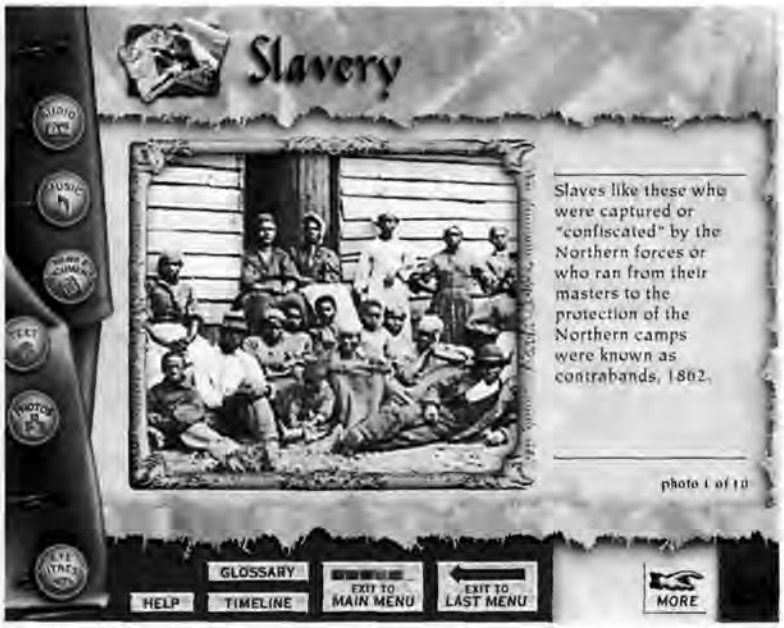
The best interpretive tools are the ones that engage the visitor as an active participant in the learning process. This is where new technology enters the picture. While interactive, multimedia exhibits cannot replace human interpreters, they are perfect supplements to traditional museum exhibits. Instead of a passive experience of viewing artifacts in glass cases, multimedia programs such as The Civil War Trust's Civil War Explorer allow the visitor to interact with the exhibit. Visitors can decide what subjects interest them and then bring the past to life by choosing video clips of battle re-enactments, period music, historic and modern photographs, original documents, or animated maps and graphs.

Multimedia programs offer much information and require little floor space. This screen capture from the Civil War Explorer shows only a few of the many subjects included on the program.

Interactive multimedia programs not only stimulate the senses to increase a visitor's enjoyment of the subject, they can also be extremely effective in interpreting to visitors with varying levels of knowledge. The Explorer, for example, uses the advantages of multimedia to illustrate concepts that are difficult to understand; animated graphics show a bullet's path through the barrel of a musket to easily explain how rifling the barrel drastically improves the musket's accuracy. A time line and glossary are available from buttons at the base of every screen. A visitor who is unfamiliar with the Civil War might have difficulty tracking the different sides. However, via the computer screen, the visitor can go to the glossary to see that "Federal" troops are also known as "Union, Yankee, or Northern," while "Confederate" troops are also referred to as "Southern" or "Rebel."

Computer exhibits and advanced technology are particularly beneficial in helping small museums and sites meet visitor needs. Like the Civil War Explorer, they are often designed to be accessible by visitors with varying levels of computer experience. On the Explorer, written captions accompany audio materials on the program for hearing-impaired visitors. For visitors in wheelchairs, the kiosk is designed to be a comfortable height from the floor. For visitors who have trouble with fine motor skills, such as young children and older adults, buttons on the screen are large and prominent; they change color when pressed successfully. Voice-overs assist vision-impaired visitors.

Context is vital in every history exhibit, yet there is never enough space in a museum to cover everything. One of the most convenient features of computer exhibits is that they can present large amounts of information in a small space. For example, at a small site like Prairie Grove State Battlefield Park, traditional museum displays focus closely on the clash between Confederate and Union generals. The Civil War Explorer enhances the visitor's experience by providing background material on such topics as causes of the war and effects on civilian life. In addition to providing information, a computer exhibit can serve as a vir-



"Coat buttons" on the left and navigation buttons on the bottom of the screen make it easy for visitors to find information on the Civil War Explorer program.

tual gallery: museums and sites can now showcase their most fragile or bulky artifacts by including them on the program. While nothing can truly replace the visceral experience of standing in the presence of an actual piece of the past, visitors can still learn from and enjoy images of artifacts when the real thing is too frail or costly to display.

Of course, like any exhibit, it takes organization and planning to ensure that visitors can find interesting material quickly and easily on a computer. Since visitors will not have access to a manual, the computer interface must be simple and self-explanatory. The following is the basic organizational structure of material on the Civil War Explorer accessed via six options appearing on the Main Menu screen:

1. "The Big Picture" provides a general introduction to the Civil War and its causes; it provides a historical framework for the rest of the Explorer.
2. "The Civil War World," as its name suggests, includes interrelated sections on military, social, political, and cultural aspects of 19th-century America.
3. "On This Date" is a calendar detailing significant events, relative to the Civil War, that occurred on a particular day. When the screen appears, the calendar is set to the current date—a visitor can then choose any date such as a birthday or wedding anniversary to see what events happened on that day.
4. "Specific Site" showcases the historic site or battlefield where the Explorer is located. Visitors can access information about the site they are visiting.
5. "Soldier Records" is a searchable database that, upon completion, will include the records of all soldiers who fought during the Civil War.
6. "Preserving Battlefields" discusses the important issue of battlefield preservation.

Screen captures courtesy The Civil War Trust.

Organization is vital since hyperlinks enable each visitor to experience the Explorer in a different way. A visitor investigating "Battles" might read that "slavery and states' rights were causes of the Civil War." Touching the underlined hyperlink for "slavery" would access the slavery section—including audio interviews with ex-slaves, spiritual music, and historic photographs. Other hyperlinks take visitors to more divergent paths further into the program. To keep visitors oriented, an icon appears at the top of each screen corresponding to the categories on the Main Menu. As visitors use hyperlinks to move through the program, visual clues help them keep their bearings.

Ultimately, the goal of any exhibit is to educate and inform; multimedia exhibits like the Explorer can also entice and entertain. The Civil War Trust believes that people will not contribute to a cause they know little about—they must be given a compelling reason to support battlefield preservation. The Trust designed the Explorer to draw visitors into the subject and to let them find their own reasons to care. While conducting evaluations of the program at Gettysburg National Military Park, I witnessed a bored 11-year old boy as he first spied the computer. His immediate reaction was excitement at the technology: running to the kiosk, he used the touch screen to move the cursor. Accidentally, he touched a button on the screen and accessed the "On This Date" calendar. Out of curiosity, he looked up his birthday, April 12. When he discovered that he had been born on the same day that the first shots were fired at Fort Sumter, he became very interested and began looking up other dates. Soon, he called his family over to look at the video clips, photos, and maps found on the program. When the family finally left the Visitor Center, he was chattering enthusiastically about all the things he had learned. The connection had been made.

Note

* Edward T. Linenthal, *Sacred Ground: Americans and Their Battlefields* (Urbana: University of Illinois Press, 1993).

Julie Fix <jfix@civilwar.org> is Civil War Explorer Coordinator, The Civil War Trust.

Mary L. Kwas and George Sabo III

"Teaching With Technology"
Contact Period in the Mississippi Valley

For the Native Americans who witnessed the arrival of the first Europeans, the event was, in many ways, cataclysmic. In order to help students understand the impact of the Contact Period in America's history, the Arkansas Archeological Survey in partnership with the Department of Foreign Languages at the University of Arkansas, is developing multimedia educational software to explore aspects of the history of Native American encounters with Europeans in the Lower Mississippi Valley. The project will incorporate images, sound clips, foreign language materials and—perhaps of greatest interest—actual texts written by early explorers describing their experiences. The project is being funded in part by a grant from the National Endowment for the Humanities under its "Teaching With Technology" program. When the three-year project is completed in 1999, the software will be made available at no cost to schools and educational institutions via CD-ROM and the Web.

Project Content

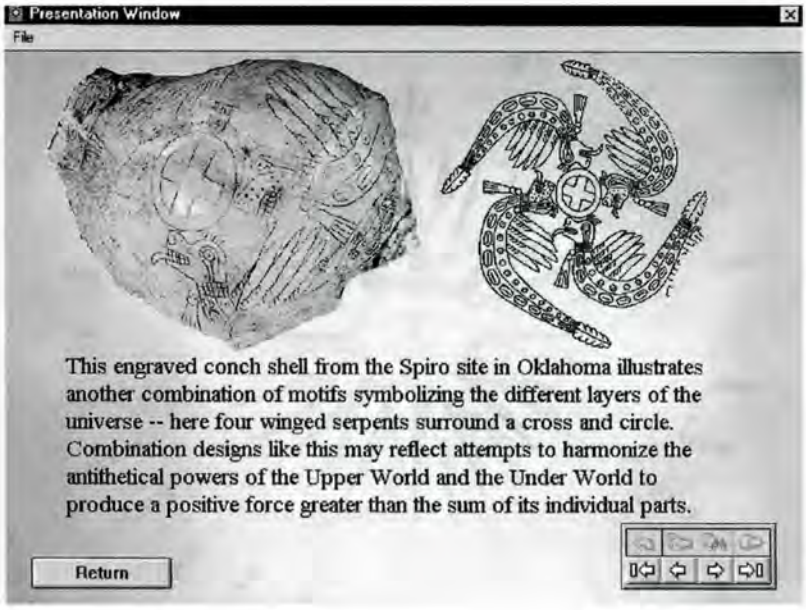
The Lower Mississippi Valley was chosen as the focus of the project because the region witnessed a greater range of cultural encounters than almost anywhere else in the New World: English, French, and Spanish colonists met dozens of distinctive Native American groups. The software is aimed at several educational levels from upper elementary to university and offers three language tracts (English, French, and Spanish) that can be used separately or in conjunction. Since many of the original documents were written by French and Spanish explorers, we hope the program will motivate students to access the foreign language tracts to learn how to read these early texts. A special program to guide students in "Reading in a Foreign Language" will be incorporated into the design of the French and Spanish tracts. Instructors who teach across the curriculum will have an educational program that includes anthropology, history, geography, social studies, English, and foreign languages.

A primary goal of the project is to help students answer the question: "How does one derive from the archeological and historical record an understanding of what happened in the past?" The software will assist students in developing the skills necessary for creative inquiry and problem solving, ultimately engaging students in the process of learning. The software is not intended to be a multimedia encyclopedia, but rather an exciting exploration of the past and the means by which it is discovered.

Learning Modules

The software will provide one introductory module and five learning modules. Each module will be arranged in three levels of difficulty, beginning with an introduction to basic concepts and learning skills, advancing through knowledge building and evaluation of information, and culminating with advanced problem solving through the creation and analysis of data sets. Each module will explore various aspects of Contact Period experiences, as follows:

- **First Encounters.** In this module, students will learn that both Native Americans and Europeans possessed distinctive world views,



Designs on a conch shell from the Spiro site illustrate a Native American belief system.

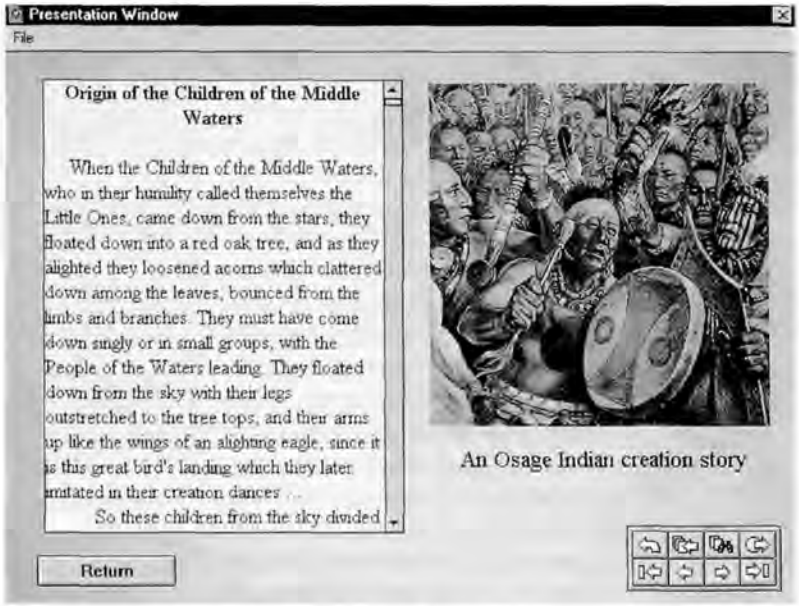
the similarities of which provided common ground for interaction, while the differences created misunderstandings and unfulfilled expectations.

- **Viewing the Land.** Ways of viewing the land and organizing relationships with the land, including how natural resources were used, also differed between Native Americans and Europeans. Through the use of maps and other graphics, students will explore geographic concepts, settlement patterns, and land use.
- **Interactions.** Native Americans and Europeans participated in rituals and other interactions through which they recognized each other's existence, created agreements to share the land and its resources, asserted rights of self-determination, sought means to cooperate, and made attempts at religious conversion. Sometimes these efforts were successful; sometimes they failed.
- **Exchanges.** Trade between Native Americans and Europeans was not just a matter of swapping material goods; mutual exchanges affected established economic patterns and created long-reaching consequences for Native peoples. In this module, students will use maps and other materials to examine the location of Native American settlements in relation to natural resources that provided goods for exchange between Native communities. Students also will explore the negative and deadly effect of European diseases upon Native Americans.
- **Legacies.** Native American interactions with colonial Europeans provided enduring legacies, preserved not only in historical documents, but also in the land and among its modern inhabitants. These legacies contribute to the value of historical knowledge in modern society. Students will be able to explore ways in which colonial-era relations between Native Americans and Europeans contributed to the shape of the land and society in the Lower Mississippi Valley today.

Review and Production

The project will be reviewed by an advisory board representing various specialties, including computer-assisted learning, foreign language learning, software development, secondary education, and humanities, as well as representatives from Native American communities. The software will be developed using Macromedia Authorware® and Director®, and will be compatible with both Macintosh and Windows platforms. It will be available on CD-ROM and over the Internet; we will provide supporting material and teacher training to enhance use of the software. Interested readers can view the evolving progress of software development at the following Web site: <www.uark.edu /depts /contact>.

We envision a product that will provide instructors on several educational levels with an exciting means to use computer technology to teach across the curriculum and to engage students in the process of learning. In doing so, we hope students will discover the value of primary sources in the archeological and historical record, enjoy learning a foreign language or learning about the past, and ultimately apply these new-found skills to life-long learning.



An Osage Indian creation story

An excerpt of an Osage creation story is illustrated with original art by Charles Banks Wilson.

Screen captures by the authors.

Mary L. Kwas <mkwas@comp.uark.edu> is a Research Assistant with the Arkansas Archeological Survey; she is administrator for the project.

George Sabo III is an archeologist with the Arkansas Archeological Survey and Professor of Anthropology at the University of Arkansas. He is writing the English-language tract.

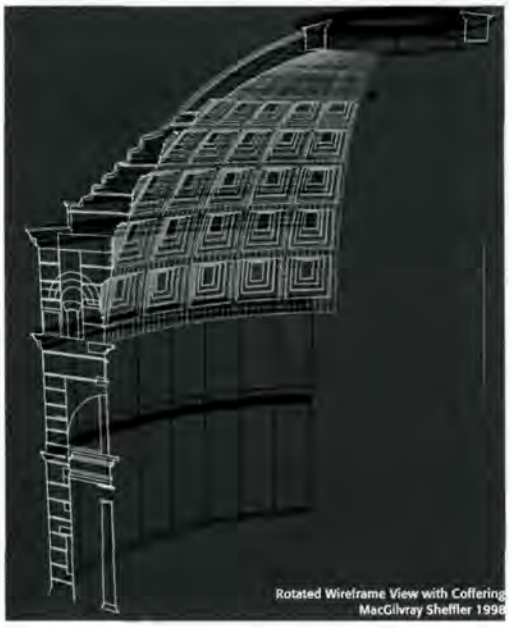
Daniel F. MacGilvray and William F. Sheffler

Visualizing the Construction of Hadrian's Pantheon

Visual material for teaching architectural history has typically been limited to photographs, drawings and slides. Until recently, the same visual materials have been used to teach the history of construction. Unlike the study of architectural history, however, the primary purpose of which is to understand the completed static object, the study of construction history requires the student to understand a dynamic process in which raw materials are first transformed into finished products which are then assembled in a systematic way to form a complex structure. Computer visualization and animation are not merely alternatives to slides and photographs but are an improvement: the dynamic processes of construction can be better illustrated with the dynamic imagery of computer animation. Many of the most interesting phases of the construction process are temporary and are dismantled and removed prior to project completion. Similarly, many important construction details, fastenings, and bracing systems are hidden behind the finished surfaces of the completed structure.

This paper describes a computer-animated visualization of the construction of the Pantheon, built by the Roman Emperor Hadrian in the second century AD. The Pantheon is relatively simple geometrically (a hemispherical dome on a round drum, with a pedimented pronaos), but is quite complex in its structure and construction. The builders used the most sophisticated construction materials and machines for its time, including elaborate scaffolding, centering and hoists, and combinations of Roman concrete and brick in a composite construction system.

Rotated wire-frame view with coffering.

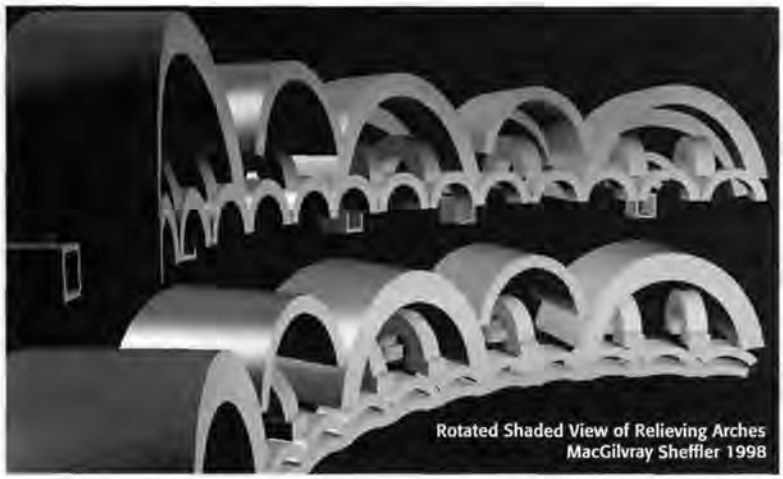


In documenting the dimensions and basic geometry of the Pantheon we were frustrated because most references contained only non-quantitative, descriptive written material illustrated with photographs, and not very useful for our purposes. Plan and elevation drawings lacked dimensions or graphic scales; there were contradictions and inconsistencies in many of the materials we did find. The most useful reference was *The Rotunda in Rome: A Study of Hadrian's Pantheon by Kjeld de Fine Licht*[1] which is an exhaustive work, complete with excellent drawings, descriptive text, and detailed dimensions. We relied primarily on De Fine Licht's drawings to establish the basic geometry and dimensions of the computer model. Large scale images of the plan and sections were scanned, as well as detail drawings of such things as entablatures and column bases.

Next, the two-dimensional images were rotoscoped into the computer to produce a three-dimensional volume. This was accomplished in Alias Studio® by importing an image plane into a window and tracing over the image with the straight lines and curves necessary to create an accurate model. This step was difficult; we needed to create a model with correct internal structure, rather than just a superficial façade . Since the construction of the Pantheon will next be animated in chronological steps, the model had to be designed such that it can be "sectioned" to illustrate the additive construction process. This was the point at which we learned the true structural complexity of the building!

It was necessary to create a detailed model that could be shown in high resolution images. To accomplish this, the model was built as a series of skins reflecting the parts of the geometry that would be seen during various camera moves. There are, for example, separate skins for the interior and the exterior of the structure. Thus, the computer will be required to render as little geometry as is needed to present to the camera the required complexity and form. Even so, some of the computer files are quite large; we divided the structure into parts to be composited in the final production.

In order to show the construction of the Pantheon in chronological sequence, it will be necessary to dissect the model into horizontal bands and/or vertical segments. This will be done using constructive solid geometry (CSG).[2] With this tool, negative volumes can be subtracted from positive



Rotated shaded view of relieving arches.

volumes to model such detail as the dome coffering. A separate model of the structural relieving arches was also made in sufficient detail to eventually show the placement of the centering and each brick making up the arch.

The granite columns and marble bases of the portico were modeled using rotoscoped curved lines taken from De Fine Licht. Rotoscoping around the z-axis allowed the incorporation of the complex torus curves of the base as well as the subtle entasis of the columns. The wooden trussed structure spanning the porch was modeled using simple parallelepipeds to define each structural member. The most complex part of the modeling was the coffering. For each of the coffers, three or four[3] unique parallelepipeds were created and deformed to allow for the curvature of the dome in each of two axes and non-parallel (radial) sides in the third axis. They were then united and subtracted from the dome volume. In order to model the hollow parts of the dome's interior structure, we decided to create them as positive volume (diagrammatically) CSG components; this also will allow them to be subtracted from the model for use in the modular animation.

Digital images by the authors.

The project is being developed in Alias Studio®, a premier modeling and animation package, on Silicon Graphic® (SGI) workstations, typically an R5000 or O2. Alias® is a NURBS-based[4] surface modeler with advanced ray-tracing, particle systems, hair generation, and non-photo realistic effects. Render times per frame are expected to be 20-30 minutes. This is a work in progress; the essential geometry has been completed, but computer modeling of specific details (i.e., column capitals), construction operations, and surface treatments continues. It is our intention to test the didactic value of the finished product with students of architectural and building construction history. A text describing the development of the Campus Martius, the earlier Pantheon of Agrippa and surrounding buildings, and the construction of Hadrian's Pantheon from foundation to occulus has been written and will be used to narrate a video that will present still images (maps, drawings, etc.), computer-animated construction operations, and a Quicktime Video™ interior spatial panorama.

Construction operations will be illustrated by cutting sections from the computer macro-model to isolate specific details, adding such things as construction centering and lifting devices, or by animating the placement of individual bricks or stones, or the raising of columns. Students viewing the video will be tested on the material and their results compared with a control group of students hearing the same narrative, but presented only with traditional two-dimensional images.

It is our thesis that the students who view the video will demonstrate an increased understanding of the construction process, thus suggesting the further incorporation of this technology into the teaching of that subject. Applications for the teaching of historical construction techniques from more recent periods or the understanding of complex historical structures are numerous. For example, the design complexities and changes over the years of such structures as St. Peters or the United States Capitol could be clearly visualized. The construction of large, complex structures, especially those that have a great deal of modularity like the Crystal Palace or the World Trade Center, could be modeled and visualized. Finally, the reaction of historic structures to physical forces (gravity, wind, earthquakes) could be modeled and studied. We also plan to make the products available for interactive viewing and learning on the Internet. For expanded text and additional illustrations, the interested reader can visit our Web site at <www.viz.tamu.edu/students/sheffler/pantheon/outline.html>.

Notes

1. Kjeld De Fine Licht, *The Rotunda in Rome: A Study of Hadrian's Pantheon* (Copenhagen: Jutland Archaeological Society, 1968).
2. CSG is based upon Boolean operators (union, subtraction, intersection) and volume principles.
3. The coffers in the first four rings have four indentations, in the fifth (uppermost) ring only three.
4. NURBS stands for Non-Uniform Rational B-Spline, a mathematical curve with C3 continuity from which patches/surfaces are generated.

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Deidre McCarthy

Applying GIS Technologies to CRM

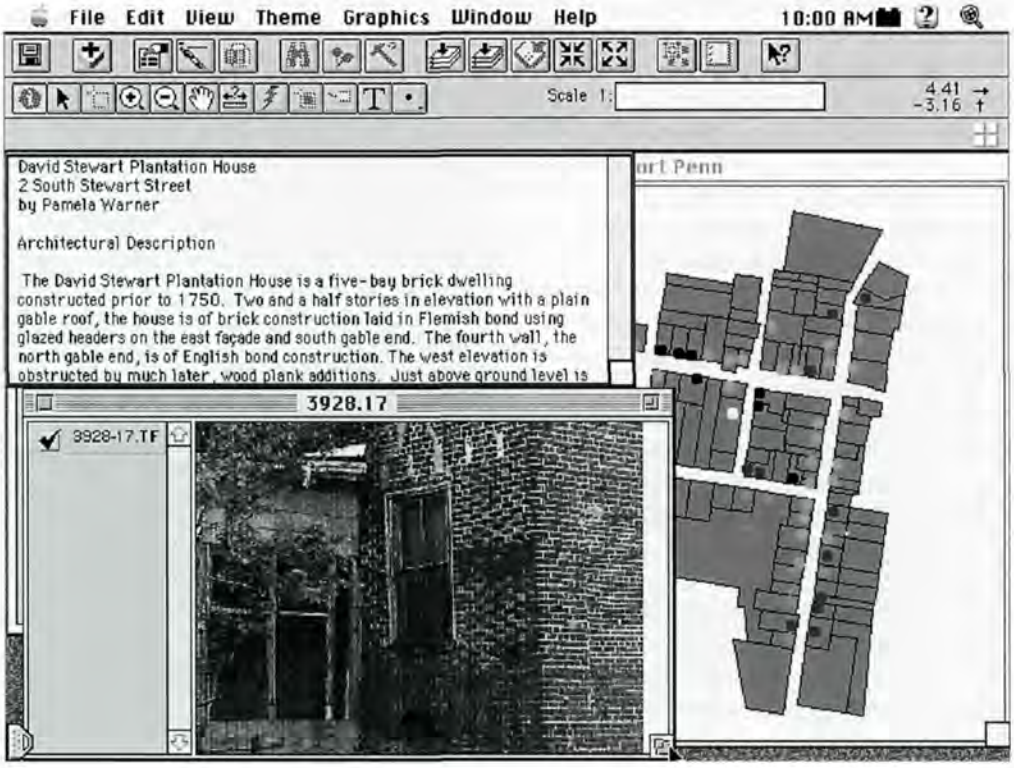
Over five million cultural resources are recorded on State and Tribal Historic Preservation Office (SHPO and THPO) inventories nationwide. These inventories serve as the major repository of cultural resource information for most preservation-related activities. SHPOs and THPOs, federal agencies, preservation professionals, and scholars increasingly use Geographic Information Systems (GIS) to access information and use these statewide inventories in new ways. The integration of maps, images, and descriptive information makes GIS technology a powerful and innovative tool for cultural resource management.

A GIS is hardware, software, and digital data combined to create an integrated and interactive mapping program. A GIS simply reflects the three-dimensional world in a series of map layers. Through this overlay technique, each data type or theme, such as topography, waterways, road networks, or cultural resources, is represented as a layer of data. Users can view each map layer individually or together producing a dynamic map controlled by the user. A database links to each theme adding dimension to the maps themselves and connecting individual map elements with their context or attributes. The power of GIS centers on the relationships created between map themes and attributes. This integration allows users to manipulate maps, run queries, or model future events. Users can quickly locate resources on maps based on a database query, or conversely, locate database information via a spatial query of map themes. This constantly changing and evolving mapping environment is unique to GIS.

One example of how GIS can be used to manage historic resources is a project completed in 1996 at the University of Delaware focusing on a National Register Historic District in Port Penn, New Castle County, Delaware. Planned and founded in 1764 by David Stewart, Port Penn's relatively small size and available documentation made it ideal for a GIS application illuminating its distinctive history.

A profile of the town was created in a GIS using ESRI's ArcView7®. Historic maps of Port Penn and building locations were overlaid to profile the town's growth. Digital versions of parcel maps from 1792, 1868, 1893, and 1995 show how the town's layout evolved. Within each parcel, an icon represents a structure in the district. National Register attribute information, as well as floor plans and photographs, link to each building; an architectural description, statement of significance, and chain of title are also indicated for each lot.

Other charts and tables provide an extensive picture of Port Penn through time. For example, information extrapolated from the GIS indicates that rates of building construction peaked between 1825-1850. It is known that, during this period, William Cleaver attempted to shift the commercial focus of Port Penn to his newly-constructed wharf. Maps of the period reflect this shift; new construction clustered near the water, dramatically changing the original town plan. Other trends, such as building functions, show simi-



The Port Penn, Delaware ArcView7® project, completed at the University of Delaware, Center for Historic Architecture and Engineering. Screen capture by the author.

lar shifts. Studies, based on National Register data, profile changing architectural trends reflected in building details and usage. Integrating this information into a GIS allows users to explore developmental changes at Port Penn. Because GIS allows the retrieval of a multitude of documents related to various themes, its value as a forum for multi-disciplinary research and planning cannot be overestimated.

Entire states can be profiled in GIS. MAPIT (Mapping and Preservation Inventory Tool), created by the National Park Service, is a GIS program created for SHPOs. With MAPIT, users can locate, inventory, and study a state's cultural resources. Similar to the Port Penn project, MAPIT links to databases, images, documents, and historic records, as well as extensive geographical data to provide as much information about each resource as possible. The MAPIT application is a customized version of ArcView7®. The pilot project, Virginia MAPIT, contains a state view; users can view and query cultural resources on a large scale to identify trends or distribution patterns. At the county view, cultural resources and their contexts are shown in detail emphasizing localized patterns and providing a preservation planning platform. Property view describes an individual site, linking to maps, documents, and images.

Each view reflects the SHPO organization containing specific functions for all seven program areas. Specific data is made available to update, edit, browse, or for analysis. In addition, a wealth of context information provides a more complete set of tools for either viewing or manipulating cultural resource data, such as digital quadrangle maps, census data, political boundaries, physical features, or shared data from other agencies. This format integrates the SHPO's archival resources; paper files and paper maps are joined making them easier to use.

The goal of the MAPIT project is to develop an effective and powerful GIS tool for SHPOs and THPOs. GIS technology presents many new possibilities for historic preservationists: the integration of data with easy access and querying capabilities will make our cultural resources more accessible, ultimately benefiting the public. Maintaining accurate and current information, shared with other governmental agencies across states and regions within a cultural resource GIS, will also lead to better planning and decision-making, and, ultimately, better cultural resource management.

Deidre McCarthy is GIS specialist on the MAPIT project for NCSHPO. MAPIT is being developed by Heritage Preservation Services, Branch of Mapping and Information Technologies, National Park Service. For more information contact the author: 202-343-9548, or <deidre_mccarthy@nps.gov>.

Portable Non-Contact 3D Scanner

The ShapeWorks™ scanner is useful for imaging archeological sites and artifacts. Carvings, pits, and objects can be easily and quickly scanned in the field with a portable version of the scanner. Vitana Corporation manufactures and markets this non-contact 3D scanner for modeling, reverse engineering, and archival applications. ShapeWorks™ is a complete hardware and software solution that includes digitizer, motion platform, PC, and software to scan, align, merge, and edit complex objects. The InSight sensor is made in four different versions with varying depths of field and accuracies from a 3 inch Depth of Field (DOF) to a large sensor with a 52 inch DOF; all are mountable on a panning motion platform that rotates up to 315 degrees. ShapeWorks™ acquires 3D XYZ points in inches or mm at a rate of 15,000 per second. 3D files can be exported in many different formats from plain XYZ point clouds to WRL and DXF files. 3D editing and compression software is included. More information can be found at: <www.vitana.com/shapeworks/index.html>.

Tom Schoenhofer
Vitana Corporation

Scan of a bas-relief cast lead decoration with 49,000 valid 3D points. Digital image courtesy of Vitana Corp.

Susan E. Lassell

Space, Time, and Technology
Incorporating Time into GIS

The framework for creating a Temporal Geographic Information System (TGIS) has existed since the 1980s* The major stumbling block in adopting this technology has been limitations on the power and storage capacity of computers. However, we are very close to achieving the necessary computing power. Thus, the challenge is threefold: to understand the differences between merely storing out-dated data and the storage of data histories for automated spatio-temporal analysis; to identify the basic elements of temporality in planning data and how they relate to a revised form of analysis for decision-making; and, to focus on long-term effectiveness during the planning stage of implementing a TGIS. This article presents an applied framework for the use of TGIS in urban and regional planning. TGIS technology allows true spatio-temporal analysis, incorporating historic trends into the basis for decision-making. As CRM professionals, we can play a vital role in identifying the methods and applications for TGIS.

The role of information in planning is to support problem solving by helping the planner locate, evaluate, and analyze relevant data in order to identify a range of solutions. The goal is to make data analysis meaningful, to turn data into information about trends, preferences, development patterns, or the locations of economic changes. GIS has helped planners get part way there. When census data was merely a report and a map, it was difficult to compare these findings with zoning, commercial real estate values, or other relevant data. GIS allows planners to compare the current state of a community on any given level, from a single property block to entire jurisdictions, with any custom combination of data types.

Planners like GIS because its information can be used to plan for the future of their communities. What they fail to recognize is that this analysis lacks temporal depth. We know how things are today, but can we really plan for the future without knowing the social, economic, and physical trends of the community? Common sense and previous planning disasters tell us we can't. Just as planning departments need preservation planners to help make the connection between heritage and development, planners need GIS tools that facilitate information analysis of both current and non-current data.

The structure of GIS facilitates flexibility in data management and information analysis by providing links between three types of data that describe entities: spatial location, descriptive attributes, and temporal existence. Time-series data involves capturing the contents of the entire database at regular intervals regardless of the degree of changed data. This results in the perceived frequency of change being dependent upon an external measurement of time rather than on the rate of change inherent to the subject of the data. Time-encoded data are typically stored in a separate database once they have become non-current, thus becoming unique and separate entities rather than retaining their association with the subject of the data. In current GIS, time is typically the fixed element, but is rarely the controlled or measured element. TGIS allows each of the three data types (spatial, temporal, attribute) to be fixed to a specified value, controlled to a range of values, and measured, depending upon the query.

To both control and measure the temporal element acknowledges that each entity exists in time, as well as in space. This temporal existence is measured by events that in some way alter the entity. In a TGIS there are three principle types of data stored to describe an entity: states, which are comprised of the features and attributes traditionally considered as geographic information (in a temporal GIS different versions of features would be stored, viewed, and analyzed); events, which are the occurrences that cause one state to change to another, creating a chain of versions for a given feature; and, evidence, which is the source documentation notifying the user that an event has occurred or that a new state now exists. Examples of states include topography, districts, parcel and building boundaries, streets, open space, hydrology, and vegetation. Events include zoning hearings, determinations of eligibility, transactions, construction projects, natural disasters, and public improvements. Evidence includes deeds, nominations, building permits and inspections, property assessments, and cultural resource surveys.

In a TGIS the state of the temporal map at any one time consists of the vertical compilation of object versions. Each object goes through mutations due to external events. An event may affect more than one object, but does not necessarily affect all objects. Data histories can be considered the string of mutations and versions that describe an object. Community histories would be the string of overall map states. The capacity to establish relationship links between evidence and events, and between events and states allows TGIS to integrate non-current data for immediate and complex spatio-temporal queries. Common query types

include concentration, connectiveness, contiguity, description, measurement, and propinquity.

A hypothetical application for this type of spatio-temporal analysis requires us to assume that a community implemented a TGIS at the beginning of the century, and has been storing the states, events, and evidence of the physical environment through today. Suppose this community wanted to determine the retirement rate of buildings in order to identify potential areas of blight or opportunities for new construction. To determine the retirement rate of the building stock, the analyst needs access to all building permits to establish a sample period, typically spanning between 15 and 30 years. From these permits, the analyst extracts the demolition permits and the construction date of these buildings, and determines the life span of each building. The mean average of these life spans represents the retirement. With the accumulated data in the TGIS, planners could determine the retirement rates in various districts, compare the differences in those rates, and conduct analysis on the events and evidence in those areas to determine causal trends for variances in rates. When building demolitions are viewed in this manner, relative to the entire building stock rather than as isolated events, it becomes clear that encouraging maintenance to support natural life spans would be more productive than attempting to prevent building abandonment. So, the TGIS helped prove the soundness of a preservation strategy for the community.

The potential uses of a TGIS in CRM are numerous and only limited by our hesitation to adopt this technology. The preservation planning goals of a community are more likely to succeed if a TGIS operates in tandem with its planning department and other decision-making institutions. This is due to the fact that TGIS models historic trends, while processing other data types. CRM professionals are, inherently, experts in temporal analysis, and therefore have an opportunity to shape the outcome of this emerging technology.

Note

* Gail Langran, *Time in Geographic Information Systems.* Diss. University of Washington, Seattle, 1989. (Ann Arbor: UMI, 1989. 9000269).

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Visiting National Register Sites on the Web

Interested in touring historic places in some of America's greatest cities, or following the path of the Underground Railroad? Now you can take these trips without leaving your office or home when you visit the National Park Service's National Register of Historic Places Web site and check out Discover our Shared Heritage—a series of National Register online travel itineraries.

Cosponsored by the National Park Service and the National Conference of State Historic Preservation Officers, the itineraries help travelers plan trips that link a variety of historic places from National Parks, to National Historic Landmarks, to state and locally significant historic resources. Each itinerary consists of a self-guided tour which includes a brief historical essay and a description of each place's significance in American history, architecture, archeology, engineering, and culture. The itineraries provide visually stimulating maps, photographs, locational information, and links to other Web sites where visitors can get information about the cities. The itineraries and maps can be printed from the Web site so that the public can use them while touring.

Site featured in "Destination Detroit," one of the National Register of Historic Places online travel itineraries.

Currently available online are travel itineraries for the Georgia-Florida Coast, Baltimore, Chicago, Seattle, Detroit, and sites associated with the Underground Railroad. Additional geographic and thematic itineraries are in development. You can learn more about the National Register of Historic Places and take these tours by visiting the National Register's homepage at: <www.cr.nps.gov/nr>.

Patrick Andrus
National Register

David W. Lowe and Bonnie A. Burns

Using GPS and GIS to Create a Historic Base Map

Petersburg National Battlefield (PNB) was authorized in 1926 "to commemorate the campaign and siege and defense of Petersburg, Virginia in 1864 and 1865 and to preserve for historical purposes the breastworks, earthworks, walls, or other defenses or shelters used by the armies therein." At 2,744 acres in several discrete units, PNB occupies a fraction of the land fought over during the siege. Only four of the 18 significant battles that took place in and around Petersburg fall within the park. To fulfill its mission of protecting resources and interpreting history, the park must continually reach out to the surrounding community.

PNB is working on a new General Management Plan (GMP) that will highlight the interdependence of the park and its surrounding community. The GMP will provide a blueprint for managing the park's resources over the next 15 years and will consider ways to encourage the community to preserve and provide access to significant sites outside park boundaries. As part of the GMP process, cultural parks are required to produce a historic base map detailing the landscape during its period of significance.

A traditional base map is a paper document that shows the historic landscape for the area inside park boundaries. If a park has been diligent, the base map will include scaled transparencies indicating modern roads, structures, or wetlands. Often, comparing past and present landscapes becomes a matter of holding up a topographical quadrangle while estimating the location of certain structures. If nearby landowners call to ask about resources located on their property, it becomes a job for a historian who refers to a different set of maps altogether. It is not an efficient process.

The Cultural Resources GIS Facility (CRGIS) of the National Park Service (NPS) is working with PNB to produce a new type of historic base map. The new map will differ from the park's earlier mapping efforts in several ways. It combines layers of historic and modern information to enable ready comparison between what was and what is at any scale. It can be readily updated to keep pace with changing land use patterns. It allows the park to generate thematic paper maps addressing issues of compliance. And, most importantly for the Petersburg community, it transcends park boundaries to encompass the entire historic landscape.

For Petersburg, we were fortunate to have one of the most accurate and detailed maps produced by topographical engineers during the Civil War. The engineers of the Army of the Potomac, under the direction of Colonel Nathaniel Michler, began mapping Petersburg in 1864, during the siege of the city. By the time they were finished in 1865, they had mapped an area of more than 127 square miles at a scale of 8 inches to the mile (1:792). This map, completed in eight sheets, shows the road network, ground cover, and entrenched Federal and Confederate lines in considerable detail. More than 3,500 structures are depicted, many labeled with residents' names. The Michler Map's scale and resolution made it ideal for our purposes.

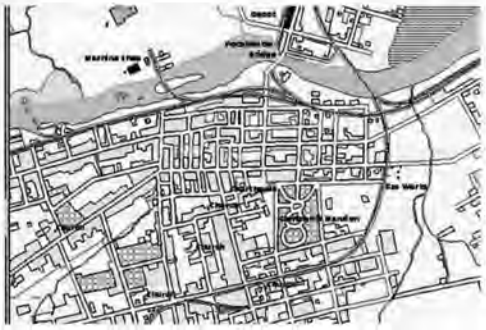
We acquired digital images (TIF files) of the eight Michler map sheets through the National Archives and Records Administration and transferred these images into ArcInfo® geographic information systems (GIS) software. At this stage, the map sheets were images without spatial attributes. To be useful in a GIS, images must be assigned real-world coordinates (longitude-latitude). This process is called georeferencing.

To georeference the images, we combined research with modern technologies. Features depicted on each map image were inventoried. The transportation network was compared to modern maps to determine which roads and intersections appeared historic. We consulted with park and local historians to identify which earthworks shown on the Michler Map survived and could be visited. Our list of surviving resources expanded to include ante-bellum structures in the Virginia state register. We identified about 200 possible points of congruence between our map images and the real world.

Two mapping crews set-out to collect coordinates for the identified points using global positioning systems (GPS). GPS units use satellite signals to pinpoint and map locations with an accuracy of +/- 1 meter. Over three days, crews logged about 450 miles and recorded nearly 120 points. These points were loaded into the ArcInfo® pro-

gram. Each surviving feature depicted on an image was assigned the coordinates collected for that location in the field. The map images were then warped, that is, stretched by ArcInfo® to generate "best-fit" coordinates for every location on the map image.

Not every registration point collected proved reliable. For example, a few GPS points were collected in the general vicinity where houses in the state files had since been demolished and built over. Some road intersections were misplaced because roads had been realigned. In other cases, the historic maps proved erroneous. The initial fit, however, was good enough that most of the erroneous points were readily identifiable. The best registration points were kept; others were discarded until features across the map sheets fell within about 20 meters of their corresponding GPS registration point. The georeferenced map sheets were displayed on-screen with modern USGS data. Historic roads and railroads were found to be largely congruent with modern ones. The dense street grid of Petersburg fell into place. Earthworks ran along appropriate contour intervals with batteries holding the high ground. The overall fit of the historic map sheets with modern data was within expected tolerances of +/- 40 meters. Each map sheet was displayed in ArcInfo®; features were traced to create digital data layers for roads, railroads, earthworks, structure sites, and land cover. Digital layers were labeled according to the map's legend.



Downtown Petersburg in digital format. Separating the data into different layers makes the historic map easier to read and allows analysis of land use patterns. Within wartime Petersburg, besieged inhabitants cultivated 327 acres behind and between buildings.

Downtown Petersburg in 1865 from the Civil War-era Michler Map.

As of this writing, five of the eight map sheets are completed and interesting statistics have begun to emerge. Each sheet displays 12.3 square miles of historic land cover. Before the armies arrived, the proportion of cleared ground to forest was roughly equal. The contending armies altered this balance, clear-cutting 22% of the woodlands (4,400 acres), primarily to create open fields of fire for artillery. This gives some sense of the immense ecological impact of the armies on the landscape during the 292-day siege. The enormity of the trench system becomes more tangible: Confederate defenses extended for 11.7 miles from the Appomattox River while opposing Federal siege lines extended 13.8 miles. Some earthwork lines are quite dense with multiple trenches and excavated approaches. The total length of all earthworks depicted on the five completed map sheets has reached 127.4 miles. Considering that many of these trenches were more than 10 feet wide and deep, this was a mammoth public works project by any measure!

The completed base map will not hang on the wall but function on a desktop. The park will use a low-cost GIS program to view and manipulate data layers and to customize and print thematic maps. Historic map layers or map images can be viewed atop digital USGS topographical quadrangles on CD-ROM. Data layers from a wide range of sources (park boundaries, earthworks mapped with GPS, National Register listings) have been included in the database. The database will continue to grow; historians can add troop movements and resource managers can add vegetation from aerial photographs. Because every point on the historic map corresponds to a real world location, researchers can query the coordinates for a house site or an earthwork, enter the coordinates into their GPS unit, navigate to that location, map what survives, and enter the information back into the database.

PNB will use the computerized historic base map to develop its GMP, but use of the information will not stop there. Information will be shared with city and county planners, particularly as parcels containing historic resources are rezoned. Perhaps it will be demonstrated by printing out a timely map, that preserving history is sometimes as simple as moving a proposed development a few hundred yards down the road. Overall, the park will be in a better position to respond to the many queries originating outside its boundaries and it may become a more responsive partner in the effort to preserve historic resources.

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Digital images by the authors.

Mitchell Hearns Bishop, Christopher Gray, and Gaetano Palumbo

New Documentation Technologies at the Getty Conservation Institute

Documentation detail, "America Tropical" mural by David Alfaro Siqueiros (Los Angeles, 1932). Photo by Leslie Rainer, courtesy the J. Paul Getty Trust.

For a number of years, the Getty Conservation Institute (GCI), a program of the J. Paul Getty Trust, has been involved in developing new systems for documenting its conservation work. Initially, digital forms of documentation were experimental systems in a research context. The success of these systems and collaborative work with other institutions has led to the beginning of their adoption for the routine documentation of GCI's projects.

Graphic documentation can be an effective tool for the diagnosis of damage to cultural property. The recording of damage types, degree, and extent can aid conservators in the diagnostic process and in preparing a conservation project. Moreover, the documentation process should become the essential element in diagnosing the state of the monument and planning the conservation project.

There is an important difference between traditional graphic documentation and computer documentation. To justify the added expense of digital documentation systems, one must extract some form of added value from the system. Typically, this takes two forms: first, we are able to capture a deeper level of information which can be dynamically accessed. Software makes it possible to elucidate relationships not readily apparent in static graphic documentation. An example of this is simple quantification of characteristic areas documented: areas of loss, linear dimensions of cracks, etc. A more profound understanding can be derived in geographic information system (GIS) software which can extrapolate significant relationships among recorded features, such as those between paint loss in a wall painting and areas of moisture, as well as the quantifications possible with CAD software.

The second form of added value is the ease of viewing and presentation afforded by digital systems. Since buildings, objects, and sites are recorded via software in their actual size and printed to scale, a radical leap in understanding the documentation can be achieved. Traditional graphic documentation removes the viewer from what is being documented—documenting the object at its original scale is a faithful spatial description of what is documented.

Data can easily be manipulated in 3D programs, draped with surfaces, and turned into virtual reality depictions. It is inherently easier to understand something from viewing this kind of presentation as opposed to stacks of drawings, photographs, and overlays found in the traditional documentation system. Also, these depictions can be disseminated electronically. The world of cultural heritage has been slow to adopt this technology for a number of reasons. To understand this we need to review the aims of traditional conservation documentation and the perspective of the conservator doing documentation.

Aims of Graphic Documentation

The objective of graphic documentation is to describe the state of conservation of a monument in order to create a baseline for analysis and diagnosis of the causes of deterioration. Further, it also serves to document conservation interventions and to function as a monitoring tool. The system we envision is computer-based, for several reasons. First, the model obtained can be reproduced in infinite originals and at scales selected by the operator; the object, whatever its size, is stored as a 1:1 model and can be displayed and analyzed in its entirety, with thematic maps. Second, significant relationships between classes of information and precise calculations of real extents can only be retrieved with the help of a computerized system. Third, the various categories of information composing the documentation record can be better organized, managed, and controlled using a computer-based management system. The use of information technology can help realize the primary goal of documentation: reproducibility and ability to be shared. Many, if not all, of these tasks are impossible using traditional graphic documentation.

One of the barriers to the adoption of digital conservation documentation has been the steep learning curve for training conservators in such systems. Working with a colleague, Giancarlo Buzzanca, at the Istituto Centrale per il Restauro (ICR) in Rome, we have developed, tested, and implemented an easy-to-use AutoCAD® menu system. Buzzanca has spent several years developing a CAD interface allowing conservators unfamiliar with computers and CAD to directly input condition information. We have found that a simple user interface customized for the project can manage most of AutoCAD's® complex functions. We have also found that menu customization builds a bridge between the average user and complex vector-based systems. These systems are important because they are becoming standard in fields requiring spatial documentation. Complex databases, images, sound, and video files can be spatially-referenced using specialized software.

This means that the system can become the foundation of an interactive archive and management tool for a project. This is our second field of investigation, which aims at building a modular system of data management in which all classes of information can be closely related. The modules are managed by a spatially-referenced software system: a query to a certain physical point can recall graphic, photographic, textual, and analytical information in database form. This allows the data to be viewed and presented in context; it also presents data in relationship to other relevant data, making it a perfect planning and management tool. For example, if a building has been thoroughly documented and is being monitored, an intervening problem can immediately be viewed in the context of previous interventions, materials introduced, environmental data, and condition history.

Test Sites: Laetoli and "America Tropical"

An image of the Laetoli project appears on page 4.

We are currently in the process of developing a pilot modular information management system (IMS) using data obtained from the Laetoli hominid footprint site in Tanzania. The site consists of a tuff layer bearing a series of well-preserved footprints of three *Australopithecus afarensis* individuals and various animal, insect, and plant impressions. This 3.5 million-year-old-site was discovered by Mary Leakey in 1979, and reburied after investigation. As part of the conservation intervention, Heinz Rüther of the University of Cape Town, South Africa, made a photogrammetric recording of the site. The 1 mm contour digital topographic model of the site is accompanied by a wide range of data, from handwritten site notes to digital photographs, including traditional graphic condition documentation of each footprint. The IMS will allow the user to query each footprint and retrieve related data regardless of its original format.

"America Tropical," a mural by David Alfaro Siqueiros in downtown Los Angeles, was painted in 1932 and immediately whitewashed due to its strong political content. The site was abandoned and is badly deteriorated. We documented the mural using high-resolution digital photographs and collected digital graphic condition documentation obtained on-site using laptop computers equipped with a customized version of AutoCAD® designed by Buzzanca and the conservators. The software enabled the conservators to draw directly on digital images. This precise spatial document will serve as a basis for future treatment plans and for monitoring the mural's condition.

Future Directions

The development of a comprehensive digital information management system should begin in the planning stage of a project. Usually, the decision to begin the IMS is mid-way or at the conclusion of a project. This is unfortunate because setting up a system at the feasibility stage of a project can be a valuable tool in the design, planning, and management of a project. A hypothetical example is a project currently in development at the GCI, involving the development of management plans for a series of archeological sites in five Central American countries. The variety of geographical, environmental, cultural, economic, and social data necessary to collect and organize in order to build baseline documentation requires complex data management systems which can only be computer-based. Assembling a body of data of this scale at the beginning of a project and using it for project planning and management is an important new undertaking for the GCI.

Conclusion

Public outreach and publication of project activity and results are becoming increasingly important for the GCI and other organizations dedicated to the preservation of cultural heritage. The worldwide threat faced by cultural heritage resources makes it imperative that we speak directly to the public. Information management systems of the type we are developing better fulfill the ethical and technical requirements of conservation documentation; they can be disseminated to the public via multimedia, the Internet, and traditional publication venues. Hopefully, public access to information will be facilitated by these tools, leading to greater awareness of the cultural patrimony, and of the activities of individuals and institutions working to preserve it.

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Richard Burt

Using Computer-Generated Images at Fort Davis National Historic Site

Fort Davis National Historic Site contains a number of adobe wall ruins that are slowly eroding back to the earth. This is true despite past preservation techniques, such as epoxy spraying and the addition of soil cement adobe caps and veneers. The National Park Service identified this widespread problem in the Vanishing Treasures Initiative. This initiative seeks to secure federal funds to implement a 10-year program to improve the preservation of prehistoric and historic ruins in 41 national parks located in six states.

The current method of identifying erosion occurring to adobe walls at Fort Davis is by annual inspections carried out by the park's maintenance staff. This inspection method relies on the qualitative assessment of the individual inspector. Quantitative information is not provided; therefore, accurate comparisons cannot be made on the condition of the wall from year to year. In order to analyze the condition of an adobe wall ruin effectively on a consistent basis, the amount of erosion occurring to the adobe over time has to be measured and quantified. The issues addressed in this paper are a methodology for measuring the amount of erosion and the representation of the erosion using computer-generated images.

The Measuring Technique

In June 1993 and August 1997, the North wall of the Forage House (HB39) was measured to obtain the Cartesian X, Y, and Z coordinates for points on the adobe surface of the wall. Depth measurements were taken at six-inch vertical and horizontal centers to produce a six-inch square grid representing the surface of each side of the wall. Notes were made if the measurement was to bare adobe, stabilized block or veneer, or to cement mortar patching. Simple measurement equipment and techniques were used such as horizontal level lines, vertical plumb lines, and rulers for the measurement of depth offsets.

The initial intention was to use the measurements to quantify and represent the total volumetric loss for the whole wall over a four-year period and the amount of erosion occurring to each side of the wall on a point-by-point basis over a four-year period. There is, however, a problem with the calculation of the erosion on a point-by-point basis: the measurement method relies on the use of temporary datum lines established from points on the wall. The depth measurements relied on a datum line established from points on the top of the wall. An apparent outward lean to the wall was noted and this caused a difference between the position of the 1993 and 1997 datum lines. This anomaly caused the depth measurements to be erroneous. This finding meant that the amount of erosion occurring on each side of the wall on a point-by-point basis is not capable of quantification. The total volumetric loss of the wall is not, however, affected by this finding. A point-by-point comparison is made to illustrate a method to model erosion, even though there is concern about the reliability of the depth measurements.

Three-dimensional Images

A three-dimensional image of the adobe core of the wall is produced using AutoCAD® Release 13 by linking together several 3D meshes, with each mesh representing part of the surface of the wall. Each mesh is created using the Cartesian

Left, three-dimensional model of erosion greater than one-inch.

Right, three-dimensional solid model of the wall.

Forage House, Fort Davis National Historic Site (north elevation, north wall).

coordinates for points on the surface of the wall. To avoid having to enter each point individually, script files are created for each mesh based on the coordinate data from Excel® spreadsheets. This method reduces both drawing time and the risk of incorrectly entered coordinates. The 3D meshes, when placed together, produce a wire frame of the adobe core of the wall. This wire frame is then rendered to produce a 3D image of the wall. AutoCAD® does not identify this set of meshes as a solid model from which mass properties can be obtained; data about the volume of the wall could not be obtained by using AutoCAD® alone.

Three-dimensional Solid Modeling

In order to obtain data about the volume of the wall, computer-generated three-dimensional solid models of the wall measured in 1993 and 1997 are constructed. These models are produced using AutoCAD's Mechanical Desktop®. The process for creating the models occurs in the following stages: (1) create lofted surfaces for the internal and external surfaces of a section of the wall using the X, Y, and Z Coordinates; (2) use the lofted surfaces for the internal and external surfaces to cut an AutoCAD® solid box to produce a solid model of part of the wall; and, (3) join all the solid sections of the wall together to produce a three-dimensional solid model.

Images by the author.

A similar process is used to create a three-dimensional solid model of the erosion occurring to various depths. This is done by substituting the internal and external surfaces in the second stage of the process, for the external surfaces measured in 1993 and 1997 or the internal surfaces measured in 1997. By moving the 1993 surfaces by the depth of erosion required in the Z direction and repeating the process above, 3D solid models of the erosion occurring over a four-year period are obtained. The computer image shows erosion of greater than one inch to the external side; the top, bottom, and ends of the wall have been included for identification purposes. It is important to remember that some of the depth measurements are erroneous and are used to show how erosion can be three-dimensionally modeled.

Mass Properties of the Wall

AutoCAD® now recognizes the model as being solid. The mass properties command is used to obtain data about the volume of the wall. This is a summary of the results of this analysis: volume of 1993 wall equals 62,876 cubic inches; volume of 1997 wall equals 58,444 cubic inches; volumetric loss equals 4,432 cubic inches; and volumetric loss equals 7.05%. The two exposed surfaces equal 14,256 square inches. Average loss of width equals 0.62 inches over the 4-year period.

Conclusion

By obtaining the Cartesian coordinates of the surface of an eroded adobe wall, various three-dimensional graphical representations of the wall are produced using AutoCAD®. By using the AutoCAD® extension, a desktop computer produces solid models of the wall. These models are analyzed to provide data about the volume of the wall. By comparing models of the wall measured at different time intervals, the quantity and percentage of erosion are calculated. This data provides those charged with preserving these ruins with valuable information on which to make decisions about future preservation strategies. The problem of measurement still remains. Ongoing research at Texas A&M University's Historic Resources Imaging Laboratory is aimed at finding an economic and non-intrusive method for measuring adobe wall ruins in order to quantify the amount of erosion occurring over specific time periods using total station surveying together with computer-rectified photogrammetry.

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Guy R. Munsch

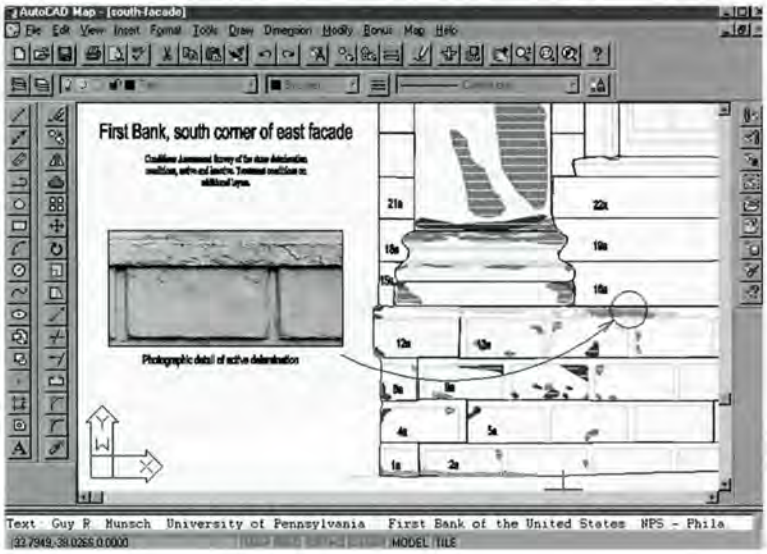
Reevaluating Success

The First Bank of the United States

As the nation prepared for the celebration of the Bicentennial in 1976, every effort was made to ensure that the city of Philadelphia and, in particular, Independence National Historical Park would be prepared to meet the expectations of millions of visitors. To that end, improvements and much needed preservation initiatives were completed at the park between 1974-76, including the conservation of the marble façade of the First Bank of the United States. That campaign, now almost a quarter of a century in passing, offers a unique barometer of the effectiveness of a range of treatment strategies and techniques over an extended period of time.

Written documentation at the time of the treatments and subsequent periodic reports provide an important record chronicling the alarming condition of the marble prior to treatment, as well as the rationale behind the techniques and materials used on the façade during the intervention. Nothing written is as informative as the surface of the stone as it exists today. Stone decay which has been, for the most part, stabilized for all these years, affords invaluable information on weathering and the effects of remedial and preventative treatments. Today, as these treatments begin to fail, deterioration conditions are again reappearing, now joined by new conditions that are as much a function of the treatments, as any natural decay properties attributed to the stone and the environment.

By combining the rendering capabilities of an architectural CAD program with GIS database analysis and photographic images, the digitized survey can be interpreted visually and quantitatively. Screen capture by the author.



Architectural conservators are increasingly faced with the prospect of working with buildings and sites that have previously been treated; the difficult questions in formulating a preservation plan become doubly so when one needs to account for physical properties of the original stone and of the previously treated materials. The sheer volume of information to be described and interpreted before recommendations, testing programs, and the development of a conservation strategy, can become overwhelming without the use of computer applications to manage critical information and to enhance visual and materials analysis.

Two key areas in the study of the First Bank have benefited from these technologies. First is the execution of a complete Conditions Assessment Survey of the façade to document the stone's condition and treatments at a given point in time and to allow precise monitoring of critical areas. Scaled, rectified 35mm photographs were taken of all surfaces of the façade , portico, and columns. Deterioration conditions for the marble and for the treatments in evidence were defined and recorded with a predetermined graphic lexicon of lines, symbols, and colors. This information was then transferred into a computer rendering program (AutoCAD® Release 14); the conditions were separated on different layers for the purpose of adapting the final drawings for specific analytical questions. Recently, GIS applications (AutoCAD® Map Release 2) have been tested which allow each stone or architectural element to be assigned to a database table enabling the researcher to query specific deterioration condition relationships while re-imaging the drawing.

The second focus has been on developing visual models of material and environmental conditions at the First Bank and their relationships to the weathering of the façade . Imaging and three-dimensional modeling programs (Photoshop 4.0®, 3D Studio Max®, and Macromedia Director®) can illustrate some of the processes of weathering and the effects of various interventions in a more accessible format. These new forms of visual analysis create an opportunity to more fully understand the history and future of a building or site and the integral role which an effective preservation plan can play in its future. This project can be viewed on the Web: <www.dolphin.upenn.edu/~guy2/index.html>.

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Maurice Luker

Columbia University's Multimedia Education Project

The Cathedral of Notre-Dame at Amiens

Begun about 1220 and located in the Picardy region north of Paris, the Cathedral of Notre-Dame at Amiens is one of the chief glories of Gothic architecture; its west façade comprises the most ambitious sculptural program of the Middle Ages. Dr. Stephen Murray of Columbia University has studied the building for over a decade and visitors to his World Wide Website on Amiens Cathedral at <www.learn.columbia.edu/Amiens.html> can explore one aspect of his work with his team of collaborators. Their broad aim is to engage a variety of media, from computer animation to digital panoramic images, in the study and interpretation of this historic monument. Support has come from the National Endowment for the Humanities (NEH) and the Samuel H. Kress Foundation, among others.

The Amiens Cathedral Web site provides easy access to hundreds of photographs and images, including historic maps and drawings, and texts in Latin or French with their English translations. A special feature permits users to explore all of the sculpture of the west façade and listen to the sculpture actually "speak" from a Biblical text or a contemporary sermon. This innovative technique has opened up an accessible way of identifying and learning about the extensive program of sculpture. It is possible to explore the interior of the cathedral using some 40 Quick Time Virtual Reality™ (QTVR) nodes or digital panoramic images.

Dr. Murray's book on Amiens has joined his previous monographs on the Gothic cathedrals of Beauvais and Troyes. Though his interest in media dates to an early film project on the Armenian capital of Ani, it was his film on Beauvais Cathedral, made as part of the Production Laboratory of the Program for Art on Film, that led him to think about the possibilities of animating a monument with a variety of media. His hope is that visitors to the Web site and to the cathedral itself will consider the creativity of the designers; the layering of the edifice in time and its structural behavior; the urban and social framework; and the multiple levels of meaning encoded in the cathedral.

Through the award of a Challenge Grant, the NEH has helped establish the Media Center for Art History to encourage other projects of this kind headed by Columbia University faculty. Participating scholars will challenge the accepted ways of teaching and publishing about art, while serving the most basic of academic pursuits: distilling ideas from fundamental research and presenting these in fresh and compelling ways to new students, professionals, and the public. The Andrew W. Mellon Foundation is backing Dr. Murray's next project on the Cathedral of Notre-Dame at Paris that will be conducted as part of a six-week seminar involving 15 college faculty from several institutions and disciplines.

Through the application of sophisticated Softimage™ digital modeling and animation, the Amiens project reveals how the great French cathedral is encoded as an image of Heaven, the way it was built, and why it nearly collapsed. Video technology lets users travel above and through the cathedral, examining all aspects of the architecture. Digital images, Trustees of Columbia University in the City of New York. All rights reserved.

Images from the Amiens Cathedral Project are also featured on the cover of this *CRM*.

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Ian Johnson

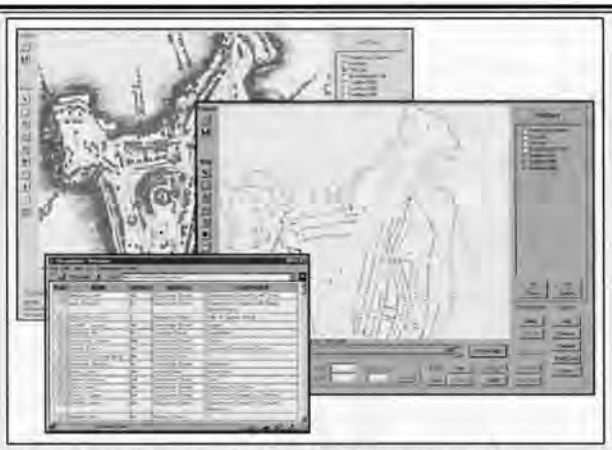
Interactive Time-Aware Interpretive Maps of Cultural Features

Adequate interpretation of historical sites or phenomena often requires the presentation of maps with a time component. This is often handled through sequences of maps showing, for example, an evolving landscape or the features of a site at particular periods. Alternative methods of showing time include symbols, color coding, or arrows. In some cases, one-off video animations or interactive computer applications are generated at considerable cost.

Developments in programmable mapping toolkits and delivery of information over the World Wide Web open up new possibilities for routine recording of cultural and natural features in time-aware databases and the display of interactive time-based maps using standard software. The TimeMap™ project of the Sydney University Archaeological Computing Laboratory aims to develop methods for recording and displaying cultural and natural map features which are dated and/or change through time. These include landscapes, cityscapes, historic sites, settlement distributions, site registers, and museum collections. The methods under development will be relevant to research, cultural resource management, and the development of interpretive materials.

The TimeMap™ project has several components:

- Development of simple recording protocols for collecting time-stamped data in conventional databases and desktop mapping systems such as MapInfo® or ArcView®. By defining a metadata standard, which interprets the content of the database to software wishing to access it, individual databases can follow their own standards while using a variety of software packages. Databases can be accessed without modification by creating an appropriate metadata table.
- Development of a time-aware desktop mapping interface, which allows a user to set specific time limits and see a map of features as they existed at that period. The software also allows the creation of subsets of data for public display from a wider research database. A later phase of the project will see development of a simplified public-access interface.
- Development of methods for temporal interpolation between observations, allowing morphing between known historical data using whatever is known about the intervening period to guide the morphing process. Interpolation of features not only allows creation of maps for points in time between known data, but also allows the generation of animation sequences to show a dynamic picture of temporal change, i.e. the building sequence of a historic site or the progress of a battle. These animations can be generated on-the-fly by end-users directly from the database.
- No serious interpretive application today can ignore the potential offered by the Internet. TimeMap™ uses the Internet in two ways: first, our software can be configured as a plug-in for a Web browser and downloaded across the Internet; and, second, and more importantly, the TimeMap™ application can access and superimpose data from multiple databases located on different servers around the globe. For example, it may superimpose datasets drawn from a number of museum catalogs onto maps drawn from a mapping agency data server. Maps and/or data can also be held locally on a CD or hard disk, allowing for distribution as stand-alone applications.



The TMView software interface showing a historic map of central Sydney, coastline change and data on early residents in the 1860s. Data for historic Sydney kindly provided by Wayne Mullen. Screen capture by the author.

A problem with many current Web-based mapping implementations is slow response. Large image-based maps are created on the server and then laboriously downloaded to the user's computer. TimeMap™ downloads relevant raw data and creates the map locally, so that zooming, querying, changing symbolism, etc., can be done almost instantaneously. Once the data is downloaded, the computer can be used as a stand-alone workstation.

Current application projects include mapping the rise and decline of Asian empires, "AsiaMap," and "Virtual Historic Sydney." We have developed the methodology and software for data collection, static maps, and local data access; we are working on access to remote datasets and in-line animation. We hope to release a test version for download from the Web and public comment in the first half of 1998.

Information on the project is available at: <www.archaeology.usyd.edu.au/research/time_map/>.

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Judith Bellafaire

The Women In Military Service For America Memorial Register

The Women In Military Service For America Memorial honors those women who have served in and with the Armed Forces of the United States starting with the American Revolution through the present day. The newly opened Memorial stands at the ceremonial entrance to Arlington National Cemetery. Inside, visitors can tour the exhibit gallery and view documentary films on the history of women in the U.S. military. Because we want to recognize each individual woman's service, we have placed women's names into a Computer Register. Visitors can use the Computer Register to access the names of some of the over 250,000 servicewomen who have registered with the Memorial Foundation to date.

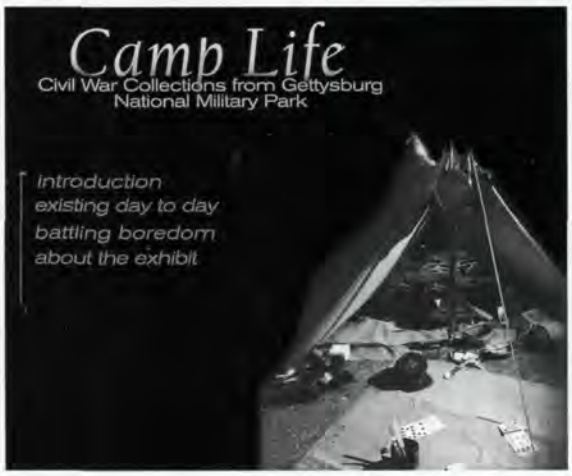
The Computer Register is often referred to as the "heart" of the Women's Memorial. Since 1987, active duty and reserve servicewomen, veterans, and the family members of these women have been registering at the Women In Military Service For America Memorial Foundation. A registration form, available from the Foundation (1-800-222-2294 or <wimsa@aol.com>) asks for information describing an individual's military service. Included are dates of military service, branch of service, highest rank achieved, birth and death dates, home town, medals and awards attained, and a narrative detailing "Memorable Military Experiences." Completed registration forms are entered into the database; print-outs of individual registrations are available at the Memorial for a minimal fee.

The Foundation estimates that more than 1.8 million women have served in or with the military in defense of the nation. The service records of women who served during the American Revolution, the Mexican-American War, the Civil War, and the Spanish-American War are currently being researched; although women did not serve in the military in these wars, they did work with the armed forces. When documentation of an individual's service is located, her name is entered into the database. Modern-era servicewomen are registered individually or by their families.

Women veterans and their families are thrilled that women's military service is finally being recognized. While women's service was sometimes fairly routine, it nonetheless frequently involved significant sacrifice. Women gave up comfortable lives in the home and/or better paying jobs in the civilian sector for the strict regimentation of military life. Women served without many of the military benefits taken for granted by men. Women served overseas, under fire, and in dangerous conditions. Many women were killed or died while in service to their country. The women veterans and their families who visit the Memorial feel overwhelmingly that "it's about time" women's military service is recognized by the nation they proudly served. And this history is made even more real through the power of the Memorial's Computer Register which is quickly becoming an emotional draw for many visitors seeking to learn more about their comrades and loved ones.

Judith Bellafaire is Curator of The Women In Military Service For America Memorial.

NPS works to preserve sites and objects associated with the nation's military history. An exhibit of museum objects from the Gettysburg National Historic Battlefield is featured at the NPS Web site (related article on p. 14). "Camp Life" Web site designed by Mark Oviatt.



H. Matthew Nowakowski

A Multimedia Visit to the White House

The highlight of my first visit to Washington, DC, was a tour of the White House. I visited the White House with other tourists under the watchful eyes of several Secret Service tour guides. When we entered the Red Room, I was awed by the intensity of the room's color. Our guide pointed to a portrait on the wall and challenged the assembly to correctly identify the subject. After several minutes, our guide was satisfied that no one knew the answer. He was about to identify the portrait when I blurted out, "John James Audubon." Of course I was right—I had thoroughly perused the official White House Guidebook prior to my tour.

It is now possible to discover whose portrait is hanging in almost any room, while touring the White House from the comfort of your home. "The White House is Our House: A CD-ROM Visit," a newly-released, multimedia, cross-platform CD-ROM program, takes users on a tour of the most famous home in America in vivid detail and at their own leisure. More than simply a tour, this content-rich program offers a real learning experience for anyone interested in our nation's history and culture.

"The White House is Our House" was produced by Autodesk® for The White House Historical Association in cooperation with the American Architectural Foundation. The program incorporates Quick Time Virtual Reality™ (QTVR) technology (navigable panoramic photography) enabling the visitor to "walk" through the White House as if taking a guided tour. Using a computer's cursor, you can pan up to view the cornice and chandeliers or down to see the intricate floor coverings. Unlike the real White House tour, the viewer can take his or her time moving through the mansion. And this tour permits access to areas usually denied visitors: the Oval Office, Cabinet Room, florist shop—even the presidential bowling alley. If a certain object or painting catches your fancy, you can click-on that "hot-spot" to get more information. The program is designed so the user can create a unique tour based on five pre-recorded themes, such as historic architecture or the lives of the First Ladies. In fact, the program is packed with information and history and includes more than 1,800 photos, 375 audio clips, and 50 video segments. This multimedia program is also a tool for teaching. Interactive activities are included; there is also a curriculum and Teacher's Resource Guide which accompanies the scholastic version of the CD-ROM.

Historians and museum professionals in America and around the world are realizing the value of multimedia as a way to provide greater access to historic sites and as a tool to reach new and diverse audiences. It may not be possible to truly replicate the visceral experiences associated with visiting a historical place. However, with the advent of virtual reality programs like "The White House is Our House," we have a close substitute for those people who, for whatever reason, are prevented from seeing and experiencing the "real thing."

Panoramic view of the Oval Office from "The White House is Our House." Image courtesy of the White House Historical Association and Mel Curtis.

Robert G. Whitlam

Invisible Datum
Using Electronic Marker Systems in Washington State

A major issue in effective cultural resource management is the efficient relocation of archeological sites. Once sites have been identified, subsequent protection efforts are based upon stable and secure data that can be unambiguously relocated. This past year, the Washington State Office of Archaeology and Historic Preservation, in cooperation with other federal, state, local, and tribal governments, implanted Electronic Marker Systems (EMS) markers at a variety of archeological site types in differing environments in Washington State. These sites have ongoing natural and human impacts; the goal of the project was to assess this technology for archeological applications.

The technology of EMS being employed in the field of underground utilities offers unique applications to archeological problems. Unlike surface stakes or data at a site, EMS are durable, passive markers that can be buried in auger holes, test pits, or trenches and have no visible surface presence that can be damaged or utilized by archeological vandals to locate sites. The underground utilities industry (including such fields as fiber optic, telephone, gas, water, sewer, and power) faces problems similar to those in the field of archeology. Like archeologists, they rely upon maps, dimensional measurements, GPS readings, and above-ground stakes and markers so they can, at some future date, revisit and relocate their buried facility. As often happens in archeology, the stakes and above-ground markers disappear, inaccuracies appear in maps, GPS readings are plus or minus, and construction changes are not reflected in as-built drawings.

Rick Bailey, Bureau of Land Management archeologist, holding a Ball Marker at a shell midden in Northern Puget Sound. Photo by the author.

In order to overcome these common problems and meet the need to efficiently relocate critical underground resources, EMS technology offers an elegant solution. EMS consists of a portable locator/transmitter unit that is a compact wearable box operated on standard "C" batteries. It is attached to a shaft-based disk that transmits signals to the buried marker. The heart of EMS technology is the locator which transmits a pulse at a given frequency—the buried marker is specifically set to respond to this signal. In effect, the buried marker is a passive antenna preset to respond to one frequency and no other. These markers have no internal power sources and are made with polyethylene shells which are impervious to the extremes of temperature, chemical, and mineral conditions found in underground environments. They come in several different types that reflect underground utility industry needs and have varying ranges within which the locator must be preset to pick up the return signal. Depending upon type of marker and depth of burial, the range is one to two meters. This technology is marketed by 3M® under the trade name Scotchmark Electronic Marker System™.

Last year, with funding from the National Center for Preservation Technology and Training (NCPTT) of the National Park Service, and in cooperation with a number of archeologists representing a wide range of agencies, missions, site types, and environments, we implanted EMS markers at several archeological sites. After a season or two of vegetation growth I relocated the implanted markers to evaluate the technology and to develop guidelines for its application to archeology. The site types were diverse: a coastal shell midden on the salt waters of Puget Sound; a large historic village site recorded by Lewis and Clark on the Columbia River; a rockshelter in the Cascade Mountains; and open lithic sites in the arid sagebrush of Eastern Washington. We were able to employ these cyberstakes in a variety of common archeological activities. At the outset we agreed to emphasize a conservation ethic. We planted the cyberstakes outside the site boundaries whenever possible or planted them in disturbed areas.

We used the two most common types of cyberstakes: the Near Surface Marker (about the size of an index finger) and the Ball Marker (about the size of a softball). Both can be carried in a vest or field pack. During survey activities, it is very easy to establish an auger hole and drop the ball marker in for a permanent, non-visible datum. You can use a near surface marker to mark shovel

probes or to mark an isolated find or formed artifact find that can then be overcovered. The cyberstakes were also employed to mark the location of test units and trenches for relocation and re-excavation in the future. We also established cyber lines and grids for erosion control points to monitor the long-term impacts of both coastal and riverine erosion.

As with any type of equipment or technology there is a learning curve: over the course of the project I developed skills that enabled me to quickly relocate an implanted cyberstake located in very dense vegetation. I was able to relocate the cyberstake in a manner that did not require disturbance of vegetation or excavation of soils. I was truly able to take electronic readings while leaving only footprints.

Cyberstakes can be a very useful tool for the archeologist to supplement the standard site form and GPS reading. It is a stable, invisible datum that can be quickly relocated without disturbing the immediate area and without leaving any above-ground trace. Finally, the use of a cyberstake is an important statement by the archeologist and the agency of their commitment to return.

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Acknowledgments

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I also greatly appreciate the support and efforts of the following archeologists in the field: Rick Bailey, Bureau of Land Management-Spokane District; Alex Bourdeau, U.S. Fish & Wildlife Service; Greg Cleveland, Yakama Indian Nation; Paul Gleeson and Kirstie Haertel, Olympic National Park; Brett Lenz and Kathy Kiefer, Grant County Public Utility District No. 2.; Rick McClure, Gifford Pinchot National Forest; Dan Meatte, Washington State Parks and Recreation Commission; Bob Mierendorf, North Cascades National Park; and Fennelle Miller, Washington State Department of Natural Resources.

Cultural Resource Management at the Air National Guard

The Environmental Planning Branch (CEVP), Air National Guard (ANG) is in the process of updating its cultural resource management (CRM) program. Under an interagency agreement, the National Park Service (NPS) developed an electronic database to support ANG efforts to manage and care for cultural resources under its stewardship. The database serves as a central depository for cultural resource and environmental information.

In 1993 and 1994, ANG installations were contacted by the NPS as the first step in collecting information about ANG lands and cultural resources. During the coming year, installations are again being contacted and surveyed to update the database. This is necessary because several installations have recently completed Cultural Resource Management Plans (CRMP). For example, Jefferson Barracks, a National Register Historic District, is evaluating archeological sites as part of an effort to ensure protection and preservation of its cultural resources.

Through a cooperative agreement between ANG and the National Conference of State Historic Preservation Officers (NCSHPO), CEVP hired a cultural resource specialist to complete the CRM database project under the direction of Dick Masse, Natural Resources Program Manager. The ANG takes seriously its stewardship responsibilities required under law and Department of Defense directives. Safeguarding its cultural resources is an extension of ANG's policy to be a "good neighbor" in the communities it serves. In consultation with the NPS, a new ANG cultural resource policy will eventually be developed and implemented.

H. Matthew Nowakowski
NCSHPO

F-4 static display, Air National Guard Readiness Center, Andrews AFB. Photo by the author.

Lara Day Kozak

Virtual Preservation in Cuba

Cuba has been the focus of world attention due to the visit of Pope John Paul II in January 1998. As Cuba enters its 39th year as a Marxist state, its splendid architectural patrimony is showing its age. With limited funding and resources, Cubans struggle to save architectural treasures. While attention has focused on colonial era locations such as Old Havana (Habana Vieja), there is also concern for areas such as Central Havana. There is growing interest in Cuban architecture and its preservation by people both within and without its borders. Designated a World Heritage Site in 1982, Havana is a mixture of architectural styles from Baroque to Art Nouveau.

Cuba poses complex planning and preservation problems in places such as Old Havana. Havana is home to many of the country's poorest residents, many of whom live in structures not intended for permanent housing. This situation poses a challenge to city planning and preservation efforts to avoid massive displacement. For many people interested in these issues, travel to Cuba to experience its cultural landscape and help save its structures is almost impossible. However, the World Wide Web is opening new doors for those interested in viewing and saving Cuban architecture, and participating in dialogs about city planning and preservation issues within Cuba.

Remains of a collapsed building near the Malecon, Havana, Cuba. Photo by the author.

In the past year, numerous Web sites have gone online documenting the preservation problems facing Cuba. The Caribbean Architecture Restoration Project (CARP) is a non-political American group working to preserve Cuban architecture; its Web site serves as a primary means of communicating its mission in a timely and cost-effective manner. Justin Oppmann, CARP's founder, notes, "The strength of the Web is that it allows people literally worldwide to learn about our conservation efforts, as well as our conference at virtually no cost." CARP has received responses from around the globe making their local efforts instantly international. Additionally, Oppmann says, "Use of the Web has generated offers from a video firm willing to donate services, journalists, photographers who travel to Cuba and wish to help out, and leaders of other architectural organizations who want to work with us." The one missing link in the virtual world of architectural preservation in Cuba is local access to the Web. Despite this problem, determined professionals and students visit Cuba to see, first-hand, the state of Cuban architectural treasures. This often adds to the worldwide af on how cultural resources in this island nation can best be preserved.

The many benefits that accumulate from Internet usage as a means to publicize preservation work are worth the small financial investment and effort to create a Web page. Many cultural resource management organizations are becoming international entities overnight just by uploading a Web page. The Web offers preservationists a new means to relay information, share strategies, and expand their support base. Preservation efforts in Cuba are a prime example of the power of the Web as an evolving preservation tool.

Noteworthy Web Sites:

- Caribbean Architecture Restoration Project (CARP): <members.aol.com/caribarch>
- Cuba in Transition—A Photo-essay in the Global Classroom by an urban policy and planning teacher at the John F. Kennedy School of Government at Harvard University: <www.ksg.harvard.edu/ people/xbriggs/>
- LA HABANA*HAVANA—An Architectural tour of Havana and Trinidad, Cuba: <www.tomco.net/~larak/cuba/cuba.htm>

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WWW Resources for CRM

National Sites

National Park Service	www.cr.nps.gov or www.nps.gov
National Center for Preservation Technology and Training (NCPTT)	www.ncptt.nps.gov
National Trust for Historic Preservation	www.nthp.org
Advisory Council on Historic Preservation	www.achp.gov
National Preservation Institute	www.npi.org
Preservation Action	www.preservenet.cornell.edu/pa.htm
HABS/HAER Database	www.cr.nps.gov/habshaer
National Register of Historic Places	www.cr.nps.gov/nr

Directories

PreserveNet	www.preservenet.cornell.edu
Cyburbia	www.arch.buffalo.edu/pairc
UNESCO	www.unesco.org
ICOMOS and US/ICOMOS	www.icomos.org

Selected SHPO Sites

Alabama SHPO	www.preserveala.org
Connecticut SHPO	spirit.lib.uconn.edu/ArchNet/Topical/CRM/Conn/ctshpo.html
Florida SHPO	www.dos.state.fl.us/dhr
North Carolina SHPO	www.hpo.dcr.state.nc.us/
Kansas SHPO	history.cc.ukans.edu/heritage/kshs/

Professional Organizations

Society of Architectural Historians	www.sah.org
American Institute of Architects	www.aia.org
American Association for State and Local History	www.aaslh.org

Special Interest Sites

Cameron Newham's Feature Database (Pevsner)	www.iinet.com.au/~cam/fde/index.html
Ian Evans' World of Old Houses	www.oldhouses.com.au
The Walk to Canada	www.npca.org/walk.html
ISTEA Reauthorization	www.istea.org
Surface Transportation Policy Project/TransAct	www.transact.org
Jefferson's Monticello	www.monticello.org

WWW resource list prepared by Amy E. Facca (related article appears on page 12).

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CRM

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