MERIDIAN

A Journal of the
MAP AND GEOGRAPHY ROUND TABLE OF THE AMERICAN LIBRARY ASSOCIATION

No. 12 1997

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CALENDAR

ALA Midwinter Meetings:

New Orleans	Jan. 9-15, 1998
Philadelphia	Jan. 22-28, 1999

ALA Annual Meetings:

Washington, D.C.	June 25-July 2, 1998

IFLA Annual Conferences:

Copenhagen	Aug. 31-Sept. 5, 1997
Amsterdam	1998

International Conference on the History of Cartography:

Lisbon	July 5-11, 1997
Athens	1999
Madrid	2001
Cambridge/Portland (USA)	2003

Exhibits:

Maps of Steel: Early American Railroad Maps – Harvard Map Collection, July-September 1997

Meeting and Exhibit announcements should be sent to the Editor.

NEXT ISSUE

A Special Issue Celebrating the 100th Anniversary of New York Public Library's Map Division! This issue, guest edited by Alice Hudson, will concentrate on the history of this esteemed collection, undoubtedly the major public library collection in this country. Its past, and present curators, are a who's who in the history of map librarianship and their reputations and writings have influenced our history for all of its one hundred years. This issue will celebrate a truly magnificent collection, its staff, and its influence on U.S. map collections.

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SUBSCRIPTIONS

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EDITORIAL

In the last issue I wrote about changes and the impacts of digital information. I am steadily reminded of just how these changes are affecting map libraries across the country and am very impressed with those libraries that now have web sites and those that are executing remarkable projects with GIS and digital data. I am also too well aware of those libraries that are continuing to struggle with the barest of paper-based collections and working just as hard to satisfy their clientele.

It seems apparent that those who are fortunate have an obligation to assist those who are not. While it may be difficult to provide services or maps that are directly appropriate to other's regional collections we can provide our maps, data, and services through resource sharing, web, and ftp access when the information can be shared. Unlike the past, when we all developed collections as though they were islands onto themselves, today's information world lacks those geographical boundaries and is far less time dependent. We talk to each other through listserv's (Maps-L and MapHist for example) and are often in constant contact via e-mail. Technology affords potentials that we should explore for sharing resources that before would have been unheard of. The smallest of libraries now has, potentially, access to information that its librarians and users would never have thought of only five years ago.

This issue, guest edited by David Allen, provides insights into services that we can expect to grow in the not too distant future. It includes extracts and updates of the papers presented at the ALA Annual Meeting in New York (1996) and provides an excellent introduction to digital imaging technology. David's own research and applications of Photo-CD technology is well-documented and his web site should be reviewed by all readers as an excellent example of sharing of resources. The Klimley and Gertz articles represent the findings of thorough studies completed at Columbia University on oversized maps and provides substantial information on digital imaging of these materials. Larsgaard's article provides not only a good review of the Alexandria Project but also a description of the cooperation being planned for digital scanning projects among the California universities. Mangan's contribution provides an update on the Library of Congress Geography and Map Division's efforts in providing electronic images of some of their materials. Cobb's article provides a case study for two very different kinds of preservation and resource sharing and argues not only for the preservation of early materials but urges that we consider preserving the digital data of today as well.

This editor is especially thankful to David Allen for agreeing to bring this issue together and for the individual authors for their willingness to share their information in this important special issue.

David A. Cobb
Editor

The Digital Imaging of Historical Maps and Aerial Photographs: An Overview

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Raster images are something of a stepchild in the world of computer cartography.

Vectorization of old maps may be valuable for some research purposes, but it defeats the objective of preservation.

The creation of digital raster images of previously published cartographic materials has passed beyond the experimental stages, and is now widely recognized as a practical technology. A number of projects—several of which are described in this issue of Meridian—have prepared the way for the digital imaging of large quantities of older maps and aerial photographs. The purpose of high quality digital imaging is, primarily, to increase access to these materials, and, secondarily, to preserve them. This essay will present an overview of the fundamentals of this technology, and thereby provide necessary background for the more specialized articles that follow.

Characteristics of Raster Images

Most projects converting paper maps to digital files entail the creation of raster images. For the sake of those who are new to computer cartography, something should be said about the characteristics of these images. Because many types of images other than maps are saved in raster format, an extensive literature is available to those who wish to pursue this subject in depth[1].

Raster images are something of a stepchild in the world of computer cartography. Most newly created digital maps are in vector format, and most geographic information system (GIS) software in use by libraries specialize in working with vector maps, although they usually have some ability to work with raster images[2]. Vector maps are preferred in the GIS world because they take up much less disk storage than raster images, and are more flexible for such purposes as rescaling maps and manipulating multiple layers. Much of the cartographic data available in libraries is in vector format. The TIGER files used by the Census Bureau and other Federal agencies are perhaps the best known example of vector maps.

Most historic maps cannot, however, be converted easily into vector format. Vector images consist of defined lines, points and curves, and the irregular squiggles and letters on many old maps do not lend themselves to vectorization. I myself do not see how programs that produce vector images can ever be designed to capture consistently all of the details on historic maps. Moreover, the splitting up of the individual layers of printed maps—one of the main reasons cited for the use of vector images—destroys their integrity as original source materials. Vectorization of old maps may be valuable for some research purposes, but it defeats the objective of preservation. A number of software programs exist that convert raster images into vector form, and those who need to work with historic maps in vector format should plan on using them [3].

There is nothing exotic about raster images. They have long been

There are a number of different types of raster images and no shortage of software for working with them.

For those who are interested in heavy-duty image editing, Adobe Photoshop is widely recognized as setting the professional standard.

Much of the confusion is caused by the failure to distinguish clearly between pixels and dots per inch...

the standard means of putting photographs and art in digital form. Satellite images and aerial photographs are among the types of images commonly saved in raster form. Although most of the digital cartographic products distributed by the U.S.G.S. are in vector form, that agency has started distributing digital raster graphics (DRG's) of its 1:24,000-, 1:100,000-, and 1:250,000-scale map series.

There are a number of different types of raster images, and there is no shortage of software for working with them. The various types of images differ primarily in such matters as the compression schemes they use and in the bit depth they support (of which more later). The forms are usually identified by their acronyms or by the three-letter suffixes on their DOS file names. Thus, GIF and JPEG (JPG) are standard on the Internet. Kodak Photo CD has its own format (PCD). TIFF (TIF) is frequently used for uncompressed image files. GIS programs, such as ArcView, typically work with only a few file types, usually including TIFF. Fortunately there are a number of programs, some of which are free or inexpensive, that convert raster files from one format to another, and can be used for viewing raster images in a variety of formats. Many of these programs are also better at manipulating and editing raster images than GIS software. For those who are interested in heavy-duty image editing, Adobe Photoshop is widely recognized as setting the professional standard. Less expensive alternatives for those who just want to display images, and perform such basic operations as cropping and converting images from one format to another include HiJaak Graphics Suite, Graphics Workshop, and Kodak Photo Access.

Understanding Pixels

In order to understand the issues surrounding the digital imaging of historic maps, it is necessary to know something about the characteristics of the pixels that make up raster images. A raster image is so called because it consists of a grid (or raster) made up of rectangular pixels. Each pixel is a solid block of gray-scale or color. The resolution of a raster image is therefore largely determined by the number of pixels in the image.

In spite of the fundamental simplicity of raster images, there is a good deal of confusion in the terminology surrounding their use. Much of the confusion is caused by the failure to distinguish clearly between pixels, which are used to measure the resolution of raster images, and dots per inch (dpi), which are used to measure the resolution of scanners and printers. They are not quite the same thing. Digital images are measured in pixels as a way of describing resolution independently of any output or display device. Thus an image 512 x 768 pixels in size (393,216 little rectangles) could theoretically be displayed on a monitor one square inch in size, or on one the size of a football grandstand. On the tiny monitor you would have to use a microscope to read all of the details in the image. On the grandstand-sized monitor, the individual pixels would be visible, and the display would look like it was made up of those cards that people hold up during half-time entertainments. As it happens, a 512 x 768 pixel image would just about fit on a normal computer screen.

To add to the confusion, there is a measure of resolution called "pixels per inch" (ppi) which is not device independent. Pixels per inch is a phrase used primarily to describe displays on computer monitors, and is roughly equivalent to dots per inch. Thus if a computer screen displays an image at 300 x 300 pixels per inch, it would roughly translate into printer output at 300 x 300 dpi on a sheet of paper the same size as the computer screen. This would be an extremely high resolution com-

These numbers are important because image resolution expressed in terms of pixels per square inch is the most important determinant of whether a digital image is adequate for purposes of research or preservation.

You can get a good approximation of the resolution of an image by dividing the number of pixels it contains by the number of square inches in the map.

Color maps are generally preserved using 24 bit pixels.

puter monitor. A standard Super VGA monitor on a PC displays 800 x 600 pixels, which is 96 x 96 pixels per inch. Such a monitor can display images larger than 800 x 600 pixels, but you have to scroll through them. A further trap for the unwary is that some computer manufacturers and software manuals describe ppi in terms of only one side of the square inch. Thus, you will frequently encounter descriptions of displays such as "72 ppi," which really means 72 x 72 ppi (or 5184 pixels per square inch).

These numbers are important because image resolution expressed in terms of pixels per square inch is the most important determinant of whether a digital image is adequate for purposes of research or preservation. The numbers that are most important are the total number of pixels in an image, which determines how much digital information it actually contains, and the ratio between that number and the size of the original map (in square inches). An image 2048 x 3072 pixels may be more adequate to capture all of the significant information on a small map, such as an 8 x 10" CIA country map. But such an image would not be able to capture all of the detail needed to read an ordinary topographic map. Thus, a little mathematics is required to determine how large an image needs to be in terms of pixels. You can get a good approximation of the resolution of an image by dividing the number of pixels it contains by the number of square inches in the map. This number would be about the same as the number of dots per inch you would have if the map were scanned directly from the original. The reason why it is often necessary to perform this calculation is that many digital images, such as those produced by the Kodak Photo CD process, are produced by scanning from slides or transparencies, which are already greatly reduced in size from the original.

There is one more thing that should be known about pixels: they have "depth." Depth determines how much color information is available for each pixel. Simple black and white images require a single bit; a pixel with a bit depth of 8 can store enough information to record 256 shades of gray or colors; and a 24 bit pixel can express 16 million possible values, and pixels with even higher bit depth are used for some purposes. Color maps are generally preserved using 24 bit pixels. If you are preserving black and white maps, or if precise rendition of color is not a concern, major savings in file size with no loss in image quality can be obtained by using fewer bits per pixel.

How Much Resolution is Enough?

There is a growing consensus that images preserved using 24 bit color need a pixel count equivalent to scanning the original at somewhere between 200 and 300 dpi. Black and white images need to be scanned at a 600 dpi equivalent. These resolutions were arrived at by examining digital images to determine how much resolution is needed to preserve the smallest meaningful details on the originals--e.g. individual contour lines on topographic maps, or the smallest type on street maps. These conclusions derive from studies made at the Library of Congress, Columbia University, and Cornell[4].

It may be objected that this resolution is not high enough for all conceivable purposes. It is probably not sufficient for those who want to study the texture of the paper a map is printed on, or to compare the shape of serifs on various type faces, or even to use a digital image to produce a high quality print for sale or exhibit. It is certain that this standard falls far short of the amount of information preserved by the grain of photographic images. One source claims that if every grain of silver halide on a 35 mm. slide were represented by a pixel, the resulting file would be about 250 mb. in size [5]. Since a 4" x 5" transparency has about 15 times the surface area of a 35 mm. slide, it would constitute about 4 gigabytes of information if it were digitized. It is technically possible to digitize maps at higher resolutions, and 600 dpi is quite possible with existing scanners. The question is whether the higher expense and larger file size resulting from such a process would be counterbalanced by the increased usefulness of the product. The answer clearly seems to be "no," except for very specialized purposes [6].

It may be objected that this resolution is not high enough for all conceivable purposes.

Raster images of maps digitized at even 200-300 dpi do require large files. Files for maps digitized to this standard usually range between 60 and 300 mb in size. Even with the rapid improvements in the speed and capacity of computers in recent years, such files remain difficult to work with. They are too large to be routinely transmitted over the Internet, and a sizable collection of maps made up of them would quickly fill even a large hard disk. Only a small portion of one of these maps can be displayed on a computer monitor without scrolling through the image. These considerations, in addition to cost, all argue against scanning at even higher resolutions.

Only a small portion of one of these maps can be displayed on a computer monitor without scrolling.

Still, the difficulty of working with large maps scanned at 300 dpi should not be exaggerated. Although it is a test of patience to download one of these images on the Internet, such images can be distributed at a reasonable cost on CD-ROM [7]. Low-resolution versions of the images can easily be distributed on the Internet or examined by users for evaluation purposes. It is not often that a patron will actually need to work with the high resolution versions of these maps, and often he or she will need to view only a portion of a map in such detail. Even at the highest resolution, these images can be viewed on an ordinary Pentium PC with a SVGA monitor by any user willing to devote fifteen or twenty minutes to loading them and scrolling through them. Doubtless these images will become even easier to work with as the capacity of storage devices and the speed of computers and communications lines increases.

Directly scanning from the paper copy of a map is not feasible for most libraries.

Methods of Producing Digital Images

Satisfactory images can be produced by scanning directly from the maps, by scanning photographic negatives or transparencies, or by the use of digital cameras. The determinants of what method to use are the size of the maps to be scanned, the condition of the maps, the number of maps to be scanned, the amount of money available, and the expertise of the people carrying out the project.

Directly scanning from the paper copy of a map is not feasible for most libraries. Ordinary scanners are not large enough to work with most maps, and I have not heard enthusiastic reports from those who have attempted to scan large maps in sections and then "stitch" them together electronically. Also, inexpensive scanners introduce distortions that make the images unacceptable for preservation and some research purposes. On the other hand, if you want to scan large numbers of maps, and have at your disposal large amounts of money and expertise, this may be the most cost-effective route to take. This seems to be the conclusion of the Library of Congress, which is scanning historic maps with $100,000 Tangent scanners [8]. The drawback of the Tangent flatbed scanners used by the Library of Congress is their 24" x 34" surface area (modifiable to 24'" x 36"), which limits the size of the maps that can be scanned. Tangent and other companies make drum and sheet feed scanners that can make high resolution scans of much larger maps, but they pose a risk to fragile materials.

A good alternative to direct scanning is scanning from a photographic negative or transparency.

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Institutions with the necessary money and trained staff may want to consider purchasing their own scanner. Kodak Photo CD and other scanning services offered by commercial vendors are viable alternatives. The drawback of this approach is that it requires careful quality control at two stages of the process, since it involves making a copy of a copy using two different technologies. Color shifts are especially difficult to control under these circumstances, and this is one of the reasons why the Library of Congress opted for direct scanning.

Digital cameras are becoming a more attractive option. The digital cameras marketed to consumers do not have nearly enough resolution to create images suitable for preservation and research. Until very recently even high-end cameras, such as the $30,000 Leaf Digital Camera Back, could only capture images at 2048 x 2048 pixels. Late in 1996, however, the $30,000 Phase One Power Phase camera back was released with a resolution of 7000 x 7000 pixels, which will doubtless become the standard for cameras in this price range. At this resolution, digital cameras are comparable with other methods of digital imaging [9].

Need for Quality Control

Many of the complaints voiced about the quality of digital images have nothing to do with the quality of the scanned image. An image scanned at 300 dpi and printed on an ink jet color printer at the same resolution can give a misleadingly poor impression of the quality of the original image. The same image looks quite different when printed at the same resolution on a high-end color printer, such as Scitex's IRIS ink-jet printer, or a dye sublimation printer, such as a Tektronix Phaser or a Kodak XLX 8600 printer. Even a medium resolution image is comparable to a photograph when reproduced on one of these printers (witness the illustrations accompanying this article). In the case of digital images scanned from slides or transparencies, poor photography is often the culprit.

In spite of these qualifications, quality control in the production of digital images is a major concern. Very often even the most reputable service providers produce images well below the theoretical ability of their equipment. These problems crop up regardless of what process is used to produce the images, and issues of quality control are currently at the forefront of the literature. A good deal of work is currently being devoted to developing suitable targets and specifications, and to assuring that the work of vendors meets stated requirements. Although these quality control problems are not yet completely solved, they have reached the point where they are manageable. Anyone contemplating a large digital imaging project should check for the latest developments in this area, and make certain that they have a clear understanding with their vendor concerning what is expected of them.

Need for a National Plan

It is clear that the time has arrived to undertake the digital imaging of large numbers of historic maps and aerial photographs[10]. The necessary technology is in place, and adequate standards have been established. The process is not inexpensive, but the potential exists to make quantities of rare and important cartographic materials available to researchers throughout the world. A concerted effort should be made to identify items to preserve digitally, to set priorities, and to obtain funding. It is important that recognized standards be consistently adhered to, and that duplication of effort be avoided. The American Memory project being undertaken by the Library of Congress and the Research Libraries Group will almost certainly form the backbone of any such effort in the United States. But much will remain to be done by individual libraries at the state and local levels, and elsewhere in the world. Professional groups, such as ALA MAGERT, can do much to promote this effort.

Professional groups can do much to promote this effort.

Endnotes

1. A good place to begin is Besser and Trant, Introduction to Imaging, which is available from the Getty Museum at http://www.ahip.getty.edu/intro_imaging. For a more detailed but readable overview see Adele Droblas Greenberg and Seth Greenberg, Digital Images: A Practical Guide (Berkeley: Osborne McGraw-Hill, 1995).

2. The importance of GIS programs being able to work with images in both raster and vector formats is becoming widely recognized, and GIS programs are improving their capabilities in this area. It is indicative of this trend that Stan Morain and Shirley Lopez Baros has recently edited a book entitled *Raster Imagery in Geographic Information Systems* (Santa Fe, NM: OnWord Press, 1996). Potential readers should be warned that the book is written by and for GIS professionals.

3. There has been some discussion of programs that convert raster images to vector form on the Maps-L listserv. Hijaak Graphics Suite and Corel Draw have utilities that convert raster to vector, but I have not been able to get satisfactory results from them. The more expensive programs may be better, but I have no experience with them. They include R2V, Laser Scan's VTRAK, ArcScan (an ArcInfo add-on), and Adobe Streamline.

4. For the studies conducted at Columbia see the articles that follow in this issue. For the work conducted at Cornell see Anne R. Kenney and Stephen Chapman, Digital Imaging for Libraries and Archives (Ithaca, N.Y.: Dept. Of Preservation and Conservation, Cornell University Library, 1996). The book by Kenney and Chapman is a valuable handbook for anyone interested in undertaking a digital imaging project.

5. This estimate comes from John Larish, Photo CD: Quality Photos at Your Fingertips (Torrance, Ca.: Micro Publishing Press, 1993), 25. This number can only be an approximation, since film grain varies greatly among different types of film.

6. The Tangent scanners mentioned below (footnote 7) can scan at 600 dpi, but scanning at this resolution would quadruple the size of the 200-300 mb files being produced at 300 dpi.

7. It is not possible to put large numbers of high resolution map images on a conventional CD. A Kodak Pro Photo CD holds about 20 compressed images. Only two or three of the 200-300 mb images being created at the Library of Congress will fit on a CD. But help is on the way. The new high density DVDs being released this year can hold up to 17 gigabytes of data. See Alan E. Bell, "Next Generation Compact Disks," Scientific American 275 (July, 1996):42-46. For those with really big data storage appetites, a company called Norsam Technologies claims to be able to put 1,400 gigabytes of information per square inch on an iridium "pancake disk" with a life span of 5,000 years. See their Web site at: www.norsam.com.

8. Tangent color systems is a division of Scangraphics. For information on Tangent scanners see http://www.scangraphics.com.

9. The list price for the Phase one Power Phase is $29,990. For information see http://www.phaseone.com.

10. Susan Klimley has already outlined the essentials of such a plan in "Digital Preservation: The Promise vs. The Reality," Proceedings of the Geoscience Information Society 26:5-9.

PLATE 1 (page11). *John Montresor. A Map of the Province of New York, with part of Pensilvania and New England (southern sheet), 1775. 29.9"x 38.6". Both the original map and the 4" x 5" transparency used to create this image are from the Library of Congress, Geography and Map Division.*

This illustration is derived from a gray scale version of the colored Pro Photo CD image. It was produced using Adobe Photoshop and printed on a 300 dpi Kodak XLX 8600 dye-sublimation printer. Note the gray scale/ruler and color bars at the bottom of the image. Because the map image occupies only a portion of the original 4" x 5" transparency, the actual maximum resolution of the image is only 3433 x 447 pixels (although the entire Pro Photo CD image is 4096 x 6144 pixels). Thus, the highest resolution image is the equivalent of scanning the 1154 square inches of the original map at only 115 dpi.

However, the image size of the resolution image exceeds the capacities of the 300 dpi printer, since the 1154 square inches of the original map is being reproduced in a space less than 50 inches square. Therefore, this plate was printed from the second highest resolution in the Pro Photo CD "Image Pack," which is exactly equivalent to the highest resolution on a regular Photo-CD (2048 x 3072 pixels). Even at this resolution, the image provides a good idea of the overall appearance of the map including a discoloration that affects the left hand side of the map. The reader should be warned that a printed copy of this and other images can give only a crude approximation of the image contained on the original Photo CD. A compressed JPEG color version of this image at approximately the same resolution is available at http://www.sunysb.edu/libmap/IMG005.jpg.


KODAK Color Control Patches
KODAK Gray Scale
PART OF NEW

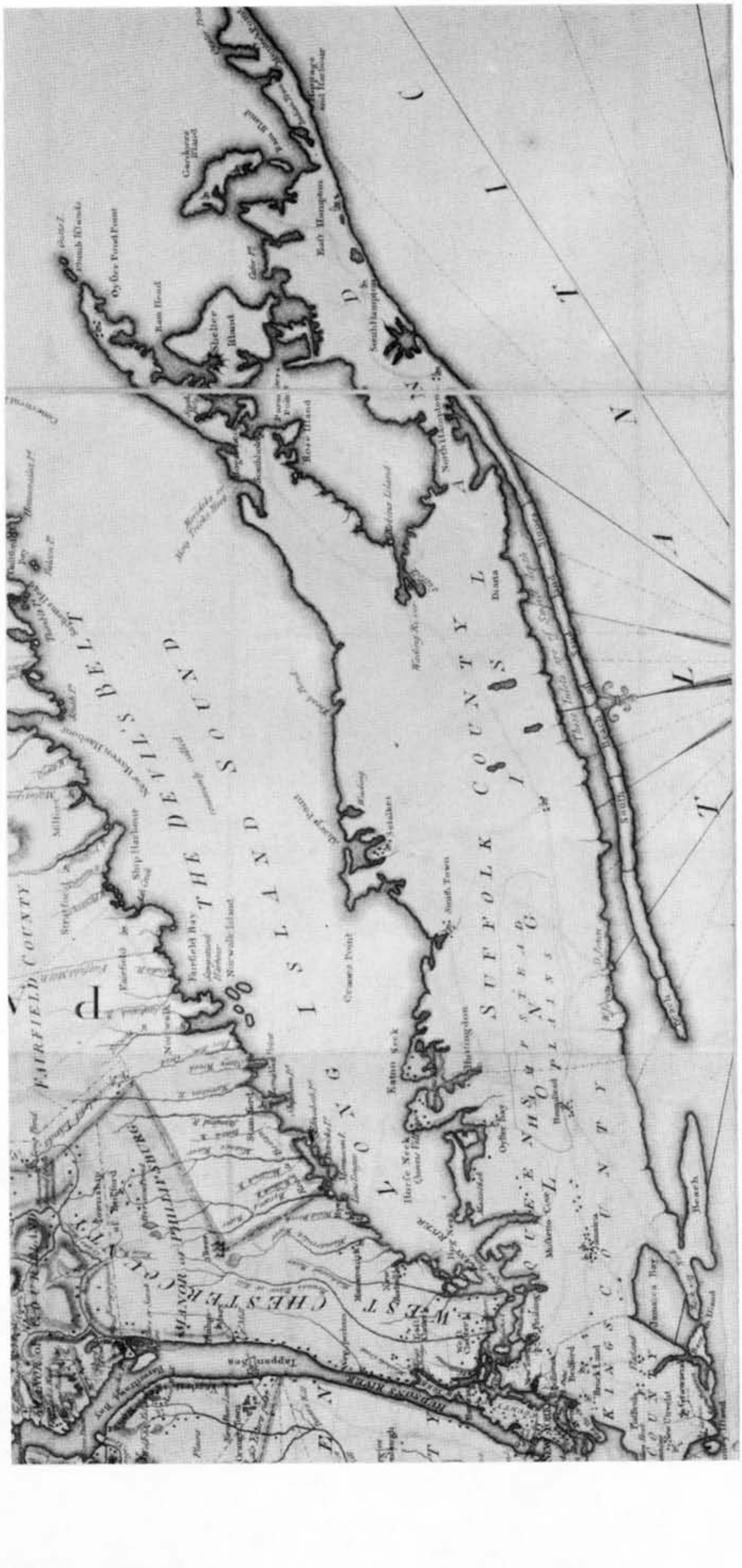

PLATE 2. *This enlargement of a portion of the previous map is made from the highest resolution 4069 x 6144 pixel image on the Pro Photo CD image pack. The size of this cropped image is 2473 x 1117 pixels, which translates to 235 x 235 dpi on the 5" x 10" printed image. Thus, the image on this plate is still considerably smaller than the portion of the original map covering the same area. With the aid of a magnifying glass, all significant details on the original map can be discerned.*

PLATE 3. *(page 13) An enlargement of a small portion of the previous image. The resolution is the equivalent of 60 x 60 dpi, indicating that it is an enlargement of the original map (scanned at 115 x 115 dpi). Even at this resolution, such fine details are retained as the hachures on the hill above Milfort (Milford, Connecticut). Although all of the letters and symbols can be interpreted, the image is somewhat fuzzy, as is particularly evident in the symbols for churches.*


Stratford
Ship Harbour
Milfort
New Haven Harbour
THE DEVIL'S BELT
commonly called
SOUND
Sachems Head
Bay
Island

Digital Imaging for the Rest of Us: Kodak Photo CD and Kodak Pro Photo CD

David Yehling Allen
State University of New York at Stony Brook

For about $100 you can get a Photo CD containing approximately 100 images.

...producing an ordinary Photo CD from 35 mm slides is well within the means of individual researchers.

Images in PCD format can be readily transformed into other formats such as GIF and JPEG.

Anyone who wants to create digital images of maps on a shoestring budget or with a minimum of technical expertise should consider Kodak Photo CD and its big brother, Kodak Pro Photo CD.

The Kodak Photo CD process involves using service providers to digitally convert photographic images in the form of slides, negatives, color microfiche, or 4" x 5" transparencies. For anyone who is just interested in experimenting with digital imaging, or who wants to convert some slides to put on the Internet or use in a multimedia display, this is definitely a good route to take. For about $100 you can get a Photo CD containing approximately 100 images. All you have to do is drop your slides off at a local camera store, and they will send them to a vendor (usually to a place called "Kodalux") which will produce the CD. This simple procedure makes Photo CD readily available for individual researchers and small libraries.

These considerations explain my own involvement with Kodak Photo CD, which I used to create a portfolio of digital maps of New York State. My project involved converting to digital images a number of slides and 4" x 5" transparencies of pre-1830 maps of the state. I took on this project in part because I wanted to get some experience with the technology, and in part because having a collection of images of early New York State maps would be useful for researchers at the State University of New York at Stony Brook. I did receive a small grant from my institution, which enabled me to purchase high quality 4" x 5" transparencies and to produce a Kodak Pro Photo CD.[1] But producing an ordinary Photo CD from 35 mm slides is well within the means of individual researchers.

In addition to low cost, there are a number of reasons why anyone contemplating a map digitization project should consider Kodak Photo CD. For one thing, there is a lot of support for Kodak Photo CD users. Kodak has a Web site and a Photo-CD listserv.[2] There is also an academic listserv called Imagelib that deals with Kodak Photo CD and related issues.[3] Most large book stores stock works on Kodak Photo CD.[4] And there are advantages to working with a product that is marketed by a major corporation, and which promises to evolve with changing technology.

Images on Kodak Photo CD are saved in a proprietary format (PCD), which can be read by most graphics programs, such as Hijaak Pro and Adobe Photoshop. Images in PCD format can be readily transformed into other formats, such as GIF, JPEG, and TIFF. The images are stored in an "image pack" consisting of five resolutions, ranging from thumbnail to 2048 x 3072 pixels. The 2048 x 3072 pixel image is much larger than anything that can be displayed on a normal computer monitor without scrolling. It produces good "evaluation quality" images of even fairly large maps (see Plate 1). Many of the images of historic maps available via the Internet are compressed JPEG images produced at this standard, and often are from Kodak Photo

The drawback of Photo CD is that it cannot preserve images larger than 157 square inches.

The quality of a digital image on a CD depends, first and foremost, on the quality of the transparency being digitized.

Image quality problems include such exotic pests as pixel smear, noise, edge reproduction, and moire effect.

CDs.[5] The drawback of Photo CD is that it cannot preserve images larger than 157 square inches at 200 dpi (70 square inches at 300 dpi), which are the de facto standards mentioned in the previous article. Thus, research or preservation quality images can be obtained only of fairly small maps, or of portions of larger maps.

When working with larger maps for purposes of preservation or research, it is necessary to go to another product called Kodak Pro Photo CD. A Pro Photo CD is essentially the same as a regular photo CD, except that another file size has been added, which is 4092 x 6144 pixels. The resulting files weigh in at an average size of about 72 mb. At this size it is possible to get only about 20 images on a disk, but these images have sufficient resolution to preserve the details on much larger maps. With the advent of digital video discs (DVD) capable of holding up to 17 gigabytes of data, the problem of storing these images should be greatly ameliorated.[6]

Producing a Kodak Pro Photo CD requires a considerable investment in time and money, although it is still easier and less expensive than trying to scan your own images. A Kodak Pro Photo CD costs approximately $500. They are usually made from 4" x 5" transparencies rather than slides, and obtaining high quality transparencies can in itself cost a lot of money and effort. The quality of a digital image on a CD depends, first and foremost, on the quality of the transparency being digitized.

If you want to get the highest image quality possible, selecting the producer of your CD is critically important. Kodak does not enforce any standards in the production of Photo Cds, and there is a great deal of variation between the work done by labs, just as there is among custom photo finishers. If you walk into the average camera shop and say that you want a Kodak Pro Photo CD, there is a good chance they will not know what you are talking about. If you insist that Kodalux makes these things, they will probably investigate, and cheerfully send your transparencies off to Kodalux. However, not all Kodak Photo CDs are the same, and Kodalux is oriented toward high volume work for the mass market. The workstation that produces Photo CDs does not do everything by itself, and image quality depends to some extent on the judgement of the person who is operating it. Color rendition is particularly a problem, and there is a good deal of variation in the rendering of things like hue, contrast, and color saturation. Here the more expensive custom labs often do a better job, although even here occasional horror stories abound. Even using professional labs, Photo CD images often come out darker than the original and with a greenish cast. Fortunately, totally accurate color rendition is not as critical with maps as with fine art, and this type of problem is easily corrected with a program like Photoshop.[7] But some people like to get it right the first time. It is useful to include a small color bar with every image to ensure that color rendition is accurate and to facilitate color correction.

Image resolution is also a problem, although usually not such an obvious one. Generally speaking, really bad image resolution is the result of poor photography. But there are more subtle problems that can occur which affect image resolution at high magnifications, and these can pose real problems if you are trying to preserve all of the detail on large maps. Image quality problems affecting fine details include such exotic pests as pixel smear, noise, edge reproduction, and moire effect. There is a growing literature on the causes and prevention of these problems, and research on this subject is ongoing.[8] The bottom line is choose your vendor carefully, include targets with your images, and have a clear written understanding with your vendor of what you expect.

Not even the best digital images will satisfy all of the concerns of preservationists, or be suitable for every conceivable research purpose.

At some point a "Super Pro" CD will doubtless be released, which will make it possible to work with larger maps.

Kodak claims its Photo CDs will last for about 100 years.

These image quality problems are not as alarming as they may sound. Not even the best digital images will satisfy all of the concerns of preservationists, or be suitable for every conceivable research purpose. On the other hand, a Kodak Photo-CD produced by a reputable service bureau will satisfy almost all research needs, and be comparable in quality to the standards set for preservation microfilming.

Several other problems with the use of Pro Photo CDs for preservation and research should be briefly mentioned. One of these is the limited file size of even Pro Photo CDs. In spite of their 72 mb. files, the 4092 x 6144 pixel images are inadequate for very large maps. At 300 dpi images this size can deal with maps no larger than 279 square inches; at 200 dpi the maximum size is 629 square inches. In most cases the maximum size is going to be even smaller, since few maps have the shape to exactly fill a 4"x 5" transparency, and space may have to be left for color bars and targets. There is reason to expect that this situation will change in the future. Although 72 mb files are still cumbersome to work with on most computers, technological improvements are making it possible to work with ever larger files. At some point a "super pro" CD will doubtless be released, which will store even larger files and make it possible to work with larger maps. Until that time arrives, there are two alternatives for those who want to preserve very large maps on Photo CDs. The first is to photograph the maps in sections. The other is to have a separate scan made by a service bureau from a 4" x 5" or 8" x 10" negative or transparency at a higher resolution than the highest provided by the Pro Photo CD image pack.

The highly derivative nature of photo CDs creates other problems. A Photo CD is a copy of a copy, which will be displayed in one of several ways. At every step in the production and display of these images it is possible for errors to creep in. Furthermore, digital images are also almost totally plastic. Once they are taken off the CD, the images can be altered pixel by pixel using a program like Photoshop. This mutability is in some ways an advantage. I routinely crop my images and modify the color balance to make them look more like the original map. Changes of this type are not likely to affect researchers, but it is perfectly possible to make all kinds of misleading changes to an image. Fortunately an original CD is almost impossible to alter. Thus one can obtain a reasonable level of security by purchasing CDs from a reputable company or an institutional source, such as a library.

Image permanence is another much discussed issue, although it is not one I am particularly concerned about. The lifetime of CDs is limited, and the lifetime of the machines that read them probably even more so. Kodak claims its Photo CDs will last for about 100 years. If true, this makes them more than a match for the most stable color films. Moreover, the digital images can be easily copied onto other media. I am confident that in a few years there will be even more stable media capable of holding large numbers of images, such as the Norsam "pancake disk" (*see endnote seven, page 10*). It should be a simple matter to copy old images onto new media as they appear.

In spite of the problems, there is no doubt in my mind that Kodak Photo CD and Pro Photo CD have many uses right now, and are arguably the best available medium for many applications. They are the most problematic as a means of producing archival quality images, but even here excellent work is already being done with them. As computer technology improves and quality control processes are refined, Kodak Photo CD, along with its competitors, will doubtless become even more versatile and reliable.

There is not doubt in my mind that Kodak Photo CD and Pro Photo CD have many uses right now and are arguably the best available medium for many applications.

Endnotes

1. Medium resolution sample images from my CDs can be found at (http://www.sunysb.edu/libmap/nymaps.htm). This project was funded by a State of New York and UUP Professional Development and Quality of Working Life Award.

2. The URL for the Kodak Web site is: http://www/kodak.com:80/digitalImaging

3. To subscribe to Imagelib, send a "subscribe" message to listserv@listserv.arizona.edu

4. For example: John Larish, *Photo CD: Quality Photos at your Fingertips* (Torrance, CA: Micro Publishing Press, 1993); Heinz von Buelow and Dirk Paulissen, *The Photo CD Book* (Grand Rapids, MI: Abbacus, 1995).

5. The images on my New York State Historic Maps page (see footnote one) are examples of 2048 x 3072 pixel images compressed with JPEG. Although the JPEG compression causes a slight loss in image quality, they provide a good idea of the level of image quality that can be achieved for fairly large maps using ordinary Kodak Photo CD. Because of the large file size of Pro Photo CD images at the highest resolution, I have not put any of them up on my site. Some of my favorites among the many sites with good collections of historic maps include: Amsterdam University (http://www.uba.uva.nl/collecties/kaarten/index.html); University of Georgia (http://scarlett.libs.uga.edu/lh/www/darchives/hargrett/maps.html); University of Arizona (http://www.library.arizona.edu/branches/spc/set/primeria/intro.html); Osher Map Library (http://www.usm.maine.edu/~maps/oml/).

6. See endnote 7, page 10.

7. Color and contrast correction can quickly become tedious and complicated, but those who want a quick and easy solution should know about the "auto adjust" feature in Photoshop, which can often perform apparent miracles. All you have to do to use it is click on "adjust" on the "image" menu, and then click on the "auto levels" option.

8. For a technical discussion of image evaluation see James M. Reilly and Frnziska S. Frey, *Recommendations for the Evaluation of Digital Images Produced from Photographic, Micro- Photographic, and Various Paper Formats.* Available from the American Memory Project technical documentation page (http://lcweb2.loc.gov/ammem/ipirpt.html).

   The Department of Preservation and Conservation at Cornell University in cooperation with ten other New York State comprehensive research universities is beta testing a set of benchmarking standards for Kodak Photo CDs. A number of this author's map images are included in this study. Results should be available by the time this article is published.

GEOGRAPHY • CARTOGRAPHY • VOYAGES • DISCOVERY • BIOGRAPHY • BIBLIOGRAPHY • EXPLORATION • HISTORY

Preserving Maps in Geology Books and Serials Using Digital Techniques

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These maps are a serious preservation issue as the problems associated with brittle paper are compounded by folding and unfolding the maps during normal use.

Geology librarians have for the last two decades been particularly interested in maps in books and serials.

Abstract

The geology literature is characterized by a large number of maps issued with books and serials as foldouts, sewn into the binding or sheets folded and stored in pockets. These maps, associated with text, are a serious preservation issue as the problems associated with brittle paper are compounded by folding and unfolding the maps during normal use. Various preservation techniques, such as microfilming and separation of text and map have been tried over the years with poor results for users.

Recent experimentation has been done using digital scanning of both text and maps. Results of experimental projects funded by the Commission on Preservation and Access indicate that even the smallest distinctions between the color coding on the maps can be captured by scanning at 200 dots per inch (dpi) at 24-bit color. Problems related to color shifts and viewing on standard computer equipment are discussed in this paper.

Introduction

Geology librarians tend to be grouped in library systems with the science and engineering librarians. It is, however, a rare geology librarian who does not develop a fairly sophisticated knowledge of maps. Many geology librarians have map collections under their care and many geology librarians hold membership in map librarianship professional organizations such as ALA's MAGERT, SLA's Geography and Map Division and the Western Association of Map Librarians (WAML). The active professional organization for geology librarians, the Geoscience Information Society, frequently has papers on maps as part of its technical and symposium papers and has occasionally devoted its entire annual symposium to map topics.

Geology is an earth based science and maps and geographic information systems are key to displaying data. Even within the broader geology designations that are now more fashionable—the earth sciences or environmental sciences —maps play an important role. Oceanography, climatology, and hydrology, for example, all utilize mapping for the study of their data.

There does seem to be a perspective characteristic of geology librarians' interest in maps, which is slightly different from that of map librarians. Geology librarians have for the last two decades been particularly interested in maps in books and serials. The origin of that interest was in preservation concerns.

All libraries had become increasingly aware of the deterioration of books printed on acidic paper since the 1850s. Massive national and state microfilming efforts were undertaken as a way of preventing the complete loss of books printed on crumbling paper. In geology libraries, the problem of book pages breaking along the fold and edges was of great concern, much as it was in other libraries. This common concern was augmented by the even more severe problem of deterioration of maps and other illustrations which were larger than page-sized and then folded and bound into the book or put in a separate pocket in the back of the book.

Many users found they could not unfold a map to look at it without having the map break along the fold line.

The folding of material, to keep it in close relationship to the text, accelerated the damage to the maps and illustrations, which were subject to opening and refolding every time they were used. Many users found they could not unfold a map to look at it without having the map break along the foldline. Once unfolded, it was often difficult to refold the map to fit back into the pocket. It was, and still is, common to find a book pocket filled with colored printed squares. Librarians found that once a map had broken along the folds, the edges continued to break off. Unlike breakage along the edge of a page, continued breakage along the map pieces meant that the area represented on the map was being lost.

Because of the inadequacy of microfilm preservation techniques, geology titles are not well represented in catalogs of microfilmed serials.

Microfilm efforts

Although extensive microfilming has been done for most disciplines, it has been resisted in geology. First, many of the geology maps are color coded. The high contrast black and white microfilm, suited to text, totally obscures the data represented by the color on the maps. Second, microfilming a large illustration in its entirety results in a distance view with little detail visible. As a result, the national guidelines for microfilming larger-than-page-sized images call for systematically sectioning the image into page-sized pieces in order to make them legible. Once this is done, the detail on the maps can be seen but the maps are cumbersome to reassemble.

The map was considered an integral part of the text which could only be read in conjunction with the map.

Because of the inadequacy of microfilm preservation techniques, geology titles are not well represented in catalogs of microfilmed serials. One area where considerable microfilming had been done is geology dissertations. University policies call for sending all dissertations to University Microfilm to be microfilmed. Geology librarians have criticized the resulting inadequate copies and although UMI made attempts to make color transparencies of color maps, interlibrary loan lending of earth science dissertations is a widespread alternative.

It was suggested by some that the solution was simply to remove the maps from books; repair, flatten and encapsulate the maps; and store them apart from the books. For the most part, geology librarians avoided this as a preservation solution. The map was considered an integral part of the text which could only be read in conjunction with the map. Ironically, the map frequently was more able to stand on its own intellectually than the text. The need to prevent further breakage of folded maps was so urgent in the case of dissertations, that maps were removed from the text—but only after a color photocopy surrogate was made to be kept with the books (Newman 1989).

The magnitude of the problem was documented in the early 1980s when a preservation study was done in the Columbia University Geology Library. The survey showed almost 90% of the items in the sample needing preservation treatment were serials; over half of the represented serial titles contained oversized, folded materials and/or materials in color (Klimley 1982). Efforts were made to explore options used by architects and engineers dealing with large drawings, but the alternatives were costly and did not seem feasible (Klimley 1984).

Identification of text and image problem

Unexpectedly, it was the efforts of art historians that helped bring the problem of preserving the maps in

For the first time, the intrinsic relationship between text and image was discussed at great length.

The results of the joint task force experiment were very mixed.

The microfiche of the maps that had been made in an earlier project were also scanned at the same effective resolution as the paper maps.

books to national attention. A meeting in 1989 stressed the importance of image to the art-history text (Scholarly Resources in Art History 1989). The Commission on Preservation and Access convened the Joint Task Force on Text and Image, bringing together people from a variety of fields that utilized images in conjunction with text, such as history, medicine, botany, zoology and geology. For the first time, the intrinsic relationship between text and image was discussed at great length and the importance of not only preserving the images but of preserving the images relationship to the text was stressed (Commission on Preservation and Access 1992).

In 1992, the Joint Task Force funded a project to experiment with alternatives to text and image preservation. The New York State Museum Bulletin, a natural history publication started in the 18th century and containing a wide variety of illustrations including many folded maps, was used as the test case. The 26 numbers of the Bulletin used in the study were published between 1905 and 1908. They contained just over 6300 pages, 392 page-sized plates and 43 oversized illustrations, mostly maps. Nineteen page images and 36 of the oversized images were in color.

Color, archival-quality, single frame microfiche were made of the oversized color images while the text was microfilmed in traditional black and white. Attempts were also made to digitize the text and images. The results of this project were very mixed. Although the microfiche retained excellent color and resolution, widely available readers only allowed for very small portions of the maps to be seen at any one time. Copies could only be made through expensive photographic processes. Few people were experienced with digitizing text, much less large color images, at the time the project was done and the results were not successful. Text was very difficult to read. In the end, the large images were done in black and white which were largely illegible (Klimley 1993).

Oversized Color Image Project

In 1994, Columbia University decided to experiment not with the entire Bulletin but to work specifically on digitizing the color oversized materials. The project was funded with a contract from the Commission on Preservation and Access. Requests for proposals were sent out to a number of companies doing digitization work and a variety of techniques were used to digitize five maps of various sizes from the Bulletin. The results were put up on a World Wide Web site and reviewed by geologists and librarians all over the world. The technical information obtained from this experiment was important not only for the digital preservation of maps but in any field where highly detailed images are to be preserved by digital means (Gertz 1995).

It was determined that for these printed maps with a finite range of colors, scanning at 200 dots per inch (dpi) at 24-bit color was adequate to capture all of the smallest elevation numbers and to represent all of the color coding. Full-sized printout on high-end equipment from the files of 200 dpi and 24-bit color proved to be satisfactory facsimiles of the originals. The microfiche of the maps that had been made in an earlier project were also scanned at the same effective resolution as the paper maps and the images produced by this techniques were just as legible as those of the scanned originals. For those who are interested, comparison can be made among scans of the paper maps and the microfiche at the project web site (http://www.columbia.edu/dlc/nysmb) under "image collection". A chart of the resolution of each image is provided in the written report (Gertz 1995, 18-20).

There were limitations to the results obtained by the oversized color image project. While the digitizing methods captured all of the

Colors varied from the original and from monitor to monitor.

Geologists and geology librarians were pleased with the resolution of the scanned images, the prospects of accessibility via World Wide Web distribution, and the level of quality of the final products.

To integrate the text and images, several hundred HTML pages were generated using Perl programs and the available metadata.

map details and color with accuracy, displaying the digital images in a useful way proved a problem. The resolution and size of commonly available color computer monitors permitted viewers to see only a small area of a map image at any time. Colors varied from the original and from monitor to monitor. Although the results of the project were made available over the Internet, only those with the fastest Ethernet connections could realistically view the maps. Even then downloading was slow.

There were some successes in the project as well. Better monitors were able to display the smallest contour-line elevation figures. High-end printed products that were made from the digital files were very good. Although printed colors shifted, they were similar to the originals and because standard color bars had been included with each map, printing could be adjusted to be close to the originals. Users were also impressed with prints that could be made on more commonly available, color printers.

While the results of the Oversized Color Image Project were imperfect, preservation experts found the color microfiche to be an acceptable preservation medium and were impressed by the level of detail captured by scanning the fiche. Geologists and geology librarians were pleased with the resolution of the scanned images, the prospects of accessibility via World Wide Web distribution and the level of quality of the printed products. And computer specialists felt that, having captured the images at a high level, the limitations of monitors and delivery over the network would be resolved as technology progressed. The urgency of the preservation issue caused us to press on with the task of relinking the text and image files into a digital entity that represented the original Bulletins.

Reintegration of text and image

In the second phase of the project (Gertz 1996), microfilm copies of four of the Bulletins were scanned by Preservation Resources at 600 dots per inch (dpi) in black and white. A TIFF image was created for each page with metadata that included the bulletin number, chapter, page number and additional relevant information. Although the 600dpi TIFF image could produce a high quality print, it is a format not supported by today's web browsers. Best results were obtained by converting to a 120dpi grey scale image that was stored as a 72dpi GIF image. The TIFF images were also converted to the Adobe Portable Document Format (PDF) to make it easy to print the text. The master file TIFF file, the viewable GIF file and the easily printed PDF file were all made available to users on the Internet.

The four Bulletin numbers contained 89 plates and figures, among these a number of maps. Maps were both page-sized and larger and ranged from sketch maps to quadrangles with geologic information overlaid. Color microfiche and 33mm slides were made and converted to a Kodak PhotoCD. The high resolution TIFF images were archived permanently. The images derived from the master files were cropped, stored at four resolutions and converted to JPEG for easier Web browsing.

To integrate the text and images, several hundred HTML pages were generated using Perl programs and the available metadata. The programs produced a table of contents, a page list, a plate list containing a thumbnail of each plate and figure, and added navigational buttons. The automatic generation of the Bulletins from the metadata was very important to the viability of the project since individual manipulation of so many images is unfeasible. Errors were detected and corrected and it was easy to modify the "look" of the entire group of pages.

Use of the digital surrogate

The belief that there is a strong relationship between the text and the images in the literature had a strong effect on the design of the Bulletin interface. A brief navigation header appeared above each page image. A range of numbers on either side of the page being viewed gave the users a sense of where they were in the book. In the printed Bulletins, some images had no page numbers. In the electronic version, care was taken to link the plates to the same pages to which they were adjacent in the text.

A plate list was created and linked to the header on each page. It was not, as it would be in the printed book, simply a list of the titles of the plates, but rather a list of thumbnail-sized pictures of the plates. One of the researchers who evaluated the electronic version of the Bulletin commented:

I like the plates page. It corresponds to the way that I often look at geological books and papers, by glancing through the figures, and then checking out the text that goes along with any interesting figures. This serves the purpose not only of the printed book index but also as a way for users to browse through the images of a Bulletin much in the way they would rifle through the pages of the printed Bulletin (Kastens, 1996).

Despite the care taken to preserve the original relationship between the images and the text, problems remain. Illustrations come to the attention of the reader of a book simply through the process of reading and turning the book's pages. A page-sized map being discussed in the text can be "bookmarked" with a finger and referred to as needed. In the electronic text, the reader does not see the images unless the file is opened, which takes at best a few seconds to load. In a well-illustrated text, the reader may be too impatient to load every image, especially when the images are of varying degrees of interest; as a result, the reader may miss important maps.

For example, in a short article on fossil animal trails, one reader opened the first image in the section and, finding it to be a photograph of the site, skipped over three subsequent images. Only when the plate list was reviewed did the reader realize that one of the skipped images was a map of the rock slab described in the article, which made the strangeness of the trails much clearer than as described in the text (Klimley 1996).

The maps in the pockets of books were not "automatically" seen by readers. A reader had to be motivated to take the map out of the pocket to see it. It might be equally time consuming to take a brittle map out of a pocket and try to open it flat for reading as it is to wait for a quadrangle-sized map to open on a computer at a resolution where the details are visible. Once open, the paper map still has many advantages. The reader can have it open on a desk for both overview and detail viewing. The pin holes in the corners of maps from books indicate that readers tack maps to their walls for long-term reference. A computer file map may never be able to duplicate the effect of living with a map for a long period of time.

Toward the end of the second phase of the project, we had the opportunity to observe a user who had a specific need to use one of the Bulletins we had digitized. The reader noticed the plate list for the Bulletin immediately and proceeded to look through the list of plates, able to tell from the thumb nail images that most were irrelevant to her need. Once she located the map she thought would be helpful, we observed that it was quite difficult for her to figure out what area was covered by the map. So little of the map showed on her conventional computer screen that she was reduced to slowly scrolling along the edge of the map, trying to find the legend.

In the printed bulletins, some images had no page numbers. In the electronic version, care was taken to link the plates to the same pages to which they were adjacent in the text.

In a well-illustrated text, the reader may be too impatient to load every image…as a result the reader may miss important maps.

The reader can have the paper map open on a desk for both overview and detail viewing.

This very first use of the digital version of the Bulletin illustrates the complexity of providing a level of accessibility and service similar to that available using the printed copy.

The user, a faculty member, said that she needed a print so she could have the map photographed for a presentation she was giving—a perfectly reasonable and common request. Unfortunately, we had not set up a routine to print the digital files. Ironically, our fall-back position, that of offering to loan the original printed map to her for the photograph, failed due to the fact that the Columbia copy of the Bulletin was missing that particular map—another of the reasons to do preservation work on this title. In the end, it was easier to print a color transparency from the computer. This very first use of the digital version of the Bulletin illustrates the complexity of providing a level of accessibility and service similar to that available using the printed copy.

The importance of protecting the geologic literature is a pressing issue.

Conclusion

The issue of text/image interaction in digital versions of journals is just beginning to emerge as a concern. Since many researchers have not done much more than use electronic books and journals as an experiment, there is little experience with the best way to reproduce the functionality of the paper book. Because of the great importance of maps to the geology literature, it is important to come up with a solution to this problem. Fortunately, the automation of the process of pulling text and images together in this project may permit the luxury of trying various solutions as more people use the materials and have suggestions for improvement.

The solution of digital preservation is not without shortcomings. At the same time, the importance of protecting the geologic literature is a pressing issue. For the time being, digital access with a microfilm archival copy seems to provide the best solution from both the access and preservation points of view.

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Technical Aspects of Preserving Maps Using Digitization

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Once high quality images have been captured and archived, it is a reasonably simple matter to derive lower quality images which can be transmitted quickly across the web.

Selection of optimum image quality when scanning a map or any other document starts with identification of the smallest meaningful element that must be legible in the end product.

Use of too low a resolution turned plus signs to minus signs...

This article discusses technical aspects of scanning maps and related materials, based on experience at Columbia University on the Oversize Color Images Project (Gertz 1995; Gertz et al. 1996) and other digital projects conducted by the author with Susan Klimley, Science and Engineering Libraries Digital Projects Librarian; Robert Cartolano, Academic Information Systems Lead Consultant; and other Columbia staff. These recommendations assume that scanning should capture images at the highest quality likely to be needed to provide access to the full information present in the original objects now and in future; and to permit preservation of the digital files long-term. Once high quality images have been captured and archived, it is a reasonably simple matter to derive from them lower quality images which can be transmitted quickly across the web under current technology and accessed by viewers with a wide range of lower-end equipment.

Resolution and Tonality

Selection of the optimum image quality when scanning a map or any other document starts with identification of the smallest meaningful element that must be legible in the end product. When dealing with textual materials, this determination is relatively easy: find the smallest letter, numeral, diacritic, or symbol that must be clearly distinguished. In printed volumes such as the Museum Bulletin issues scanned in the Oversize Image Project, the smallest textual element is often the superscript footnote number, although, as Cornell discovered, scientific and mathematical symbols can also play this role. Use of too low a resolution turned + signs to - signs during scanning of mathematics monographs (Kenney 1993, 389). On printed maps the smallest textual element is often the elevation number or the scale; the Oversize Image Project test maps contained one-millimeter high elevation numbers.

Non-textual materials pose more questions. What is the smallest meaningful element in a photograph or artwork? In part this depends on who will use the scanned image and in what way. A non-specialist may look at a landscape casually, while a geologist may need to be able to distinguish the stratigraphy of the cliff in the background. While general recommendations can be made, examination of test images by representative viewers provides useful guidance.

Legibility results from a combination of resolution and tonality. Resolution refers to the number of pixels or dots per inch (dpi) relative to the original object—the more pixels used to represent the original object, the more detail is recorded. Resolution may be expressed as the horizontal and vertical pixels which make up the image. For example, 512 x 768 describes an image consisting of 512 pixels across and 768 pixels down. "Dots per inch" is typically used to refer to the number of pixels per inch captured from the original object stored in the digital file. Confusingly, dpi can also be used to describe the number of pixels available in computer displays and the output of printers. These senses are not the same, and in this article dpi refers only to capture.

Tonality concerns the number of bits used to convey gray-scale or color by each pixel.

Tonality, or bit depth, concerns the number of bits used to convey gray-scale or color by each pixel. A 1-bit pixel has two possible values, black or white. Gray-scale frequently employs eight bits, allowing for 256 shades ranging from pure white to pure black. So-called full color often employs 24 bits, for a total range of some 16 million shades. Because an 8-bit pixel captures more information than a 1-bit pixel, an equivalent degree of detail can be captured in gray-scale at a lower resolution than in black-and-white, and the necessary resolution for 24-bit may well be even lower. Kenney and Chapman (1996, 18, 24-25) provide formulas for computing the appropriate dpi, given the dimensions of the original object, the height of the smallest meaningful element, and the desired level of tonality.

Curators may also justifiably prefer to take a photograph of a fragile or valuable map rather than scanning it directly.

In the preservation community there is general agreement that normal modern printed black-and-white text should be captured at 600 dpi in order to assure that all symbols, italic text, and other fine details are captured and can be both viewed at the screen and printed out with full legibility. There is a growing consensus that handwritten documents, typescripts, and similar materials should be captured at 300 dpi gray-scale (Kenney and Chapman 1996, 33). Research on optimal settings for color is ongoing; in the Oversize Image Project after testing a range of resolutions, we found that at least for printed maps with a finite range of colors, 200 dpi at 24-bit color was adequate to capture all of the smallest elevation numbers and to represent all of the color coding (Gertz 1995), although originals with more complexity or depth may require 300 dpi. Full-size printouts of the maps on high-end equipment from files of 200 dpi and 24-bit color proved to be satisfactory facsimiles of the originals.

Effective resolution refers to resolution relative to the size of the original document.

Film Intermediaries

Film intermediaries such as 4" x 5" transparencies or single-frame microfiche (where the map or other original object fills the entire microfiche) can simplify the scanning of large maps because most scanners cannot handle oversize items. Curators may also justifiably prefer to take a photograph of a fragile or valuable map rather than scanning it directly. If properly made and stored, the film intermediary can act as a preservation copy of the item. However, the quality of the intermediary will have a direct impact on the quality of the digital image. If the intermediary is poorly made, scratched, faded, or out of focus, the scanned image will be inferior.

In the Oversize Images Project we were working with scans made from microfiche of the maps as well as working with scans from the actual paper maps. When the microfiche were scanned at the same effective resolution as the original paper maps, the images produced were just as legible as those of the scanned originals. Effective resolution refers to resolution relative to the size of the original document. Scanning the original map at 200 dpi means that a map 20 inches wide requires 20 inches x 200 dots or 4,000 dots across its surface in order to reproduce the 1-millimeter smallest elements at full legibility. The microfiche of the same map also requires 4,000 dots across the surface of the map image to capture the same degree of detail; but in this case the microfiche image of the map is perhaps only 4 inches wide, so that we are talking about scanning every inch of the microfiche at 1,000 dpi. For those who are interested, comparison can be made among scans of the project paper maps and microfiche at a range of effective resolutions. The images are displayed at the project web site under "image collection". A chart of the resolution of each image is provided in the written report (Gertz 1995, 18- 20) and in the on-line version (under Phase I report).

Accurate capture and display of color is neither simple nor cheap.

Issues Relating to Color

Accurate capture and display of color is neither simple nor cheap. Color can be captured with 24-bit scanning, as described above, but it will not necessarily be extremely accurate or true to the original without further effort. If "true" color is required, the capture process will entail extremely expensive equipment which can be color balanced and calibrated according to one of several standard color spaces. These are systems for defining precisely how to represent the natural range of visible colors mathematically. Communication among equipment manufactured by different vendors is complicated because they use competing color space systems; and many devices and software packages are designed to use only subsets of the full color space systems. An image captured with full color will necessarily display or print with a reduced color range if the monitor or printer cannot provide full color. And even the most expensive equipment must be carefully calibrated before use. A fuller discussion of these issues can be found in Ester 1996, 12-17.

An image captured with full color will necessarily display or print with a reduced color rate if the monitor or printer cannot provide full color.

Fortunately, it appears likely that "true" color is not necessary for most printed maps, but only reasonably accurate representation of the original colors. To assure even this level of accuracy, inclusion of standard color and gray-scale targets is essential when scanning color materials, even if high-end color equipment is not employed. If an image is captured at appropriate resolution and tonality with the color and gray-scale targets present, it becomes possible for viewers to calibrate their monitors and printers to match the original colors within reason.

Color standard targets consist of color patches to which equipment can be calibrated.

Targets

Targets serve several purposes. First, they allow the person operating the scanning station to assure that the equipment is performing to specification and to carry out color calibration. See ANSI/AIIM 1988 and Reilly and Frey 1996 for use of targets by the scanning technician as part of the routine preparation of equipment. Second, they allow quality control of images through visual inspection of the targets on monitors and printers, similar to that performed for microfilming (Kenney and Chapman 1996, 28-31). Third, they allow viewers of the completed images to calibrate their own monitors and printers to assure optimum display and printing.

Several resolution targets are available (Reilly and Frey 1996, 28-32). The most useful incorporate a variety of typefaces in diminishing sizes, bar targets with converging lines, and gray-scale targets. The combination of targets allows for testing of legibility, modulation, and tonality.

Color standard targets consist of color patches to which equipment can be calibrated. Several types are available, from color bars which provide two rows of nine color patches in saturated and pastel versions, to full-page targets covered with a large range of patches. The bar targets are designed to be captured in the image with the original object and thus allow calibration to the colors in that image. The full-page target is designed for color management by the capture and output equipment, and is generally captured as one of the first images in a batch of color scanning.

The gray-scale target can also take the form of a bar. A series of gray shade patches moving from white to black is provided, with different targets varying from eight or so patches to over twenty. The target is obviously important for gray-scale

Both the color bars and the gray-scale bars often include meter or inch rulers which are useful for documenting the scale of the object being scanned.

...it is essential to have a representative sample of objects scanned to see if the vendor can really meet the specifications.

scanning, where it is used to determine whether the equipment is capturing the full range of shading, through observation of how many of the patches can be distinguished. In color scanning the gray-scale targets are also important because they allow measurement of the capture of shadows and highlights. Many resolution targets incorporate the gray-scale bars, but the bars are also available separately for inclusion in the image with the original object.

Both the color bars and the gray-scale bars often include meter or inch rulers which are useful for documenting the scale of the object being scanned. In the case of maps this can be essential where the scale on the map is expressed in a form such as "1 inch = 1 mile." The scanned map displayed on the screen or printed out is no longer the original size, and a visible ruler is a necessity.

When color bars and/or gray-scale bars are included with the object during scanning, they do consume a certain amount of the available space, so that fewer of the pixels are actually used to capture the object itself. Careful placement of the bars will minimize the loss of space; consistent placement will allow automatic cropping of the images for thumbnail and other lower-resolution displays.

Working with Vendors

When working with vendors (as indeed when scanning in-house) great care must be taken to ensure that digital capture is properly performed and that the images are of uniform high quality. The first step is to determine what quality is required for the planned short- term and long-term uses of the images, and then to write the specifications up: resolution, tonality, use of particular targets, file format for storage and transmission, compression methods, delivery medium (CD, DAT, etc.), file naming schema, management data to be provided, and so forth. This serves as the basis for identification of vendors who offer services which match the specifications and who can name clients who have had similar work done to act as references.

When a potential vendor has been identified, it is essential to have a representative sample of objects scanned to see if the vendor can really meet the specifications. Full quality control must be performed on the sample images, both at the monitor and through printouts. Obviously, the equipment used for inspection must be of sufficient quality to display and print the images to the specifications. Low-end equipment will display images poorly even if the vendor has done an excellent job with the scanning; similarly, equipment with limited color capacity cannot be used to evaluate the color quality of an image.

While producing digital images is a complex and potentially expensive process, the results justify the effort when viewers benefit from high-quality maps and other materials whose paper versions are out-of-print, damaged, or of limited access. Careful attention to technical aspects of scanning will help guarantee a product that can serve viewers now and in the future.

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Access and Preservation via Digital Surrogate for Spatial Data

Mary Lynette Larsgaard
University of California Santa Barbara

Introduction

One of those problems of success in many spatial-data collections is how to preserve heavily used collections while at the same time making these collections available for what appears to be an ever-increasing audience. This paper will range from work done in one specific spatial-data collection, to a consortial approach, to an overall view for georeferenced information, as seen from the viewpoint of the digital library.

...how to preserve heavily used collections while at the same time making those collections available for what appears to be an ever-increasing audience.

Access or Preservation—or Both?

Some key thoughts in most map librarians' minds when they contemplate moving hardcopy collections into digital form are:

- Who are my library's primary users—present and future—and what are their needs?
- What purposes and benefits does this project have?
- I don't want to have this work done again—but how can my library financially support preservation-level scanning?

What is needed for users of this collection? Do they need access to the printing separates, or is a digital picture, whose information layers may not be manipulated digitally, acceptable?

The results of having asked these questions and having arrived at some of the answers at the Map and Imagery Laboratory (MIL) are the topic of this paper.

MIL's digital efforts are in three inter-related areas:

- Davidson Library;
- University of California/Stanford Map Librarians Group (UCSMLG); and
- Alexandria Digital Library (ADL).

In actuality, these three areas are interrelated, since the Davidson Library administration is a strong supporter of MIL's participation in UCSMLG and of the Alexandria Digital Library, and since UCSMLG is considered a primary source of information.

Davidson Library: The library administration has supported a comparison study of scanning of air photos, by three different firms: Stokes Imaging, Luna Ltd., and TGS Technologies. The object of this study was to find out what would be an optimal way to get MIL's 3,800,000 air photos scanned, preferably as many as possible in time to form a part of the ADL collections. As will be noted later, MIL already had a scanner which was being used mainly to scan air photos; but our primary goal at the time of purchase of that scanner was to have an inexpensive data-ingest scanner for Alexandria research. Prices per scan differed considerably from firm to firm, varying directly with the size of the file generated by the scanning procedure (itself dependent on dpi and bit depth).

The object of this study was to find out what would be an optimal way to get MIL's 3,800,000 air photos scanned.

A few points were discovered very quickly. Eight-bit depth is usually sufficient for general use of air photos (although we have experimented and scanned some at 24-bit depth—and then decided the tradeoff

Eight-bit depth is usually sufficient for general use of air photos.

of having a file three times the size of an 8-bit file was probably not justified for our general users), and 24-bit depth is appropriate for air photos.

Or, to put it another way, what is "enough" resolution?

Our decision as to appropriate dpi level was made by eyeball, noting that an air-photo print scanned at 600 dpi gives the general user approximately what is available from the actual print. Neither 150 nor 300 dpi is sufficient while 600 dpi is for many users—but how much more detail is needed for very sophisticated users and for archival purposes? Or, to put it another way, what is "enough" resolution? And the answer is, as always, that depends—who are your users and what do they need to do with the information?

Scanning to the size of the silver-halide grains in the film emulsion results in very large files.

Scanning to the size of the silver-halide grains (12 microns) in the film emulsion—which is appropriate for archival purposes—results in very large files. There is currently a scanner designed especially for air photos (it even has a roll-film transport)—Lenzar's LENZPRO—which will scan to that level. It is also very fast, taking two minutes and eight seconds to scan a 9" x 9" air photo, resulting in an 800MB file; it is intended for heavy-duty production scanning, and thus is ideal from MIL's point of view—but the cost of ca. $120,000 is not!

Another decision is whether it is best to scan one's own materials, or to contract out the scanning.

Another decision is whether it is best to scan one's own materials, or to contract out the scanning. Once again, it depends—is this a one-shot deal, or will your library continue to do scanning over long periods of time; and moreover, will you and affiliated institutions be doing scanning of so many items that economies of scale may be realized by collaborative operations? This leads us to the next of MIL's projects for digital access and preservation.

University of California/Stanford Map Librarians Group (UCSMLG): The UCSMLG is a close-knit group that has been in existence since the mid-1970s. On June 20, 1996, the group held a meeting at MIL. We had available a handout, from a previous meeting held on June 14 at the University of California at Berkeley libraries, that had addressed the more general question of digital imaging of all types of library materials. This draft is currently being revised and we hope for a final version later this year (1). The criteria given in this handout, titled "Principles of Selection for Digitization," are: meets current faculty and student information needs; offers economies of scale by benefiting many faculty and students (locally and worldwide); maintains local or consortial collection balance among disciplines, information formats, and instructional and research tools; adds value over paper- or film-based copies in various ways (e.g., more timely availability, more extensive content, greater functionality, greater access, improved resource sharing due to the ubiquity of digitized resources, increasing usefulness of the total collection, etc.; justifies costs of digitization, including archival maintenance and access costs for the library as well as for its users; achieves the goals of conversion to digital form (e.g., publishing, archiving, replacing, preserving); meets criteria of copyright, fair use, and other legal restrictions imposed on intellectual property; provides orderly access and navigation to and within the item or collection; is accessible from all institutionally-supported computing platforms and networked environments; employs formats that follow industry standards and are fully documented; platform-independent, available in a multiplicity of formats; originals difficult to use; commitment made by library to preserve both originals and digital files; possible to capture information adequately, to enable the digital version at least to serve as a surrogate for the original, thereby reducing demand for (and thus wear and tear on) originals; originals not damaged by the conversion process; losses of integrity of files caused by

With this list in hand, the group put together a list of items that most needed to be digitized.

Maps of historical interest, including old plat maps of Berkeley and maps that show the burned area of San Francisco after the 1906 earthquake...

What seems to be a workable solution is to have two scanners.

migration of files minimal; preservation problem already exists with original (e.g., risk of damage or loss); security needed for original; of interest to funding agencies; originals have research value; etc.

With this list in our hands, the group discussed what needed to be done, and as a result put together a first-step draft white paper (2) (goals; procedures) and a list of items that most needed to be digitized (e.g., unique, heavily used collections at each library; items each library uses heavily, such as historic U.S. Geological Survey topographic quadrangles of California; etc.). The white paper is available at: http://alexandria.ucsb.edu/~carver/ucop3.htm

Following is a sample listing of collections suggested for digital imaging by the map libraries:

- Topographic survey [of the coasts of the United States] / U.S. Coast & Geodetic Survey. Scale 1:5,000-1:80,000. 1851? G3700 svar.U5 Case B Library has: 256 sheets, Reports T-1825-7, T-3653 NOTE: Scan Bay area 1:10,000 sheets. First geodetic survey of the coastline.
- Pacific Aerial Surveys. [Aerial photography, Berkeley campus, 1994]. Scale [ca. 1:600] Oakland, CA : Hammon/Jensen/Wallen & Associates, 1994. Map Room G4364.B5:2U5A4 1994.P3 Case B Library has: 22 col. photos. NO copyright.
- United States. National Ocean Service. [United States nautical charts]. Scales vary ; Mercator proj. Washington, D.C. : U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, [18—? Map Room G3701.P5 svar.U51 Case B - NOTE: Scan all Bay area charts 1849-present, perhaps at 20 year intervals. Useful for shoreline changes.
- Non-copyrighted Bay-area cities. i.e. pre-1946 copyright expired, maps, esp. Oakland, Berkeley, San Francisco
- Index maps for maps and air photos—AMS/DMA index maps would be ideal, since most are small. (1K-3K sheets?)
- All CA topographic quads (or maybe those before a certain date, say 1950)(2K? sheets)
- County road maps from Caltrans. Maybe consider imaging one set for each decade?
- Maps of historical interest, including old plat maps of Berkeley, maps that show the burned area of San Francisco after the 1906 earthquake, how the San Francisco shoreline changed, county maps showing California rancho boundaries, etc.
- Outline and base maps of all kinds (county boundaries, hydrology, main roads, etc.)—useful for students and people in business
- California Forest and Range Experiment Station. Vegetation type maps of California and western Nevada. Prepared by Forest Survey Staff, A. E. Wieslander in charge... in cooperation with the University of California. [Washington, D.C., 1932-38].
- Los Angeles City. Bureau of Engineering. Street Opening & Widening Division. Topographic map sets of Santa Monica Mountains, Sunland-Tujunga-Verdugo Mountains, North-East Los Angeles, Sylmar-Granada Hills, Chatsworth Reservoir-Canoga-Park-Knapp Ranch, Baldwin Hills-Westchester-Playa Del Rey, San Pedro, LA Freeway Downtown Loop, Central LA, and Benedict Canyon. Los Angeles: Bureau of Engineering, 1959-75.
- Los Angeles (Calif.). Police Dept. Area boundaries of the Los Angeles Police Department [map]. Los Angeles, CA: Los Angeles Police Department,

The overall goal of the Alexandria Digital Library is to build a distributed digital library for geographically referenced materials.

Since it is estimated that about 90 percent of all spatial data is available only in hard-copy form, metadata is of the greatest importance.

MIL's collections contain nearly 3.8 million air photos. The photographs of Southern California, especially of the older flights, are heavily used.

Cartography and Visual Aids Unit, [1992-96]

- Nature Conservancy (U.S.) Color infra-red aerial photos of Santa Cruz Island. Santa Barbara, CA: Pacific Western Aerial Surveys, 1985.
- United States. Bureau of the Census. 1990 County Block Maps. S.T.F. series for Los Angeles County (includes census tracts. Washington: U.S. Bureau of the Census, [1991].
- United States. Bureau of Land Management. [Township plat maps of the United States]. [1855?-

What seems to be a workable (but not easily fundable) solution is to have two scanners—one for oversize items (e.g., maps)—and the other a production-level scanner for air photos, that would travel from campus to campus, starting with the items of greatest use to the largest number of University of California users (e.g., the aforementioned historic USGS topographic quadrangles), or unique items at greatest risk of being damaged or lost. In any case, the scanned items would be prime candidates for inclusion in the Alexandria Digital Library.

The Alexandria Digital Library: First, I will describe the Alexandria Digital Library, how it began, what it is, and its goals and accomplishments. Its overall goal is to build a distributed digital library for geographically referenced materials—maps, images, text, multimedia, and so forth. The Alexandria Digital Library is one of six Digital Library Initiative (DLI) projects funded jointly by the National Science Foundation (NSF), the Advanced Research Projects Agency (ARPA), and the National Aeronautics and Space Administration (NASA). The six funded institutions are Carnegie-Mellon, Stanford, the University of California at Berkeley, the University of California at Santa Barbara, the University of Illinois at Urbana-Champaign, and the University of Michigan at Ann Arbor. Each of the six projects—which began in October of 1994, and run through September of 1998—has a different focus; the focus of ADL is to provide online access to georeferenced information, with an emphasis on spatial data. Since it is estimated that about 90 percent of all spatial data is available only in hard-copy form, metadata is of the greatest importance, given that very often this is all the user will be able to find in digital form. ADL has a beta-test site on the Web, which we encourage you to visit, try out, and let us know how we might improve it. For more information on ADL, or on any of the other five DLI projects, go to the Web site:

http: / / alexandria.sdc.ucsb.edu

As a major part of the prototype, approximately one hundred items in digital form were ingested. Approximately 60 of these were aerial photographs; only three were hardcopy maps, and the rest were georeferenced information already in digital form (e.g., AVHRR—Advanced Very High Resolution Radiometer; DEM—Digital Elevation Model; DLG—Digital Line Graph; TIGER files from the 1990 U.S. Census; Landsat satellite images; SPOT satellite images; a text on the Channel Islands with a link to an image of the islands). A CD-ROM was then made with metadata for all the images plus about 40 of the actual digital items.

Why did the prototype—in the scanning arena—focus on air photos? First, MIL's collections contain nearly 3.8 million air photos. The photographs of southern California, especially of the older flights (such as a 1928 flight of the coast of Santa Barbara County), are very heavily used. This very frequent pulling and refiling (some indexes are used several times in one day)—even though it is done by student assistants and not by the users—is deleterious to the indexes and the frames. It is extremely labor-intensive; one

Unfortunately, it is almost impossible to get a good color balance unless one is scanning a transparency on a light table.

It takes well under five minutes to scan one item, even at the 600 dpi that MIL selected to scan its air photos.

Another reason that the air photos are an excellent choice for scanning is that the size of a monitor of a computer is seldom more than twenty-one inches, and for the majority of users, it is much less.

search can easily take several hours of staff time to pull and refile. It is easy to misfile and, as is true with all the "spineless" cartographic materials, when an item is misfiled, especially in such a large collection, it's gone.

The scanners MIL has are a venerable (ca. 1987), finicky Eikonix and a Sharp JX-610. Purchased in 1987 for about $60,000, the Eikonix takes 45 minutes to scan a color object in a 48MB file or about 20 minutes to scan a 15MB black and white file. In either case the result is a 6,000 x 6,000 pixel image, no matter what the size of the object, be it 35mm slide or 5' x 4' nautical chart. Unfortunately, it is almost impossible to get a good color balance unless one is scanning a transparency on a light table (a consistent light source is essential). Maps are not transparencies, and in addition we were not interested in scanning the maps in sections, as has been done in other libraries; this meant we were effectively limited to scanning air photos. The Sharp has a maximum size of 11" x 17", with several different dpi's possible—150, 200, 300, 400, and 600. It takes well under five minutes to scan one item, even at the 600 dpi that MIL selected to scan its air photos (which resulted in 29MB for black and white and 98MB for color). Thus the Sharp (which was ordered with a special attachment so that it could scan transparencies) is ideal to scan 9 " x 9" air photos, which constitute the vast majority of MIL's air photo collection; we do have about 90,000 4" x 5" obliques and perhaps 10,000 9" x 18" air photos. We discovered later that the Sharp introduces some distortion, in the direction of the scanning arm; this means that the scans are not appropriate for use in photogrammetry, although for general use, they are fine.

During January of 1997, MIL initiated a pilot production-scanning project, using the Sharp scanner and funded by the University of Arizona. One skilled (Arc/Info; Unix; scanner) worker could scan and create metadata at three frames per hour. This worker also generated coordinates for frames off air-photo mosaics and other indexes at the rate of 400 frames per hour.

Another reason that the air photos are an excellent choice for scanning is that the size of a monitor of a computer is seldom more than twenty-one inches and for probably the majority of users it is much less. Air photos are perfect; they are 9" x 9", and thus can be displayed on many monitors at exactly the size of the original item, or even larger. While it is true that air photos are very high resolution, well beyond the 600 dpi-maximum of the Sharp scanner, for many users, the 600 dpi resolution that appears on a screen monitor seems to be acceptable.

While there are maps that are 8.5" x 11", the bulk of MIL's maps are far larger, since MIL specializes in medium-scale topographic sheets (say, 2' x 3') and nautical charts (which can easily be, as was previously mentioned, 3' x 4' and even larger). This meant that if MIL had decided to scan maps, users would first have had to view a thumbnail, and then zoom into an area of interest; the problems of providing users with a location map, scale, north arrow, and legend that could be popped up at any time the user needed them will need to be solved over the next two years, but were certainly not anything we could deal with in the short term.

Air photos are one layer of information, which means that scanning them works extremely well as a form of information delivery. What some users need is to manipulate the different layers of information that make up each map, which means that ideally the individual print separates would be scanned (although there is technology that can "scan" a printed map and separate out the layers with some level of success). On the other hand, many users just need to look at a map (sometimes slightingly called the "pretty picture" syndrome) so certainly scans of maps are by no means useless. It happens that the University of California at Santa Barbara has both a very active Geography Department that emphasizes the use of spatial data in digital form, and the National Center for Geographic Information and Analysis. Given those two points, and given that Alexandria is a research project, what would be most appropriate both for the faculty and for the ADL funding agencies is to work with layers of information.

On the other hand, many users just need to look at a map…

During a late-January 1997 meeting of the ADL Advisory Board, the main recommendation of the Board was the need for increased content (data and metadata) in Alexandria. In light of this recommendation, MIL is working on extending the pilot production-scanning project, since the nearly one gigabyte a day resulting from this work now has a place to go—disk storage—and a server capable of handling heavy traffic—a DEC AlphaServer 4100, whose system name is, appropriately enough, fat_albert.

MIL is working on extending the pilot production-scanning project, since the nearly one gigabyte a day resulting from this work now has a place to go—disk storage.

Conclusion

Spatial-data collections find themselves in the "interesting times" of the Chinese proverb, as we simultaneously maintain our hard-copy collections while steadily and increasingly collecting data in digital form. Scanning the hard-copy collections to keep them from damage caused by handling appears to be the way we will need to proceed.

Spatial data collections find themselves in the "interesting times" of the Chinese proverb…

Footnotes

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2. [Carver, Larry]. Draft 1.0 (UC/S working group for distributed spatially indexed information), 8-19-96; Alexandria Digital Library for Spatially Indexed Information. Santa Barbara, CA: Map and Imagery Laboratory, Davidson Library. Http://alexandria.sdc.ucsb.edu/~carver/ucop3.htm

LC/G&M's Scanning Program: Where We Are and How We Got Here

Elizabeth Mangan
Library of Congress

It was clear that the complex and expensive array of computer equipment that was required would be difficult, if not impossible, to acquire through normal budgetary channels.

The purpose of the center is to coordinate the contribution of various resources from a wide spectrum of the geographic information and cartography industry.

These donations will facilitate sharing the rich cartographic resources of the Division electronically.

When the staff of the Geography and Map Division began assessing how digital forms of geographic and cartographic information could be integrated into its collections, we realized the new technologies would require knowledge and skills that we did not possess. It was also clear that the complex and expensive array of computer equipment that was required would be difficult, if not impossible, to acquire through the normal budgetary channels for appropriated funds.

In November 1993 the James Madison Council, a private sector advisory group to the Library, provided $30,000 to investigate the establishment of a corporate support group for the Division. That same month, Alan M. Voorhees, a long-time friend and supporter of the Geography and Map Division and the Library, volunteered to lead the effort in attracting industry support.

The first meeting of this corporate support group, which was named the Center for Geographic Information, was held at the Library on January 12th, 1995, when eight firms committed to being charter members: Autometric, Inc., Environmental Systems Research Institute, Harvard Design and Mapping Company, H.M. Gousha Company, Intergraph Federal Systems, MAGELLAN Geographix, MapInfo Corporation, and Tangent Engineering. Mr. Voorhees, who is chairman of the board of Autometric, a firm engaged in many aspects of the latest geographic technologies, agreed to be chairman of the Center for Geographic Information.

The purpose of the Center is to coordinate the contribution of various resources and knowledge from a wide spectrum of the geographic information and cartography industry. These donations will:

1. assist the Geography and Map Division in making the transition to the age of electronic maps and digital forms of geographic information through advice, training, and financial support for acquiring hardware, software, and data sets;
2. facilitate sharing the rich cartographic resources of the Division electronically;
3. promote the use of electronic forms of geographic information by many sectors of the nation, including libraries, academia, industry and commerce, education, and the general public;
4. encourage the deposit of digital spatial data sets by American and foreign governments, industry, and academic producers; and
5. advance the Library's publication, education, and exhibition programs in geographic information and cartography.

The charter members of the Center established full membership at $5,000 annually and associate membership at $500 annually. Support from industry members also includes in-kind assistance, as necessary, in providing the Division with appropriate equipment and software to begin developing expertise in the scanning of maps and the use of software and digital forms of geographic data; deposit of data sets; and participation on committees to accomplish the goals of the Center.

Members have enhanced access to the Library's vast collections of cartographic materials.

The Division's collections now contain approximately 4,000 CDs and computer software packages.

Direct cash contributions to the center totals approximately $100,000, and the value of hardware and software contributed to date is over $700,000.

Members of the Center benefit in a number of ways:

1. the Division's expertise in cataloging cartographic materials is shared with developers and users of digital forms of geographic information;

2. because of its unique position within the Library, the Center can sponsor programs that address specific needs of the cartographic and geographic information communities and provide useful links among these communities and with Congress and other institutions;

3. by working with producers and users of geographic information and digital cartography the Division can ensure that digital forms of geographic information are systematically collected and preserved for the future use of the nation; and,

4. most importantly, members have enhanced access to the Library's vast collections of cartographic materials, which they are encouraged to use as resource material and to distribute in a variety of value-added formats.

For those of you who might not know, the Library of Congress collection of cartographic materials is the largest in the world, containing approximately 4.6 million maps; more than 60,000 atlases, which contain another 8 to 10 million maps; approximately 300 globes; as well as relief models, puzzles, fans, powder horns, and almost anything else that might have a map on it. In the early 1990s, digital files of geographic data began appearing among cartographic materials deposited by federal mapping agencies and cartographic software through copyright deposits. The Division's collections now contain approximately 4,000 CDs and computer software packages which are controlled in an online ProCite database restricted to Division staff.

The Center for Geographic Information has met five times since the organizational meeting in January 1995: June 1995 at the Library; October 1995 at MAGELLAN Geographix in Santa Barbara, California; May 1996, back at the Library; September 1996 in Bellvue, Washington, sponsored by Corbis; and January 1997 in Denver, Colorado, sponsored by Tangent.

As of the first of April the Centers membership has grown to 14 members and 10 associate members. The new members are Autodesk, Inc., Corbis Corporation, Digicolor, Inc., the Hewlett-Packard Company, LizardTech, Inc., Microsoft Corporation, Mindscape, Inc., Rand McNally and Company, and Tactician Corporation. The new associate members are ADC The Map People, CommuniVision, EDR/Sanborn, Inc., Adrian B. Ettlinger, Macromedia, Inc., MapLink, Inc., Navigator Publishing, Spatial Data Institute, and Systems Planning and Analysis.

We have made great strides in moving into the new world of digital geographic information in the last three and a half years, largely because of the efforts of our staff and their success in convincing private sector companies that they have a lot to gain by becoming involved in this enterprise. Direct cash contributions to the Center totals approximately $100,000, and the value of hardware and software contributed to date is over $700,000.

The first meeting resulted in the first donation. Robert Garber, Chief Operating Officer of Tangent Engineering, now Tangent Color Systems, spearheaded the indefinite loan of a large-format, flatbed, color scanner; a Sun Sparc workstation, and a Hewlett Packard 650 plotter. This system can scan flat items up to 24" by 34", in 24-bit color, at resolutions up to 600 dots per inch. Of course the plotter only prints at 300 dpi.

As a result of this donation, we acquired the technology to scan maps, and the Library's overall National Digital Library Program (NDLP) adopted our proposal to establish a National Digital Library Program for Cartographic Materials, which it has agreed to support

During the first year after the scanner was installed, we scanned several hundred maps in a trial phase.

With the HP donation of computer equipment, the Center for Geographic Information took a giant leap forward.

In preparation for the installation of this new equipment, the Division's Reading Room was reconfigured to construct a secured area.

through the funding of four positions in the Division to run the scanning program.

In a ceremony in the Division in April 1995, Dr. Billington and John Kluge, President of the James Madison Council, cut the ribbon on the scanner and participated in the scanning of the first image from the Library's cartographic collections, George Washington's *A plan of my farm on Little Huntg. Creek & Potomk*, which the first President drew in 1776. The result is so fine that it is difficult to distinguish the scanned map from the original manuscript.

During the first year after the scanner was installed, we scanned several hundred maps in a trial or testing phase and have been working with the members of the Center on technical standards and workflow design in preparation for large-scale scanning projects for the NDL.

Shortly after the donation of the scanning system, the Hewlett Packard Company made a major donation to the Division and we found ourselves in the enviable position of having the full infrastructure necessary to accomplish our long-range goals. With the HP donation of computer equipment worth nearly $600,000, the Center for Geographic Information and the Divisions related GIS Facility both took a giant leap forward.

During a reception in May 1996 to thank Hewlett-Packard for its generous donation in support of the Library's NDL Program for Cartographic Materials, the Librarian of Congress, Dr. James Billington remarked on the importance of this gift. He observed that, "In helping the Geography and Map Division adapt to the modern world of geography and cartography, the executives of HP who made this donation possible have also embellished the vision of their company's co-founder, David Packard," adding that the NDL Program was started with $13 million in seed money of which $5 million was from the Lucille and David Packard Foundation.

In preparation for the installation of this new equipment, the Division's Reading Room was re-configured to construct a secured area to house the servers and optical storage jukebox as well as the scanning equipment. Access to this area is restricted to selected staff members through the use of a swipe card system to unlock the doors. Additionally, an alarm system with both motion and infrared-heat detectors is used to secure the area when we are closed.

The HP donation will assist in the development of the Division's GIS Facility as well as its NDLP scanning effort. It consists of a Series 9000, K400 Server, featuring four 100 MHz processors, 1.2Gb system memory, 8Gb internal hard-drive, running HP/UNIX and a SureStore 165ST optical disk jukebox, featuring slots for 128 Write-Once-Read-Many (WORM) or Rewriteable optical disks for a total of 165Gb of storage. HP also donated three 712/100 workstations, featuring 100 MHz, PA-RISC processors and 192Mb of system memory, running HP/UNIX and a Series 9000 J-200 workstation, featuring two 100 MHz processors, 256Mb RAM, 2Gb hard-drive, and special graphics enhancement, to replace the Sun Sparc workstation on loan from Tangent for the NDL Program.

Recognizing our need for equipment to provide access to the digital images created for the NDLP and to allow patrons to use Geographic Information Systems, HP donated three HP Vectra PCs, featuring 120 MHz processors, running Windows 95; three HP Pavillion PCs, featuring 166 MHz processors and full multi-media capabilities, running Windows 95; three Envisex P Series X-Window Stations; a 715/100 workstation, featuring a 100 MHz, PA-RISC processor, 256Mb of system memory, and an enhanced graphics display, running HP/UNIX; two DeskJet 1600CM color printers; a LaserJet 4MV, 11" x 17" printer, and a DesignJet 755C, 36" roll feed, color plotter, with 72Mb of memory.

Following the installation of the equipment we were able to appoint the remainder of our NDL team. We now have five full-time staff members responsible for creating digital images, a Processing Technician, two Digital Conversion Specialists, a Digital Conversion Coordinator for Production, and a Digital Conversion Coordinator for Systems, who also serves as our WebMaster.

We now have five full-time staff members responsible for creating digital images.

Ten core historic Americana aggregations from the Division's collections have been designated to be scanned for the National Digital Library Program. These include Civil War maps, county land ownership maps and atlases, late 19th and early 20th century panoramic maps of U.S. cities, Sanborn fire insurance maps, and maps and atlases of the District of Columbia. During the first year after the arrival of the scanner we tested the scanning of a variety of materials from the collections, and even though most all of the items scanned have been done as on-demand requests, we have been able to scan examples from most of the aggregates designated for the NDLP.

Ten core historic American aggregations from the Division's collections have been designated to be scanned.

You have probably noticed that I have been using the word "scanning" rather than "digitizing" in describing these activities. The Division is heedful of this distinction because the images we are creating are raster images that have not been geo-referenced.

Since Tangent scanners had formerly only been used by the military for scanning current maps, the scanning of the Library's collections is their first opportunity to have this equipment used with older materials which present a whole new range of problems, including: discoloration; scanning through Mylar ; atlas bindings which can't be flattened; brittle, disintegrating maps, to name just a few. The handling of our valuable, rare, and often delicate items presents problems all their own. Once these items are scanned we don't want to expose them to the process unnecessarily. Unfortunately the scanner doesn't seem to understand this concern. While scanning the Division's Agnese atlas the two lenses went out of calibration, resulting in a mis-alignment on each image, which wasn't discovered until the entire atlas had been scanned! Tangent has continued to work closely with us while we are learning the scanning software and to make the necessary modifications to both the scanner and the software when problems arise and to upgrade the software when improvements are made.

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The Scanning Committee of the Center for Geographic Information is advising us in setting up our NDL production of images. The Committee was established during the Center's meeting last May to discuss the workflow and technical issues concerning the images for the NDLP. The Committee has advised us to scan at 300 dpi and to save the images in TIFF format.

In establishing a production workflow we have encountered a number of stumbling blocks in getting the equipment networked using the Library's standard twisted-pair token ring network and processing the images in preparation to making the them available on the web. Moving the images around in this environment has proven problematic. Finding software to manipulate and edit the images which is compatible with the HP/UNIX has been hopeless since most software of this type is written primarily for Solaris/UNIX. When we discovered that Claris had developed Macintosh emulation software for HP/UNIX, we were confident that we would be able to use the Macintosh version of *xRes* on the workstations provided by HP. Macromedia, one of the Center's members, donated two copies of *xRes*, the Macintosh version and the WindowsNT version. Unfortunately, we have been unable to successfully load the Claris emulation software.

Following the xRes processing, the images are temporarily stored on HP Surestore jukebox magnetic optical platters.

This software integrates multiple resolutions of an image in a single file, which means that when users zoom in they get better and better resolution.

LizardTech's MrSid doesn't require any special hardware to operate.

We have loaded the WindowsNT version of *xRes* on an Intergraph workstation which is on loan to the Library for evaluation. Since this machine is located one floor above us, we must ftp the image to the Intergraph machine in order to perform quality review and post-processing to rotate, crop, adjust brightness or contrast, and stitch together the TIFF images. Through working with these large images, approximately 180Mb each, and conferring with Macromedia, we have determined that the ideal computer for this task would be a single processor Pentium Pro, at least 166 MHz, with 500Mb of RAM, graphic accelerator card, 21-inch monitor, and an 8Gb hard-drive running WindowsNT; or, alternatively, a Macintosh 9600 PowerPC with a 300 MHz single processor.

Following the xRes processing, the images are temporarily stored on HP Surestore jukebox magnetic optical platters which can each store 1.3Gb. We then compress the image, using a wavelet-based image compressor software called Multi-Resolution Seamless Image Database, or MrSID, which was developed by LizardTech, another corporate partner in the Center for Geographic Information. This software integrates multiple resolutions of an image in a single file which means that when users zoom in they get better and better resolution. Since MrSID stores the images in a seamless manner the user can zoom in and out. A Netscape plug-in which will enable a user to pan, providing immediate access to any portion of a large image as quickly and easily as another, is scheduled to be released in the next few months.

Although MrSID is a "lossy" image compressor, we can compress the image at a ratio of nearly 22:1 and not experience any loss of information, because MrSID keeps track of every pixel from every image. One of the unique features of this compression method is its ability to decompress only that portion of the image requested by the user, which means that images of any size can be decompressed by a user with as little as 1Mb of RAM. Additionally, MrSID builds on each successive resolution by using data already decompressed and loaded, so the user gets immediate access to any location in the image at any resolution.

This software has four components:

- MrSID Compress, to compress images;
- MrSID Retrieve, to decompress MrSID files for use with other software;
- MrSID Viewer, a stand-alone application for viewing MrSID files; and,
- MrSID Distributed Image Database Server for Internet access to MrSID files.

MrSID doesn't require any special hardware to operate. MrSID Retrieve and Viewer operate on any platform, MS Windows 3.1, 95, NT, and MacOS and requires about 1Mb of RAM. MrSID Compress and Distributed Database Server operate in Windows NT, UNIX, and MacOS and require 32Mb physical RAM plus enough storage for the original image and for the compressed file. Input files can be raw data or in a number of popular raster formats including TIFF. MrSID Viewer allows exporting in MrSID compressed format and in non-MrSID formats.

The first aggregate of items to be scanned as a G&M Division project is our collection of panoramic views. Following the listing of items in *Panoramic Maps of Cities in the United States and Canada: A Checklist of Maps in the Collections of the Library of Congress*, published in 1984, we have completed Alabama through Minnesota. Permission to include facsimiles and items for which we have a photographic reproduction from another institution will be sought, so that those items can be made available in electronic form.

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We have also created a number of plotted images to be presented by Dr. Billington as gifts to Senators, Congressmen, and other dignitaries.

have encountered a number of problems with these. Even with access to a book scanner the size and weight of many atlases would prohibit the use of this type of scanner. We have tested using a digital camera suspended above an atlas in a book cradle, but the distortion inherent in the variable distance to the center of the cameras lens, especially in the gutter, have thus far proven unsolvable.

In addition to the bibliographic data in the USMARC record, which will serve as the primary access to the images in the Library's system, we will be building a metadata database using Paradox. The metadata database will include non-bibliographic data, including the number of images required for each scanned map, the number of versions of each image, the date the item was scanned, the scanner used, the reason or project for which the item was scanned, etc.

An unexpected benefit of our scanning program has been a new avenue for acquisitions. During the visit of the Madison Council in May 1995, the Chief of the Division was showing a facsimile of View of the University of Virginia, Charlottesville & Monticello taken from Lewis Mountain which was drawn by Casimir Bohn and published by E. Sasche & Co. in 1856, when Mr. Voorhees mentioned that he owned an original of this view. Mr Voorhees said that he would donate the original to the Library if he could have a print from the scanned image to replace it, since it was hung in his hotel in Richmond. When a former staff member, who is extremely knowledgeable in the history of cartography and printing, was visiting the hotel for a meeting and saw and examined the framed view he remarked, "I thought Al gave the original to the Library."

We have also created a number of plotted images to be presented by Dr. Billington as gifts to Senators, Congressmen, and other dignitaries, including a facsimile atlas which will be presented to the Pope during a visit this month by the Madison Council to Rome.

The Division's homepage is now available at http://lcweb.loc.gov/rr/geogmap/gmpage.html and the images we have created are accessible through our web site or the Library's American Memory web site at http://lcweb2.loc.gov/ammem/pmhtml/panhome.html.

Preservation of Cartographic Materials: A Case Study

David Cobb
Harvard University

Let us be sure to understand that this process, the actual treatment of the original itself, is the only one that preserves the item and not just its information.

Filming a 6 foot x 9 foot map and placing it on a one inch square piece of film has rather disastrous implications for access, viewing, and copying.

While most libraries do not like to admit their mistakes, I will admit to you that this project failed miserably on almost every variable that we attempted to evaluate.

Traditionally, preservation of maps has usually involved familiar practices of paper conservation and may have involved simple techniques such as tape removal, mending of small tears, and paper cleaning. Similarly, the process could become more involved with washing, applying a lining, varnish removal, and deacidification; and these processes usually would be performed by professionally trained conservators. Such processes continue today for collections that have completed needs assessment surveys and determine that certain items have artifactual value beyond their information content. In other words, such items meet certain criteria: they are deemed important to the institution's archival memory; they represent a significant cartographic example of that regions history; the item has significant monetary value; it is extremely rare and available in very few collections; or, is simply unique. Let us be sure to understand that this process, the actual treatment of the original itself, is the only one that preserves the item and not just its information.

Another process that is often used for embrittled materials is microfilming and, unfortunately, several collections of maps have been "preserved" in this manner. Another variant of this process is microfiche with which we are all too familiar. It is unfortunate because this is simply not a very satisfactory method for reformatting or saving map information. Filming a 6' x 9' map and placing it on a one-inch square piece of film has rather disastrous implications for access, viewing (much less research), and for copying. However, in some cases, this is the only format that you can acquire if interested in fire insurance maps, some atlases, and a variety of special collections offered by libraries. Most libraries are familiar with the number of fire insurance maps available on microfilm and I suspect your patrons are as fond of using them as ours are?

But before you think this may be another discussion of these two varieties of preservation let me assure you that it is not. I want to discuss two very different approaches to the preservation of cartographic materials that are ongoing in the Harvard Map Collection.

The first involved the creation of a prototype collection of maps that could be used to evaluate the use of Kodak Photo CD technology. For a variety of reasons we chose the geographical area of the Middle East and specifically the country of Israel. While most libraries do not like to admit their mistakes, I will admit to you that this project failed miserably on almost every variable that we attempted to evaluate. The major factor was that too many of the maps resembled my microfilm analogy of the 6' x 9' map being reduced to one inch of film. However, in this case, we were taking a 2' x 4' map—think of the geographic north-south shape of Israel—and attempting to reduce that to a 35mm color slide. When we photographed our ubiquitous 8.5" x 11" CIA map of Israel we had much better success, however, there are very few such sized maps for Israel. The issue here was not the failure of

The issue here was not the failure of the Kodak Photo CD technology, but rather the innocence that we exhibited while riding on the edge of a new technology in that historic year of 1994.

What is far more difficult is to then provide bibliographical or descriptive access...

Why can't we now index more information such as bridges, wharves, buildings, and parks?

the Kodak Photo CD technology, but rather the innocence that we exhibited while riding on the edge of a new technology in that historic year of 1994!

Perhaps we should have learned to step back and let others experiment, but it wasn't long before we entertained further experimentation with this technology as it tantalized our minds with thoughts of improved access and mitigation of preservation concerns. Our discussions with a commercial firm, already working at Harvard on other scanning projects, led us to believe that we might have success if we chose a genre of materials smaller in size and a consistency of size would also make it more cost efficient. After some review, we created a selection of consistently sized materials that were less than 3' x 3' by choosing to photograph and scan sections of our early fire insurance map collection. After initial testing proved satisfactory, we decided to photograph ca. 2,500 images from several years and from different map publishers. Remember, this was also going to be a test on improved access and we needed a large image file which could be tested as a suitable substitute for paper files.

First, once again, let me remind you that this is not preserving the item but rather reformatting it. However, this reformatting hopefully will improve access to these materials, allow the originals to be used far less, and that may be considered a "preservation" benefit to this process.

Let me stress that it is relatively easy and inexpensive to photograph and scan onto Kodak Photo CD's. What is far more difficult is to then provide bibliographical or descriptive access to, not only the titles on these CD's, but also the individual images themselves. Certain atlas titles, for example, included double-page maps and it was decided to photograph each of these as two images, rather than one. Suddenly, the one page index at the front of each volume was no longer valid as it now had two individual images for each one in the original. As our technology increases, be forewarned that you will fall prey to another techno phobia: why can't we now index more information such as bridges, wharves, buildings, parks, etc. The problem is you can, and this is fine if you reformatted 10 or 12 maps, but not fine when you have done ca. 2,500 of them.

Additionally, you are faced with creating a separate database for searching these items, keying the index to an individual CD, then inserting the CD, and searching for Image #27 for example. In other words, there is no magic software that allows you to query "Massachusetts State House" and in fifteen seconds the image showing the State House appears on your screen. In reality, you will have to create a database with all of the buildings you wish to search and then key them to "CD #X" and then "Image X" on that CD. This will become more complicated if you have 4 or 5 different images of the State House, on different CD's, representing different chronological dates, different publishers, and perhaps even different scales. To be perfectly honest, this is the stage where we find ourselves: attempting to decide which database will best satisfy our needs knowing that we will have multiple results to some of our searches and identifying a database that is expandable.

The Kodak Photo CD technology provides you with five different resolutions ranging in computer file size from ca. 256 KB to 18 MB. Some computers may not even be able to work with this largest file of 18 MB and it suffers from being relatively slow to load (an average of 45 seconds on a high end machine) and the entire image often cannot be viewed on one screen. Conversely, if someone wishes to concentrate on a particular segment of the map, requiring several zoom magnifications, this is the best size to work with. The intermediate file size, 4.5 MB, loads much more quickly, can be viewed entirely on one screen, and does allow considerable flexibility within the image.

For larger maps, and for serious research purposes, libraries may wish to consider the Kodak Pro Photo CD where an additional sixth file size averaging 72 MB, has been added. Obviously, fewer maps can be placed on one CD but the resolution for detailed viewing offers considerable improvements. It should be added that this information is current as of April 1997 and we can expect considerable improvement in CD, software, and equipment technology in the next few years, if not in the next few months.

Let me state categorically that CD technology is not, and probably will not be, THE answer to our preservation or access problems.

Let me state categorically that CD technology is not, and probably will not be, THE answer to our preservation or access problems. Perhaps it is appropriate to insert in our discussion the phrase: "at what price?" A Photo CD with ca. 100 images can be created for ca. $100 to which should be added 35mm photography of the materials. Our intent was never to "discard or recycle" our original maps but rather to improve access to them and better preserve them through the planned less handling as mentioned earlier. We believe we can create a useful indexing database and then completely substitute the digital copies for reference and research rather than the originals thereby mitigating our preservation concerns for these materials. Our access to these materials improves as students can produce color copies in the Map Collection in less than a few minutes. Moreover, imaging software allows the user to magnify their specific area of interest, albeit limited, better than the human eye can and far less expensively than photographic processes used in the past.

Our intent was never to "discard or recycle" our original maps but rather to improve access to them...

Therefore, we will accomplish our goals of improved access and preservation for this collection using CD digital technology. For considerably less than $5,000 we have been able to take nearly 3,000 fragile materials out of circulation, away even from reference, and yet believe we will be able to improve access to them. Obviously, the benefits are on the access side and we will still have to address the preservation issues in the future. Our goal was to preserve materials for the future when we might be better able to address these issues; we were definitely fearful of losing many of these items due to the increased popularity of early fire insurance maps. It is hoped, over the next several years, to move more heavily used and fragile materials to this format for quick reference, ease of copying, and to decrease use of the original paper materials. Such materials will include additional fire insurance maps, maps of the Boston region, maps of New England, and some of our urban maps of European cities which are heavily used by landscape architecture and planning students.

A quite different, and yet very related, project was created based upon the need of students and faculty. Essentially, that need was their use of the 1990 U.S. Federal Census, it was aging rapidly, and they required additional information that would be up-to-date. Even though very few of our students are from Massachusetts they are still using the state, and the City of Boston, as the laboratory for many of their studies which require socio-economic and environmental data.

Unlike the rest of the country where counties are the basis for most data dissemination, it is the town that is the collection dataset for most of New England.

Unlike the rest of the country where counties are the basis for most data dissemination ,it is the town that is the collection dataset for most of New England. This was still not nearly as detailed as census tracts or block groups, but in Massachusetts 351 towns certainly provided a far greater geospatial variation than would its fourteen counties. We soon found ourselves collecting information on shopping centers, tax rates, employment, supplemental income, race, and ethnicity. It also soon became apparent that we were identifying data that was far more detailed than the decennial Census

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ESRI's cooperation was invaluable to this project and their time investment and expertise allowed us to progress to our defined goals and objectives.

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and data that would never be included in any decennial Census.

An Advisory Board, including a local geography professor and demographer, led us to believe that we should publish an atlas for the State of Massachusetts. Further discussions led us to realize the folly of such a proposition. We knew that it would become a static collection of information the moment it was published and the very data itself revealed the dynamics of the changing economy, society's transitions, and the increasing challenges to our environment.

It soon became apparent that we should consider what had been in front of us the whole time: the World Wide Web. There were other atlases on the Web which we studied, reviewed, and then created a list of our own needs:

- Work interactively rather than just providing images.
- Expandable.
- Work with current Internet provider software packages.
- Provide zoom features.
- Provide geographic data features: scale, legend, and radial mapping.
- Provide graphic images, data behind them, and metadata files.
- Allow users easy access and self-explanatory use—a REAL challenge!

We are fortunate to have a cooperative working relationship with the Environmental Research Systems Institute, Inc. through the ARL GIS Literacy Project and with its Boston regional office. Discussions soon began as to how we might address our needs and goals related to the collection, cataloging, and dissemination of digital data and progressed from considering ARC-INFO, to Map Objects, and eventually to the Arc View Internet Explorer. ESRI's cooperation was invaluable to this project and their time investment and expertise allowed us to progress to our defined goals and objectives.

A cooperative resource sharing relationship with one of Massachusetts planning organizations, the Metropolitan Area Planning Council, led to discussions with the Massachusetts Regional Planning Associations. Their support, and financial assistance, moved the project forward and led us to concentrate our efforts in the following categories: geographic boundaries; communications; crime; education; employment; environmental regulation; income; physical characteristics; population; race/ethnicity; real estate/lodging; and transportation.

The atlas debuted on January 10, 1997 as one of the first interactive state atlases with 150 different data layers. The user interface continues to be reviewed, revised, and hopefully improved. The limitations of one screen to inform "everyone about everything" is challenging and yet it should be realized that most people will probably not read your instructions on "How to Use the Atlas." The challenge is to address GIS issues in a non-jargon language that will be understood by a variety of users that are essentially unfamiliar with the techniques or principles of GIS. We assume that our users will range from the state official or business planner, with some GIS experience, to the middle school student who may just happen upon the Atlas on the Internet. It is important that we not affront the intelligence of the practioner nor make it so difficult for the uniniated to use it.

Such a project has several implications regarding service and data interests.

Emphasize State & Local Data vs. Federal Data

Regardless of what may happen with Census 2000, libraries will always be faced with the issue of updating the decennial census as researchers continue to demand, and expect, more up-to-date data and geography. If the data collection for Census 2000 should be decreased this will place an even greater emphasis

While it is difficult to monitor currently, it is apparent that a wider variety of users are attracted to the digital data and its applications than those previously attracted to traditional print resources.

Libraries that are able to move from the traditional print world into the digital world have a tremendous marketing/PR potential.

We must look at data as an access versus ownership issue...

and dependence upon state and local data for planning and research purposes. Our past practices in libraries have not given this data its proper credit and we may find ourselves more dependent upon it than ever before.

New Partnerships with Data Creators

As libraries become more familiar with GIS technology, and data management techniques, we will become "players" in the digital field of GIS access and will be able to exhibit our strength of adding service. It is very probable that libraries will now be invited to sit and discuss access and service issues with the data creators and form a profitable cooperative relationship.

Creates a 'Library Without Walls'

Implications are positive for the digital library as we allow more users to enter this library than ever before, it is not dependent upon discipline, and it is theoretically open twenty-four hours a day and 365 days a year. The negative side is that we may no longer know our users nor are we able to provide the reference interview that can be so important to providing the appropriate material for the question.

Attracts Users that would never use the Library

While it is difficult to monitor currently, it is apparent that a wider variety of users are attracted to digital data and its applications than those previously attracted to traditional print resources. It is also important to note that interest in the print collections is rising in a similar geometric pattern as persons may initially approach the library with a digital question and leave with a traditional map copy.

Marketing/PR of GIS Services

Libraries that are able to move from the traditional print world into the digital world, and back and forth, have a tremendous marketing/PR potential. They have the ability to boast of their traditional collections and yet let their users and the library administration know that they have not become a paper museum. They have chosen to participate in the new digital technology and maps are one of the most powerful tools in this arena.

Rethinking Archival Responsibilities

As we begin to collect (and save?) digital data it becomes evident that we must give some consideration to archival responsibilities. If we choose to display a map of welfare recipients in 1996 what choices should we make when the 1998 data arrives—do we simply delete the "old" data? Often, as libraries are well aware, it is the historical data that is far more valuable than current information.

Emphasis on Data

A GIS database emphasizes data, not maps, and that will be a potentially significant change for map libraries as they evolve into the next millenium. Not only will this change our current thought process but it may place us in conflict with other departments and disciplines that have considered "data" their discipline. It is important that we work with others in the Library, and outside, to convince them of the critical importance of GIS as an analytical tool and how data dependent the technology is. We must also look at data as an access versus ownership issue and that is a library philosophy that will continue to be discussed well into the future.

REVIEW

By Arlene Olivero

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Map Collection

Bartholomew Euro Maps on CD-ROM Version 1.0

1996

Bartholomew Digital Data
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Bartholomew Euro Maps on CD-ROM provides an extremely rich vector data set for the European continent at the scale of 1:1,000,000. The CD-ROM is available in either ArcView, MapInfo, Atlas GIS, and AutoCAD format and contains nearly forty separate layers of digital data. These layers include towns; tourist points; roads; ferry routes; public and private rail lines; international and local airports; international boundary lines; major and minor internal boundary lines; administrative divisions; built-up urban areas; rivers; lakes; coastline; canals; miscellaneous water features; graticule lines at intervals of 10° longitude and 5° latitude; woodland (British Isles only); reserves; forest parks; regional parks; national parks; sand; topographic contour regions; sea depth contour regions; mountain points; and a gazetteer of cities and towns, including population where known.

The data set is stored in longitude/latitude coordinates with no cartographic projection. The primary source of this data was the U.S. Defense Mapping Agency Operational Navigational Chart series at 1:1,000,000, although additional sources are used. All layers are consistent throughout Europe, except for the British Isles (United Kingdom, Republic of Ireland and Isle of Man) which contain slightly more detail in certain data layers. For example, some intermediate contours and certain additional layers such as woodland are provided for the British Isles only.

The layers on the CD-ROM can be accessed individually or by opening a helpful sample project on the disk which includes a view containing all the layers, with appropriate settings for display and labeling. The CD-ROM also provides useful sample legends for every theme which allows users to individually and quickly symbolize the data if the user does not want to create customized symbology for a layer.

Because each data layer covers the entire continent, and thus contains a very large set of data, more detailed layers take some time to draw at small scales. Although other vendors have addressed this issue by dividing large continental datasets up into smaller geographic "tile," Bartholomew has chosen to increase drawing speed by providing a corresponding spatial index for every layer and by wisely dividing certain subject layers into multiple smaller, yet still continental, layers. For example, the town layers are divided into small towns, medium towns, large towns, and extra large towns. Similarly, the river and lake layers are divided into small rivers and lakes, medium rivers and lakes, and large rivers and lakes, while the road layer is divided into toll and other motorways, dual carriageway major roads, single carriageway major roads, single carriageway minor roads. An overview layer of generalized polygons for each country is also provided. These generalized or less detailed layers can be drawn much more quickly at small scales and as the user zooms in, more detailed layers can be turned on. Because the data on this CD-ROM still only cover one continent, Bartholomew's solution functions quite well, especially for users with the knowledge to not turn on the more detailed layers at small scales.

Future editions of this product should address current metadata limitations and consider adding additional layers or data attributes to existing layers. For example, metadata describing the source, date, and accuracy of each data layer is currently not provided. Although the layer's attribute table column names and variables are currently intuitively understandable, a document fully describing the values found in each layer's attribute table would be very helpful. Additionally, future editions should consider providing a generalized contours layer to facilitating drawing this massive data layer at small scales, and additional internal administrative division polygon layers such as postal codes or parliamentary districts might be added. Expanding the data attributes stored with each layer, such as adding the names of large rivers and lakes and names of National Parks or Reserves, would also be a valuable improvement.

In conclusion, Bartholomew Euro Maps on CD-ROM, provides an excellent source of digital data for continental Europe at the 1:1,000,000 scale. Its strongest point is that retrieval of data layers is much quicker and easier with this product than with other 1:,1,000,000 scale digital databases such as Digital Chart of the World. For example to view a European continental layer, Bartholomew Euro Maps allows a user to open a single continental file for any layer, while in ESRI's Digital Chart of the World which divides the world into 5 degree by 5 degree layer tiles, a user would have to open and extract separate files from over 70 tiles and then merge these 70 files together before viewing a total European continental layer. Bartholomew Euro Maps on CD-ROM also provides data layers that some other 1:1,000,000 scale digital products such as Digital Chart of the World lack.

For example, it includes reserves and national parks, ferry routes, sea depth contours, and finer topographic contour lines than Digital Chart of the World. Although its limited metadata and table attribute fields do present some obstacles to more sophisticated users, Bartholomew Euro Maps on CD-ROM is a very extensive European digital database which I would highly recommend as a strong base for any map library's European digital data collection.

REVIEW

By Arlene Olivero

GIS Specialist
Harvard
Map Collection

Omni Gazetter

1992

Omnigraphics, Inc.

Detroit, MI

Price: $995

The Omni Gazetteer is a gazetteer of place names and locations for nearly 1,500,000 populated places, structures, facilities, locales, historic places and named geographic features in the fifty states, District of Columbia, Puerto Rico, and U.S. Territories. This SilverPlatter database is designed to run under the basic PC SilverPlatter Information Retrieval System for the DOS environment. For each gazetteer feature, the name of the feature, place code, state code, county code, feature type, zip code, population value, northern and southern latitude, longitude, map name, elevation, Board on Geographic Names date and source is provided. It is a very comprehensive United States gazetteer which includes the entire U.S.G.S. Geographic Names Information System (GNIS) database plus additional features such as census areas, historical places, military areas, postal stations, and other places from a variety of additional sources.

With the Omni Gazetteer users can search for a specific item by name, search for all occurrences of a particular type of feature, and make more complex queries by combining the "and," "or," <, >, =, <=, and >= operators and cross-referencing mechanisms. A helpful pop-up "Index" menu of available object "types" allows users to quickly view and highlight types of features for querying. After selecting given feature types, additional qualifiers can be added to the search. For example, a user could locate all towns with a population greater than 10,000 in Massachusetts by searching for all feature type "towns" with the qualifier "and Massachusetts in st" and the qualifier "population >= 10,000." Users can also further modify searches by highlighting terms directly from a record to query and thus create useful cross-referencing searches. All searches are stored during a session and can be further modified after they are run. They can also be permanently saved and then reused. This storage and modification system provides an excellent mechanism for quickly researching and further clarifying searches. I also find it easier to use than the search modification and saving function in GNIS.

The Omni Gazetteer also allows users to download or print the results of a search. Its downloading functions are significant as they allow users to sort the records by a specific field, select only specific records for downloading, select only certain fields for downloading, and name the output file. This can be very helpful for researchers who might only want to download the site name and longitude and latitude to create a table for importation into a GIS mapping system, for example.

Although forming valid search requests and understanding the functions available in this gazetteer takes some practice for users unfamiliar with the product or other SilverPlatter databases, the Omni Gazetteer does provide excellent on-line help. It also contains a useful index of variant place names which can be queried during searches. This very helpful feature is missing from some other gazetteers such as GNIS.

Although the Omni Gazetteer's functionality and available data highly reflect the USGS Geographic Names Information System, I would recommend this product to academic research libraries seeking a truly comprehensive United States digital gazetteer. The product currently contains nearly 20% non-GNIS data, and future editions of the gazetteer will hopefully concentrate on adding additional non-GNIS data. Future editions of the product should also consider updating from a DOS driven to a more user-friendly, interactive, Windows interface. If the querying and retrieval interface of this product was changed to a more interactive, Windows environment, I feel that the product would be even more effective since its use would be more intuitive, simple, and quickly learned by patrons.

REVIEW

By Arlene Olivero

GIS Specialist
Harvard
Map Collection

Review of Street Atlas Version 4.0

1996

DeLorme 181 US Route 1
South P.O Box 298

Freeport, ME 04032 USA

www.delorme.com

Price: $45

DeLorme's Street Atlas USA Version 4.0 combines detailed, street-level maps of the United States with easy to use tools to locate and display places. Features such as major and minor streets, populated places, airports, rivers, lakes, mountains, parks, and other points of interest are all labeled on the detailed maps. Areas can be located by searching on Zip Code, name of the city or town, by latitude/longitude, by telephone area exchange, and even by individual street address. Traditional magnification tools in this program allow viewing maps at higher or lower magnitudes. At a specific zoom level, the user can pan by clicking on the map to recenter it at that given point or by using a clickable "compass" which pans the user to adjacent views. A small overview map is also provided to show a view of the area surrounding the main map.

At a given zoom level, the program will automatically provide the level of display and labeling detail appropriate for the geographic area shown. Available customization tools include tools to draw shapes, lines, text, or add "map notes" to a view. These drawing features have been significantly expanded and improved in this version of Street Atlas. The options menu also allows the user to remove all labels from certain classes of features or hide the display of entire classes; however, users are still unable to remove a specific label or choose to label only a given object within a class. This remains a distinct limitation of this version of the program. Users also cannot change the colors by which features are symbolized on the maps.

Other new mapping features of Street Atlas Version 4.0 include the ability to display a grid of longitude and latitude; display zip code boundaries and demographic information; import lists of address data from databases and phone CD software programs for graphical display; calculate distance, circumference, area, and radius of features; support GPS tracking, and display of other on-line information. The new demographics option is particularly helpful because it allows users to access demographic summary information from the 1990 census for individual Zip Code areas. The new address data table importation support is also significant because it allows large numbers of addresses from tables or CD software programs, including DeLorme's Phone Search USA, to be quickly displayed on a map. The new GPS connectivity ability is also helpful to track your progress as you travel. Finally, if you have an Internet provider, this new version of Street Atlas can receive and display on-line weather, road construction, and upcoming events data on your maps.

Street Atlas Version 4.0 has also improved its map layout, downloading, and exporting functionality. The layouts of maps can be customized by adding a title, manipulating the size and placement of the map and legend on the page, and by removing certain features such as the legend or title if desired. Maps can also be saved to the clipboard, saved as Street Atlas .sa4 files, or saved as a new e-mailable MapDoc that can be used to recreate an exact Street Atlas 4.0 view for someone else with a copy of Street Atlas 4.0.

In conclusion, Street Atlas 4.0 provides an excellent digital street atlas of the United States. With this versions' increasingly complex functionality, the program has maintained a quick drawing and user-friendly design which have made previous versions of this product so popular. This design combined with it's functionality and excellent on-line help, makes this product an essential and highly used item in our library's digital reference shelf.

REVIEW

By Richard Gelpke
Department of Geography
Univ. of Massachusetts
at Boston

US Terrain Series Massachusetts

1992

Earthvisions
655 Portsmouth Avenue
Greenland, NH 03480

www.earthvisions.com

$100.00

Earthvisions has developed a very positive Windows-based (Ver 3.1, Win95 or Win NT) software which utilizes scanned images of the U.S. Geological Survey's topographic maps of the State of Massachusetts and includes proprietary software ("G-Ref") to view the images.

The CD-ROM contains all the 1:25,000-scale (140 maps) and 1:100,000-scale (14 maps) topographic maps for Massachusetts. Once installed, a very simple and fast process, a small program resides on the hard drive (ca. 2 MB). Considerably more space is required (ca. 8 MB) to view the images. While map retrieval speed is dependent on your CD access time, a quad speed seemed quite acceptable. Once installed, the program is intuitive, which is especially gratifying since there are no printed instructions although the online help is a typical Windows help file. The quality of the scanning is very good as both colors and text are sharp on the screen.

Once started one can very quickly bring up a topographic map and view it in several predefined zoom levels. A state outline (showing counties) with the topographic map borders superimposed allow easy identification of any specific map quickly. Magnifications include "Close-up" ("1x") which is the actual printed paper map scale; half that ("2x") and quarter ("3x") that scale. A unique feature is that clicking on 1x, 2 x, or 3x instantly changes the scale and you can click between the 1:25,000and the 1:100,000-scale maps and retain the same location. Another particularly useful feature is that redraw is very fast; it does not clear the screen when you move around (as does the USGS DRG files) but simply adds the new section of the map. Also, the latitude/longitude coordinates (to tenths of a degree) display in the top menu and records wherever the cursor is located.

A 'compass tool bar' in the left panel keeps you in place. Similarly, a map overview shows you where you are within the entire map sheet being viewed and a state overview shows your position within the state. The bottom menu is the "one-map/two-map" tool which represents one of the most unique features of the program. Anyone who uses map sheets realizes you often need the adjacent quadrangle. Using a second window G-Ref can bring up the adjacent map (whichever one you request) and positions it geospatially so that you can measure across or create a path as if it were one map. You can even scroll—only north/south however—both windows simultaneously; in essence, they are tiled together.

Exporting a map, one window at a time, creates sizeable files in either .TIF or .BMP formats. In order to print across more than one map it is necessary to export to a draw program and match the two, or more images, in that program. It is possible to export a .TIF image, for example, and bring it into MapInfo as a raster image backdrop for TIGER files or other such data.

Other useful features include a measuring tool showing starting and ending latitude/longitude coordinates of a drawn line as well as its length (feet, kilometers, or miles) and heading (true or magnetic north) and, for closing lines, the area (square feet, acres or square kilometers). You can also 'mark' locations (naming them and identifying coordinates) and create paths which could be useful for those interested in orienteering. There is also a list of categories of features which you can search and even add your own.

A wish list for future versions would include dealing with the corners of four adjacent maps at once, being able to export a view that would span more than one window, and having custom or flexible magnification levels.

Potential users of this program would include geologists, geographers, engineers, surveyors, and developers among others. This program could prove to be indispensable for setting up an orienteering course or a hiking route over considerable distance. Since the program runs well on a laptop with a CD-ROM reader it is conceivable to use the maps in the field. Emergency response in remote areas and approximate verifications on GPS readings in the field could utilize this program.

As individual topographic printed maps are now approaching $5 this program, at $100, pays for itself for the price of 20 paper maps and you get 154 maps in the case of Massachusetts. Earthvisions has scanned the other New England states and its website can be verified for future progress. This reviewer is impressed with this first version and can recommend its purchase for most academic libraries.

REVIEW

By Joseph Carver
Harvard Map Collection

Norwich's Map of Africa: An Illustrated and Annotated Carto-Bibliography

Oscar I. Norwich

1997

Bibliographical descriptions by Pam Kolbe.

Revised and edited by Jeffrey C. Stone.

Norwich, Vermont

Terra Nova Press

xxxvii, 408 pages.

ISBN: 0-964-90004-1

(hardback) $100.00.

When a volume such as *Norwich's Maps of Africa* appears, it is always tempting to hope that it will be the book that puts all previous studies in perspective, fills the gaps in our knowledge, and provides a synthesis that is both coherent and entertaining. Prefaces are designed for just such a purpose: to discourage inflated expectations, to state in as humble a fashion as possible that the ensuing text is a modest contribution to the field, with few pretensions and limited aspirations. In the preface and in the subtitle itself, this book announces quite clearly that it is primarily a cartobibliography, the result of one collector's obsessive hobby, a passion pursued for over three decades by Oscar I. Norwich, a South African who gathered more than 400 maps of the continent and the country that he called home.

Of course, no single collector is able to assemble more than a skewed sample of maps covering a region as vast as Africa. Idiosyncrasies of taste, vagaries of the market, and financial constraints conspire to make a collection the reflection of one individual's personal vision. Those who look for a history of cartography here will come away disappointed, even though parts of that history are well documented and illustrated here. And those who seek to learn more of the role of Africans in the encounter between two cultures will be even more disappointed. These maps are the product of a European imagination—mythicizing, simplifying, reducing a region of enormous variety in economy, society, and geography to a handful of symbols and stereotypes.

Familiar with the first edition of Norwich, I was prepared to find similar strengths and weaknesses in the revision. With a few exceptions, the same maps are included, but the quality of the reproduction is finer. The new edition profits from Jeffrey Stone's introductory chapter on the history of maps of Africa and from the expanded bibliography. Stone's critical historical perspective is particularly welcome in a text that provides little contextual analysis. In the descriptions accompanying the individual maps, the commentary is too often limited to factual notes about how Europeans came, saw, and conquered "the dark continent."

Like its predecessor, *Maps of Africa* is divided into eight sections: the Continent of Africa, Southern Africa, Cape of Good Hope, Sea Charts, Northern Africa, Eastern Africa, Western Africa, and Islands, Town Plans and Ports. (Because of Norwich's personal interest in South Africa, its maps quite naturally assume a disproportionately large role in the collection and in the book.) The cartobibliography for each of the 345 illustrated maps follows a regular format: publication information, comparison of features in contemporary maps, detailed description of the cartouche, and brief biographical sketches of those involved in the production of the map. The biographical entries borrow liberally, often quoting verbatim and without attribution, from Tooley's *Dictionary of Mapmakers* and his *Collectors' Guide to Maps of the African Continent and Southern Africa.* Each of the sections proceeds chronologically, but I would not recommend reading the book sequentially. *Maps of Africa* is designed to be used primarily as a reference work, consulted to examine or compare a few maps. Much of the description is redundant—a boon in a reference work but not in a narrative history. Reading the text in one or two sittings is apt to induce paralysis in the hand that turns the page.

As one who spent a previous incarnation as an editor, I was dismayed by the lack of attention to fact-checking and spelling. With all of the intervening years between the first edition and the revised version, one would expect that more of the initial errors would have been rectified. The preface claims this to be the case, but I find little evidence of it. I hasten to add that it is no mean challenge to transcribe text in eight languages, especially from materials printed in a time when variant spellings were legion; yet it undermines confidence in the scholarship of a book when one finds mistakes in such abundance. In the transcription of titles alone, I count well over two dozen errors, including "vaissaux de la francais" for "vaisseaux francais," five versions of "naauwkeurige" (ironically, the Dutch word for accurate) in a time when two variations were practiced, "practer" for "praeter," and others it would be too tedious to mention. One of the more egregious lapses is the title assigned to a detail of Coronelli's globe gores of 1688. The gores, reproduced in their entirety in Map 52, clearly show a descriptive passage that occupies four of the six gores. (The text in Italian describes the source of the Nile). The commentary for Map 162, one of the gores, uses as title a fragment of the inscription. However, the truncated text makes no grammatical or semantic sense. The transcribed passage begins "Lo creddero nato dalle della Luna i Geografi a si moderni Riportarono ghesi la gloriosa distinnotitia..."—a far cry from "Lo creddero nato dalle Montagne della Luna I Geografi antichi e diversi moderni. Riportarono poi I Portoghesi la gloriosa distinta notitia..."

Unfortunately this carelessness is not limited to the transcription of cartobibliographical data. The commentary accompanying the maps also suffers from its share of errors. In one instance, it is claimed that Sanson's *L'Afrique* was published in 1557 (more than four decades before he was born); in another, a 1688 map of Africa by A. Phérotée de la Croix is attributed to Abbé Louis Antoine Nicolle Delacroix (fl. 1750).

Now that I have duly registered my grievances, I must state clearly that I consider *Maps of Africa* to be a valuable resource. When the first edition of Norwich's cartobibliography was published in 1983, it was greeted as a welcome addition to what had been a poorly cultivated field. In the meantime, that field has enjoyed the attention of a few more industrious tillers, but *Maps of Africa* is still, and will undoubtably remain for some time, a major contribution to our knowledge of how Western Europeans first depicted their continental neighbor to the South. Its revision, though flawed, is also cause for celebration, if for no other reason than the opportunity once again to praise its virtues as well as it chide it for errors of commission and omission. Merely to see good work remain in print is reason enough to feel grateful to those who have made the whole enterprise possible. I may not share its historical perspective; given its track record of errors, I will double-check its facts in other sources; but I would not want it to be too far out of reach.

MEETING REPORT

By Alice Hudson
New York Public Library

Fourth Annual International Miami Map Fair

Miami, Florida

February, 1997

Ah, yes, Miami in February. Sounded like a good deal to me, much warmer than New York in February. Happily I was correct, and during my visit to the Map Fair I enjoyed wonderful Florida hospitality and weather – '70s and '80s in February is a nice concept, no?

The Map Fair officially opened with a delicious steak dinner for speakers, dealers, and guests on Friday evening. Saturday morning the antiquarian map dealers were busy setting up, and registration for participants took place, as the Fourth Annual Miami Map Fair opened officially at the Historical Museum of Southern Florida.

At 11 am on Saturday a panel discussion was held on "What to look for when buying an antique map." Alice Hudson, map librarian; Michael Slicker, map dealer; and Dr. Seymour Schwartz, map collector were panelists. This was followed by visits to the various antiquarian dealers booths and lunch on the plaza outside the Museum.

At 3 pm on Saturday Dr. Seymour Schwartz, of Rochester, NY, noted map collector and coauthor of The Mapping of America, and author of The French and Indian War, spoke. He focused on the building of his collection, and shared with us a few of the items he still seeks to add. There weren't many! The evening ended with a wonderful wine and hors d'oeuvres reception held in the Historical Museum of Southern Florida's exhibition, Tropical Dreams.

Sunday morning was spent by many touring Biscayne Bay by boat. The Map Fair opened again at noon. At 2 pm Alice Hudson gave a workshop on "How the Map Library can help and serve Map Collectors." She gave the participants a four page handout of the same title, with citations to map library directories, basic books on map collecting, important bibliographies and early placename gazetteers; WEB addresses and other computer information of note for antiquarian map collectors.

Map dealers at the Fair included the following: Alexandre; the Ark; Ben Hoepelman; Reinhold Berg; Artcraft; Sandra and John Berryman; Phyllis Y. Brown; Clive Burden; Cartographia London; Cartographic Arts; Cartophile; Jo Ann and Richard Casten; Heritage Map Museum; T.S. Hotter; Kunstantiquariant Am Gasteig; Lighthouse; Mapas y Grabados Antiquous, Argentina; Martayan Lan; Brendan Moss; Harrison Murphy; New Ross; Joseph Rubini; Thomas & Ahngsana Suarez; Paulus Swaen; Henry Taliaferro; and World Map Co.

I list the above as a clear message that the Miami Map Fair is a serious event, most worthy of your attention. The hospitality and graciousness of the hosts cannot be overstated. And the February break, away from anything serious at my desk, was a welcome relief.

Next year in Miami again! Watch for announcements on MapHist, Mercator's World, and Meridian.

MEETING REPORT

By Alice Hudson
New York Public Library

American Geographical Society Awards Reception and Dinner

New York City

March 13,1997

Dr. Anastasia Van Burkalow, Department Chair (1961-73), and Professor Emirata, Department of Geology and Geography, Hunter College, City University of New York, was awarded an Honorary Fellowship in AGS.

Drs. Deborah E. and Frank J. Popper, of New York College of Staten Island, CUNY, and Rutgers University, respectively, were awarded the Paul Vouras Medal for their work on the changing Great Plains, most especially their landmark work on the "Buffalo Commons."

Dr. Maidarjavyn Ganzorig, Director of Informatics and Remote Sensing Center of Mongolia, was awarded the O.M. Miller Cartographic Medal. He charmingly commented on the Mongolians long interest in the sky and sky travel, and thus the naturalness of his work in remote sensing.

Dr. Melvis G. Marcus, Professor of Geography at Arizona State University, was posthumously awarded the Cullum Geographic Medal. Tragically, Dr. Marcus died just recently on a field trip taking students out to do geography "on the ground." He had been told of the award a few weeks before his death, and was very pleased at the honor, although he did wonder if "their standards had been lowered!" Not likely, as Dr. Marcus was well loved and respected in the field, and honored for his work in physical geography, most especially for when it was losing ground to the statisticians in the 1960s. It was announced at this meeting that the National Academy of Sciences would be distributing their new report, Rediscovering Geography, at the Fort Worth, Texas AAG meeting in April 1997.

This was a touching and very moving awards program. It was a celebration of the best and brightest in geography, and a celebration of the field itself.

INTERNET MISCELLANY

MAKING OF AMERICA

http://www.umdl.umich.edu/moa/

Making of America represents a cooperative effort to preserve and improve access to primary resources relating to the U.S. through digital technology. Beginning in 1995, initial collaboration involves collections at the University of Michigan and Cornell University. Currently, 5,000 volumes from each university are being selected and scanned.

ANTIQUE MAPS OF ICELAND

http://kort.bok.hi.is/kort/english.html

Antique Maps of Iceland. This site includes images of all pre-1900 maps of Iceland that are in the National and University Library of Iceland. A short description in Icelandic and English is available for each map.

MAP CATALOGING MANUAL

http://www.tlcdelivers.com/tlc/crs

The Library Corporation Catalogers Reference Shelf is a collection of 21 MARC manuals and other reference works frequently needed by technical services staff. This includes the Map Cataloging Manual.

MAP SOCIETIES AROUND THE WORLD

http://www.csuohio.edu/CUT/MapSoc/Index.htm

This site maintains a comprehensive listing of map societies searchable by geographic area or by organization name.