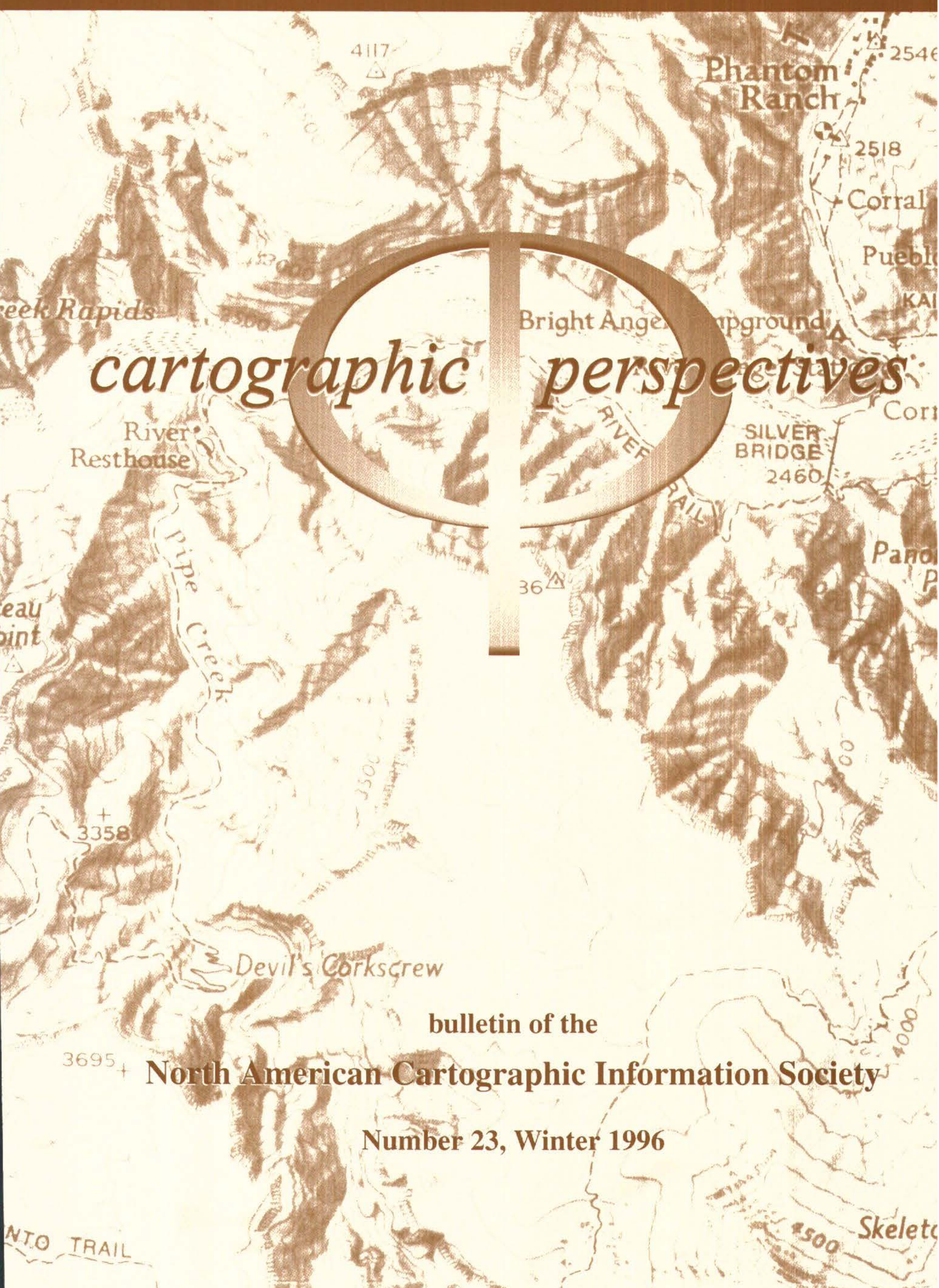

cartographic perspectives

bulletin of the

North American Cartographic Information Society

Number 23, Winter 1996

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Number 23, Winter 1996

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messages

MESSAGE FROM THE NACIS PRESIDENT

Living in Wisconsin always affords one the opportunity to experience and appreciate the change in climatic seasons. The progression is natural and symbolic of the cycles that we all encounter during our lifetime. An organization must also experience cycles of growth and change, and this year NACIS members will witness several.

First, we will bid adieu to Sona Andrews as our editor of *Cartographic Perspectives*. Over the last several years she has provided meritorious service to our organization that will be very difficult to replace. Her imagination, tireless devotion, and intense desire to improve our journal will be sorely missed by all cartographic professionals. At the NACIS Annual Banquet last October Sona was presented with a plague signifying her achievements as Editor.

Given Sona's impending editorship retirement, the *Cartographic Perspectives* Editorial Board is now currently searching for a new editor. By this Spring a selection will be made and we hope to have a smooth transition between editors before the end of

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Summer. Whoever the new editor is I hope all members will give their support and best wishes to this intrepid cartographer.

Second, it is likely that the NACIS annual dues will be increased this year. This can be attributed mostly to the rising costs of printing *Cartographic Perspectives* and its increase in pages per issue. Both past and present NACIS Board Members extensively discussed this issue and considered many alternatives, such as limiting the number of pages per issue. In the end, however, everyone agree that *Cartographic Perspectives* should be strongly supported since it provides a timely and innovative publication that has also elevated the status of NACIS as an organization. During the beginning of this year, several Board Members and I will be analyzing how much we should increase the annual dues. A short report will then be sent to members about the dues increase and members will be asked to vote (i.e. yes/no) on the recommended increase at the Annual Meeting this Fall in San Antonio. I don't believe any President relishes the idea of being remembered for a dues increase, but both the Board and I agreed that it is necessary if we want to maintain our journal's quality and breadth.

Third, I would like all NACIS members to help sign up a new member this year. Whether it is be a student or a twenty-year professional, NACIS has much to offer and even with a dues increase will still be very inexpensive to join. We have a body of great members right now, but it is always healthy for an organization to get a transfusion of new ideas and perspectives.

Lastly, I would like everyone to consider attending our 1996 Annual Meeting this Fall in San Antonio, Texas. It will be held downtown at the Menger Hotel during the first week of October. I am always amazed at the success of NACIS meetings. The workshops, field trips, papers, and discussion forums are always of the highest caliber, and there is terrific interaction among the conference participants.

The candor and *esprit de corps* between conference attendees was once again exemplified at the Wilmington, North Carolina Meeting. Where else could you have cartographers from the widest array of professions and backgrounds imaginable discussing their craft? Students, professors, librarians, federal government employees, and cartographic entrepreneurs all felt welcome at Wilmington. A NACIS meeting is also a perfect opportunity to energize your cartographic psyche and indulge in cartographic repartee.

At our Wilmington Meeting I also sensed an air of electricity that signified how exciting a time it is for cartographers. We are witnessing vast changes in the way we create and present maps and spatial information, and we are presented with more challenges than ever before. Cartographers are a hearty breed and we tend to thrive in the opportunities that are presented to us. We are a robust and enthusiastic group and that is why NACIS is such a strong organization.

Best wishes for the year, and I hope to see many of you in San Antonio this Fall.

Keith Rice
NACIS President

about the cover

The cover was designed and produced by Laurence T. Mandelin, a graduate of the Geography Department of the University of Wisconsin-Milwaukee. The map was taken from "The Heart of the Grand Canyon, Grand Canyon National Park, Arizona" published in 1978 by the National Geographic Society. A portion of the map that shows the area around Phantom Ranch and the Colorado River was scanned in OFOTO in the MAC Format. It was cropped and saved as a TIFF File and exported to the MS-DOS Format and imported into Corel Photo Paint! In Corel Photo Paint! it was and lighted in contrast and brightness. That TIFF was imported into Corel Draw! where the *CP* logo and text were added.

We would like to extend a special thanks to the National Geographic Society for granting us permission to use their map for the cover.

Edge Pixels: the Effect of Scanning Resolution on Color Reproduction

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As a result of the digital revolution, many journal articles have been written on the technical aspects of digitization. One of the most documented facts is that increased scanning resolution means greater legibility of the text and fine details of the digital file. However, little has been written about the fact that increasing the resolution also results in better color reproduction, and it is this issue that this paper will address. While the differences in color reproduction between high resolution scans and lower resolution scans are subtle, they can be quantified and illustrated graphically using the histogram feature of Adobe Photoshop (an image processing software package). This article begins by reviewing the principles of scanning after which several color images, both color and black and white, scanned at increasing resolutions, will be presented to support the author's thesis.

INTRODUCTION

The digital revolution has unleashed a barrage of journal articles that have dealt with many of the technical aspects of digitizing paper-based images and text. For instance, in a major study, Cornell University, Xerox Corporation and the Commission on Preservation and Access (CPA) undertook a collaborative effort to test a prototype system for recording the text of deteriorating books as digital images (Cloonan 1993, Cohen 1993). Among other things, the study concluded that 600 dots per inch (dpi) scanning and printing results in a high quality paper replacement for brittle textual materials (CPA 1992).

The digital revolution has unleashed a barrage of journal articles that have dealt with many of the technical aspects of digitizing paper-based images and text.

Yale University has also undertaken a study to digitize fragile materials. This project is being carried out in three phases. The goals of the second phase are to assemble, test, and evaluate the basic operating elements of imaging architecture (Conway and Weaver 1994). As a result of this research, it was determined that the optimal scanning resolution for capturing full legibility of microfilm and photographs is 600 dpi (Conway and Weaver 1994).

The Bodleian Library at Oxford University is currently working on two separate projects to scan photographs. Gartner (1994) briefly describes the process of digitization and the impact of scanning resolution on text legibility. In another article, Kenney and Conway (1994) discuss four issues related to digitization: 1) system functionality, 2) storage media deterioration, 3) digital image data quality, and 4) integrity of sources. Their treatment of scanning resolution is in terms of black and white text, that is, the ability of the scanner to capture the fineness of detail and the legibility of print. Furthermore, Cohen (1993) also touches upon scanning resolution as it relates to the legibility of text. Tilton (1994), on the other hand, discusses scanning resolution in terms of the display size of the digital image. That is, he comments upon the relationship between screen resolution and magnification ratio in order to determine the proper scanning resolution for a digital image.

Cartolano, Gertz and Klimley (1995) determined that full legibility of 1 mm text can be achieved if the original image is scanned at 200 dpi in 24 bit color. They stated that "once the full information is captured at the highest resolution required for full capture, it should not be necessary to re-scan in the future, since no information would be added by scanning at a higher resolution" (Cartolano et al. 1995, 11).

It is this sentiment, which is implicit in all the articles mentioned so far, that is challenged in this paper. That is, information that is vital to the integrity of the digital image will be added if the image is scanned at a higher resolution. That information manifests itself in the form of better color reproduction, which is of critical importance if the image is meant to be an access copy of an archival document.

While the differences in color reproduction between high resolution scans and lower resolution scans are subtle, they can be quantified and illustrated graphically . . .

While a review of eight articles could hardly be called a complete examination of the relevant literature, two related trends do appear. First, one of the best documented facts in these and similar articles is that increased scanning resolution results in greater legibility of the text and fine details of the digital image. This is not in dispute here. However, the second trend that emerges from these articles is that the discussion of color reproduction tends to focus on issues of bit depth (for example, Cartolano et al. 1995) and palette shifts (for example, Tilton 1994). Little has been written about the fact that increasing the scanning resolution also results in better color reproduction. While the differences in color reproduction between high resolution scans and lower resolution scans are subtle, they can be quantified and illustrated graphically using the histogram feature of Adobe Photoshop, an image processing software package for the Macintosh. After a brief review of the principles of scanning, several images scanned at increasing resolutions, along with their histograms, will be presented in this paper to support the author's thesis.[1]

SCANNING RESOLUTION AND COLOR REPRODUCTION

The type of scanning discussed here produces output in raster format. That is, the information is displayed as an array of square cells, or pixels, each representing a corresponding piece of the original document (Pazner et al. 1992). When the original document is scanned, the scanner "sees" it as an ordered formation of pixels, each having a color or shade of gray, each of which reflect different amounts of light. The scanner then assigns a number to represent the reflectance of each pixel. This matrix of numbers becomes the digital image file.

This explanation of the process of scanning, while exceedingly brief, outlines the most important variable of concern to this paper, that is, the assignment of a single number to represent the reflectance value for the entire area of a square pixel, the size of which depends upon the preselected scanning resolution. Herein lies the basic problem. For example, a scanning resolution of one dpi would result in a digital image that has one pixel per square inch of the original document. All the colors present within the area represented by that pixel would be combined and a single number would be assigned that represents the average reflectance value for that pixel. In other words, all the discrete colors that are present within that area on the original would be blended to create a single color for the digitized image. If, however, the scanning resolution were increased, meaning that pixel size is decreased, then more colors could be portrayed within that same one square inch area because more pixels would be required to depict the same size area at the greater resolution; each pixel would be assigned its own separate color value that represented the reflectance of that smaller pixel area on the original document.

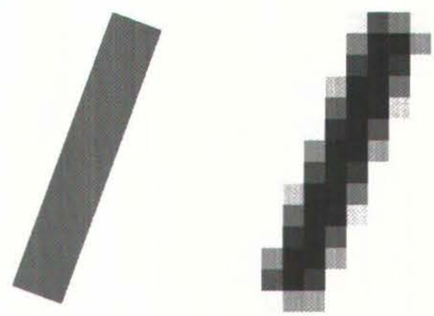
1. All the images used in this paper were scanned using the default settings for brightness, contrast and threshold. No extra image processing was done. In this way, the author hopes to ensure that comparison between the images will not be influenced by any data manipulation technique.

Figure 1. Demonstration of the effects of scanning resolution on color reproduction.

Figure 1a. Figure 1b. Figure 1c.

This principle is illustrated in Figure 1. The large empty boxes in Figure 1a represent the pre-selected scanning resolution, or the pixel size, and the black box represents a spot of color on the original image. In this example, when scanned, the spot of color would fall on the intersection of the four pixels. As a result, the scanner would combine the black color with the white background and produce a digital image that consists of four gray pixels, as in Figure 1b. In essence, the process of digitization has produced a completely new color that was not present in the original document. If, however, the scanning resolution were doubled, as in Figure 1c, then the black spot would no longer fall on the intersection of four large pixels, but completely fill four smaller pixels. In this instance, the black spot on the white background would be reproduced exactly, with no new colors added to the digital image.

Rarely do all the pixels in a digital image fall completely within the area dominated by one color or another. Usually there are a number of pixels that fall along the line separating areas of different colors. These are referred to in this paper as "edge-pixels." For example, Figure 2 depicts two heavy black lines on a white background. The line was originally drawn in ClarisDraw at 72 dpi and printed on a 360 dpi ink jet printer. The hard-copy was then scanned at 9 dpi. The digital image file was then imported into ClarisDraw where it was placed on the same page as the 72 dpi version for purposes of comparison. Because the lines are diagonal in relation to the pixel grid, there are many edge-pixels in the 9 dpi version which fall both within the body of the line and within the white background. Notice that these edge-pixels are various shades of gray, the darkness of which is dependent upon how much of the pixel fell within the body of the line. In other words, those edge-pixels that have the majority of their area covered by the line are darker than those which are mostly within the white background. In this instance, the scanner has produced a digital image that contains very few black pixels while producing many shades of gray that were not present in the original image.

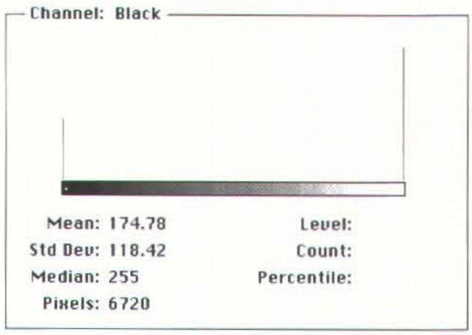


72 dpi 9 dpi

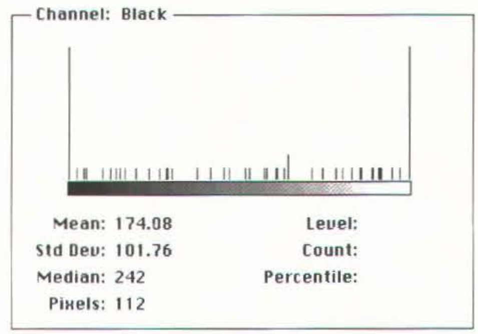
Figure 2. Comparison of images scanned at different resolutions.

This becomes very apparent when viewing the histograms for these two images (Figure 3, page 6). The x-axes of these histograms represent the color values from 0 (black) on the left to 255 (white) on the right. The y-axes represent the number of pixels in the image that have that particular value. The graph for the 72 dpi version clearly shows that there are only two colors present within that image, namely black and white. There is a tall, thin line at the extreme right end of the x axis of this histogram–it represents the number of white pixels. Conversely, the line at the extreme left end of the x-axis represents the number of black pixels in the image. Notice that there are no other values depicted on this graph, meaning that there are no other colors present within the image. However, on the histogram for the 9 dpi version, there are lines all along the graph, mean

Figure 3. Histograms for images in Figure 2.



72 dpi



9 dpi

ing that there are a substantial number of pixels that have intermediate values–essentially, they are various shades of gray.

This principle of edge-pixels can have some very interesting effects on color images. On very colorful originals, such as full color maps and color air photos, there could be a great number of edge-pixels present in the digital image. For example, Figure 4 (page 9) portrays four images of the same place from the National Topographic Series 1:50,000 Bath sheet (number 31C/2, edition 5, 1979) scanned at increasing resolutions. This image is a detail of a park (see the location map), the original size of which on the map was 3.74 mm by 6.78 mm (0.147 inches by 0.267 inches). Notice in the 75 dpi version, there is a line of brown and tan pixels along the right and bottom edges of the image while the rest of the image consists of green and taupe pixels. In the 150 dpi version, the brown line on the right side has become purple. This is very intriguing, for the NTS legend contains eight colors–red, orange, blue, brown, black, gray, green, and white. There are no features portrayed in purple on the original map sheet. This means that the colors present in the original which are contained within the purple pixel area were combined by the scanner to produce new colors that are not found on the original map. Also notice that the interior portion of the image has a greater variety of color compared to the 75 dpi version. Again, most of these shades are peculiar to the digital image and are not found on the original document.

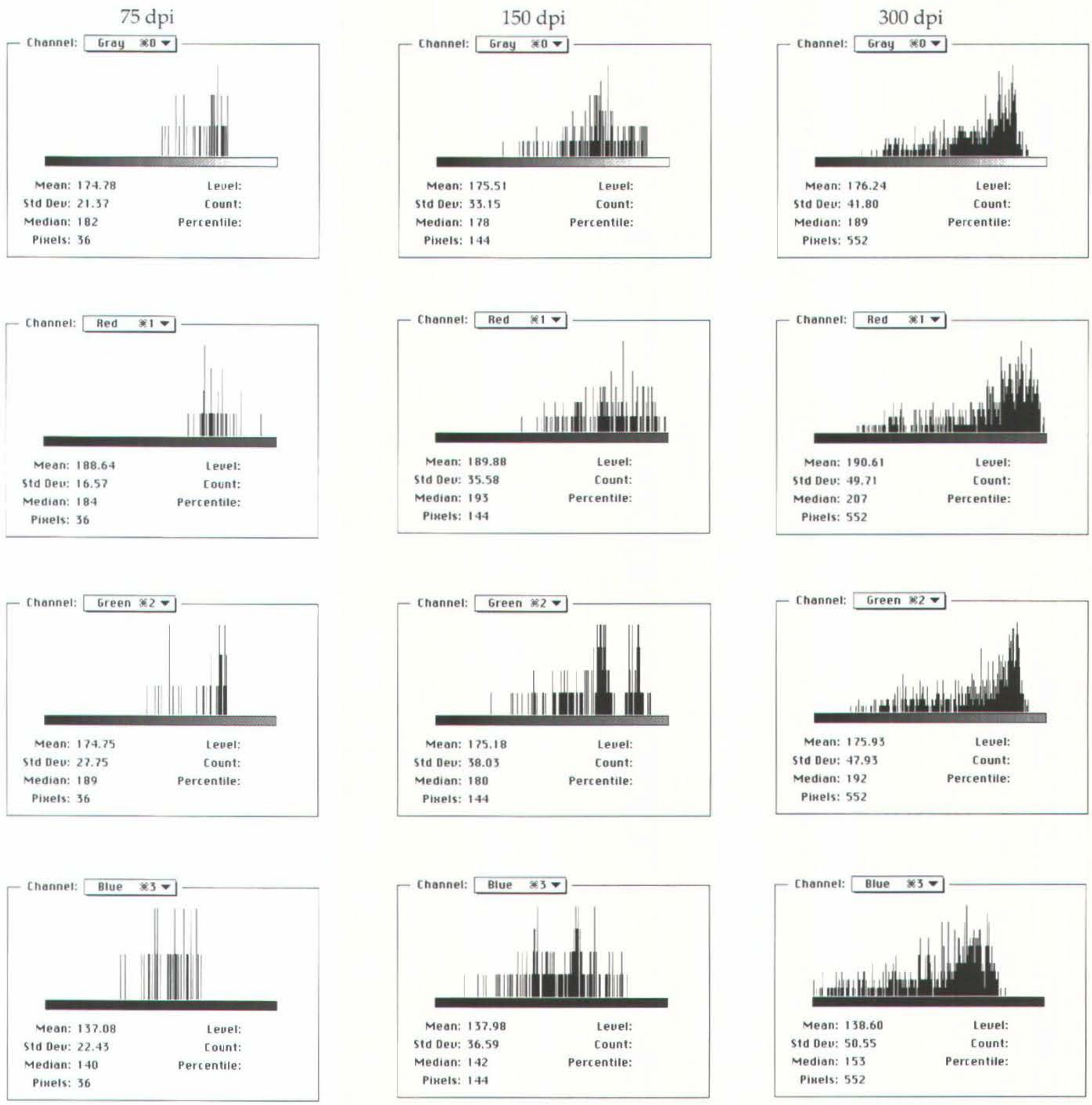
as pixel size decreases . . . the effect of the edge-pixel phenomenon is mitigated and a closer reproduction of the colors of the original document is the inevitable result.

Like the 75 dpi and 150 dpi versions of this image, the 300 dpi and 400 dpi versions also contain many artifactual colors due to the edge-pixel phenomenon. Close scrutiny reveals that there is a small but significant number of pixels in the body of these images that are turquoise or aqua; neither of these colors are represented in the legend of the original document. Furthermore, the right and bottom edges are no longer brown, as in the 75 dpi version, or purple, as in the 150 dpi image, but a mottled collection of red, pink, gray, tan and brown pixels; some of these colors are in fact represented in the legend. Therefore, while these higher resolution images both contain artifactual colors, because more and more pixels are beginning to portray colors which are in the legend of the original, one can conclude that there is a positive relationship between scanning resolution and the quality of color reproduction. In other words, as pixel size decreases (or as scanning resolution increases), the effect of the edge-pixel phenomenon is mitigated and a closer reproduction of the colors of the original document is the inevitable result.

The histograms of these images highlight the differences in color reproduction between the increasing scanning resolutions. Photoshop 3.0 will generate a separate histogram for each color channel, plus a gray histogram that represents the overall brightness of the image (Figure 5). The histograms for the higher resolution images are denser because they portray more pixels, but the general trends between the histograms can be compared and analyzed. For example, all the histograms for the 75 dpi image depict a relatively narrow color range with a spike that dominates the graph. As the resolution increases, the color range widens and the spike becomes less dominant. This indicates that the digital images are portraying many more subtle variations of color. Furthermore, as indicated by the "mean" color value, the images are becoming brighter as the resolution increases. Therefore, as the only difference between the digital images is the scanning resolution, the differences in the histograms are products of the increased resolution.

When viewing the images, the user may be hard pressed to find any substantial color variations between higher resolution and lower resolution scans; as demonstrated with the histograms of the color images, the

Figure 5. Histograms for images in Figure 4.



differences are very subtle. Indeed, how the image is viewed will have an impact on the theoretical "gain" in color reproduction; the gain is most noticeable when the image is greatly magnified. That is, if the image is to be viewed on a 1 to 1 magnification ratio as a paper print out, then the increased quality of the color will be virtually unseen. However, if the image is magnified on a high resolution computer screen, then the differences are most conspicuous.

CONCLUSIONS

When digitizing a color image, the digital preservationist must ask him/herself the following question: are the images to be used for research purposes, or for browsing and/or indexing? The answer to this question will have an impact upon the resolution and standards which will be used in the digitization process. Different researchers have different uses for digital images. If the image is to be used in an application where the quality is not critical, for example as an index image, then considerations other than color reproduction, such as file size, compression ratio, and minimum legibility requirements, must take priority. However, another researcher may be concerned with the paper stock on which the original work was produced. He/she may be interested in identifying the watermark, or seeing the chain lines and laid lines in an attempt to identify the paper manufacturer. Likewise, another researcher may be interested in the inks and dyes used in the printing process. In these instances, digital images are typically used by researchers either in lieu of handling the fragile originals or because the originals are not easily accessible due to their location, and under these circumstances, better color reproduction will be invaluable to the researcher. If the digital image contains a large number of artifactual colors from the digitization process the usefulness of the image is reduced dramatically.

. . . images intended for research purposes need much more accurate color reproduction than those intended for browsing or indexing.

Under most circumstances, images intended for research purposes need much more accurate color reproduction than those intended for browsing or indexing. It is recommended that research images be digitized using the highest possible quality standards for color reproduction. As one of the tenets of digital preservation is to produce a faithful replica of the original, it is ironic that most research into digital imaging is concerned with finding that quality which is simply "good enough." That is, in the search for the "perfect" compromise between file size and image quality, all too often the priority is to minimize the disk space required to store an image rather than find the optimal image quality. It is impossible for a digital preservationist today to know what will be required of digital images in the future. Therefore, if the image is to be used for archival/research purposes, it is imperative that the image be captured at the highest possible quality. Given that the technology for capturing, storing, retrieving and viewing images is constantly improving, images that are "good enough" today likely will be wholly inadequate in the near future.

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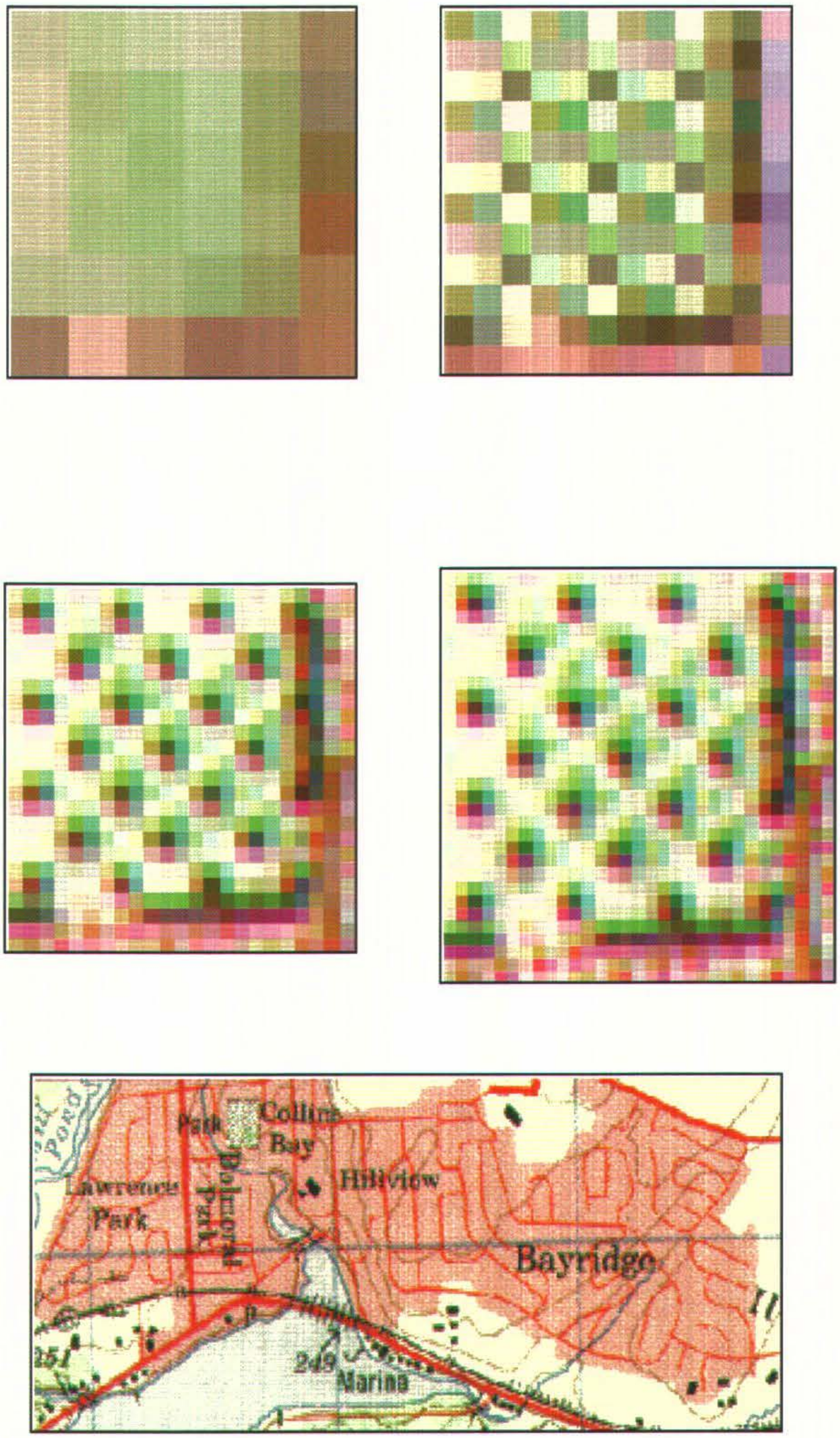
The author wishes to thank the anonymous reviewers whose comments and criticisms helped make this a stronger article. The author also wishes to thank Dr. P.J. Stooke for his guidance and patience. Thank you. ❑

Figure 4. The effects of scanning resolution on color reproduction.



CALL FOR PARTICIPATION

XVI Annual Meeting of the North American Cartographic Information Society

San Antonio, Texas
Oct. 2 – 5, 1996

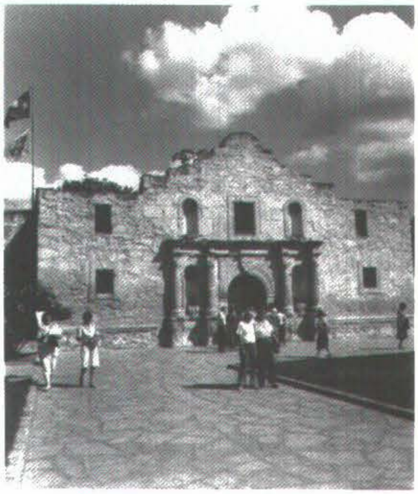
The NACIS Program Committee invites your participation in this meeting by:

• giving a paper •
• organizing a session •
• developing a panel discussion •
• conducting a workshop •
• preparing a poster or exhibit •

Poster, paper sessions, and panel discussions are now being organized on a variety of topics, including interactive forms of cartography, cartographic animation, and multimedia presentations. All cartographic-related topics are welcome. Please plan now on contributing to the meeting.

Special Focus of the XVI ANNUAL Meeting
CARTOGRAPHY AND THE INTERNET

Special sessions and a workshop are being planned on the distribution of maps through the Internet.



The Alamo - Shrine of Texas Liberty
photo courtesy of San Antonio Convention & Visitors Bureau

Mission San Jose Y Miguel de Aguay
photo courtesy of San Antonio Convention & Visitors Bure

Persons interested in participating should develop a proposal or abstract which includes the author's name, professional address, telephone number and a description not to exceed 250 words. Student participation is encouraged. Proposals should be sent to:

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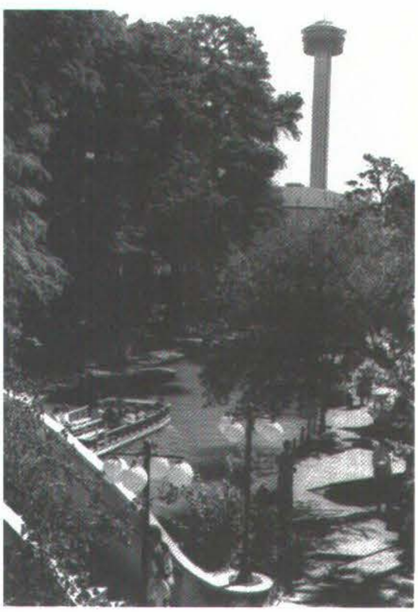
Phone: (402) 554-4805
FAX: (402) 554-3518
e-mail: geolib@cwis.unomaha.edu

conference Web site:
http://maps.unomaha.edu/NACIS/Conference.html



San Antonio River Walk
photo courtesy of San Antonio Convention & Visitors Bureau

PROPOSALS and ABSTRACTS MUST BE RECEIVED BY APRIL 30, 1996

Participants will be notified by May 30, 1996 of the acceptance of their abstracts or proposals.

For those interested in touring the San Antonio area before or after the meetings, you may wish to write or call for information about attractions in the San Antonio area:

San Antonio Visitor Information Center
P.O. Box 2277
San Antonio, Texas 78298
Phone: (210) 270-8700

The Production of Smooth Scale Changes in an Animated Map Project

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The proliferation of home and business computers has resulted in a dramatic increase in the number of animated maps in private, institutional, commercial, and academic settings. As authoring software that allows the production of such maps becomes cheaper and easier to use, animated maps will continue to become more numerous and sophisticated. This increase in the number and complexity of animated maps and the resultant need to automate their design and production calls for novel cartographic approaches. This paper stems from a project involving the design of animated maps for a typical multimedia product. An important element of the animations were the transitions between maps of different scales. An explanation of an algorithm to choose map scales suggests how aesthetic judgments can be incorporated into the automated production flow for the finished product.

ANIMATED MAPS, INTERACTIVE MAPS, AND HYBRID MAPS

Dynamic maps can take the form of animated maps, interactive maps, and combinations of the two. I will use the term *dynamic* to refer to the broad category of maps that can change during viewing. *Animated* maps offer little user control and present changes of map attributes in a manner that is either logically or chronologically linear. *Interactive* maps allow the user to adapt or control the map display.

Map design strategies for dynamic maps have categorized the maps according to the primary characteristic exploited by the temporal dimension: sonification, animation, and interaction (DiBiase et al. 1992). Sonification involves the use of sound to represent data (Krygier 1994), but since there is no fundamental role played by map scales in this type of map sonic maps will not be addressed in this paper. Scale changes are, however, useful and well-suited to animated and interactive maps. The animation in which there is "the illusion of motion created from a sequence of still images" (DiBiase et al. 1992) is perhaps the most common form of map animation. These maps, commonly found on television newscasts and educational computer software, are linear presentations of a series of frames or static map images. Scale changes are particularly useful for illustrative purposes in this sort of animated narrative (Dorling 1992b, 633). The animated maps discussed in detail later in this article are of this type.

Much of the literature on animation has emphasized its use for representing time series data. Some attention, however, has also been given to the role of animation and interaction for exploring non-temporal data (e.g. DiBiase et al. 1992, Dorling 1992a and 1992b). In the context of what he calls *animating space*, Dorling argues that changing the scale of the map is the only way to properly examine large and complex data sets (Dorling 1992a, 1992b). When the change over time of the mapped data is too complex for the observer to notice both spatial and temporal patterns, Dorling argues for temporally static maps, or maps that show a time slice from a particular moment. Zooming and panning across these maps allows the examination of details in cases where aggregation of data is unacceptable. This strategy of animating space instead of animating time is particularly useful in the social sciences where extreme variations in data values are found over small areas.

Unlike animated maps, interactive maps have no fixed structure; the user interacts with the display to view different scenarios or representations. The interaction allows the user to question data to gain a better understanding, or to tailor the display to match the knowledge the user brings to the map. Monmonier (1991, 4) points out the need for an "antidote" to the "dangerous abuse" that his Atlas Touring and other "carefully orchestrated sequence(s) of persuasive graphics" invite. He mentions the need for "experiential maps" that allow users to explore data interactively, thereby forming their own opinions.

Unlike animated maps, interactive maps have no fixed structure; the user interacts with the display to view different scenarios or representations.

Interaction is essential in the analysis of three-dimensional digital data models (Moellering 1980). Kraak mentions the importance of geometric transformations in the visualization of three-dimensional maps, citing their complexity and the difficulty of the human mind to process depth clues. "Manipulation of the maps is not restricted to their content, but also includes their position in three-dimensional space" (Kraak 1993, 13–14). Geometric transformations like zooming, scaling (both involve scale changes) and rotating are necessary in order to take advantage of the added information in the terrain model. Since the display method—the monitor—is two-dimensional, interaction is necessary to "see" the information added by the three-dimensional model.

The importance of smooth scale changes in dynamic interaction and animated maps is underscored by a report (Harwood 1989) on dynamic map displays for helicopter flight. Pilots used on-board map displays for a variety of tasks, and their success was shown to improve when the map displays were smooth and unobtrusive. Similarly, researchers have found "greater user preference for and confidence in representations which provide smooth change between images" displayed on computer monitors (Rheingans 1992).

DESIGN FOR A MULTIMEDIA ENCYCLOPEDIA

Scale changes proved to be invaluable in keeping map viewers oriented and the narration coherent in thirty animated maps commissioned by Grolier for its *New Grolier Multimedia Encyclopedia* on CD-ROM (Grolier 1994). This encyclopedia is aimed at adult and high school-aged home users, and the animated maps were a major selling point for the 1994 version. The maps portray major world events such as the Gulf War, the Korean War, Magellan's circumnavigation of the world, and the spread of overland routes across the colonial United States. The animations include audio narration and also text narration for micro-computers that have no sound capability. Flashing symbols and areas are used to highlight important static map information while movement is represented with flow arrows and sprites.[1] The publisher's priorities were in creating a product of high aesthetic quality and visual excitement. David DiBiase has written in detail about the project (DiBiase 1994).

The design of the maps was intriguing because guidelines and conventions for the medium have not yet been established. Another challenge was the fact that the publisher failed to determine how well the animations, delivered in the form of Macromedia Director movies, would survive the final transition to QuickTime movies.[2] Finally, Grolier 's assumptions about the typical user's computer configuration limited, for example, the number of frames that could be used and the size of the maps on screen.

1. Gersmehl (1990) provides a glossary of this and other terms frequently used in animations.

2. See Cartwright (1994) for an explanation of QuickTime and other technical terms.

MAP DESIGN

The pressure of designing fifteen animations in only twelve weeks forced us to confront many issues in a hurry. What elements that are common to static maps should be included? Which elements are redundant and should be abandoned? While these and similar issues regarding the transition from static to animated mapping have been noted (Cartwright 1994), few guidelines or design principles exist. Gooding and Forrest are clearly correct when they state that "... if video maps are to be used effectively, they should be developed specifically for that medium" (1990).

Similarly, our animated maps had to be designed for the desktop personal computer medium using CD-ROM. Resolution was limited to the 72 pixel–per–inch monitor standard to contain file size and the amount of required storage space on the CD-ROM. The map area was limited to a field four hundred pixels wide and two hundred eighty pixels high (roughly 5.5 by 4 inches) to ensure that the animations fit on the smallest Macintosh screens. This made the choices of map elements critical. Too many elements on the map display seemed to clutter the geographical information. A legend was one of the elements we found to be superfluous for our animated maps. It was more effective to explain an event and its players with spoken and written narration than by filling the map with placename lettering.

The most significant and fundamentally unique design concern for the maps was the possibility of using time as a variable to express information . . .

The most significant and fundamentally unique design concern for the maps was the possibility of using time as a variable to express information (DiBiase et al. 1992, Kousoulakou and Kraak 1992, Kraak and MacEachren 1994). The use of animation time to correspond with historical time was fundamental to the animations produced; the stories were usually told in a chronologically linear fashion. Flashing symbols to symbolize events such as battles drew the viewer's attention to small places on small–scale maps. Repetition of animation sequences represented repeated attacks on cities. The timing of the story (through the manipulation of how long an animation frame was displayed) was important for making the stories comprehensible. Timing was also used for dramatic effect to underscore the numbers of people killed in wars.

The display of different maps at different scales over the course of the animation was essential to keeping the narratives coherent, and appropriate scale changes were the crucial link between these maps. Changing scale meant that the story could be played out on a map that was always at the appropriate scale for the subject matter. Making the scale change smooth provided a link between the maps and kept the viewer spatially oriented, providing a coherent narrative while keeping the viewer's attention focused on the story subject and not on the scale change.

THE ROLE OF SCALE CHANGES

The nature of the events to be animated demanded that we use maps at different scales. The animation of the Korean War, for example, opens with a map of southeast Asia to acquaint the viewer with the location of Korea. Narration then switches to a map of Korea on which troop movements can be shown. The animation of the United States Revolutionary War repeatedly changes scale. A small-scale map shows the shape and size of the original colonies to set the scene, then large-scale maps of troop movements in, for example, the New York–New Jersey region express the local and regional events.

Traditional static maps use insets to show where in the world the featured place is, or to show an area of detail. The nature of animations, however, makes these inset maps extraneous and pointless (and a cause of eye strain in a window less than six inches wide). Instead, maps can be presented as *dynamic insets* at the scale that is appropriate to the thematic information. Over time, the display can shift from one map to another at a different scale, thereby overcoming the spatial constraints that apply to the printed page. This is an example of the effective exploitation of the temporal dimension of animations.

An abrupt switch in an animation from one map scale to the next without a transition would be disruptive to the animation and to the flow of information, obscuring the spatial relationship between the maps, thereby disorienting the viewer. Therefore, there is a need for transition techniques such as *zoom-ins, zoom-outs,* and *exploding insets* (terms to be defined below) to provide the link between different maps. As is the case with many map design choices (like those concerning typeface, layout, and color palette), the effectiveness of these transitions lies in their ability to allow the map reader to remain focused on the theme of the map. Good map design avoids attracting the viewer's attention to individual elements by ensuring that the map elements remain transparent. Map animations, therefore, need to shift between different maps without losing the map user's attention to the transition.

Map animations, therefore, need to shift between different maps without losing the map user's attention to the transition.

One way to accomplish this is by using a high number of frames in order to give the impression of continuous change. This ideal situation would be possible with unlimited memory space, but limits on the number of frames allowed are imposed at every link in the chain from the cartographer's computer to the display on the consumer's monitor. Animation files, especially when they include audio tracks as Grolier's did, require substantial amounts of storage space, a function of the length of the animation, the size of the animation window on the screen, audio bit depth (a function of the variation allowed in pitch, timbre, etc.), and the color bit depth (a function of the number of colors used in the palette).[3] Even when storage space isn't the issue, only the fastest microcomputers can move from one frame to the next at a rate faster than the eye can perceive a change on the screen. Finally, the monitors on which these animations are viewed can only refresh (or paint the next image onto) their screens at a certain limited frequency determined by their scan rate. Inevitably, then, a sophisticated viewer is able to distinguish between individual frames. But if the transition is well designed, the viewer's attention will be kept on the map and not on the difference between individual frames. Since technologic constraints demand that the number of frames remain small, the care put into the selection of transition frames must be great if transitions are to play their role inconspicuously.[4]

AN EQUATION TO DESCRIBE THE SCALE CHANGE

The simplest example of a scale change that we will consider is a zoom-in from a small-scale map to one of larger scale. Each map in the zoom is at a larger scale than the previous one, and its land area is smaller than the previous map's area. There is always only one map visible, and that map takes up the entire animation window.

Thematic content determines the map scales at the beginning and end of the zoom. The number of desired steps, or frames (usually a compromise between memory limits and desired frame resolution), must also be known. Regular intervals from one scale to the next, as defined by

3. Typical size for an animation file made with Macromedia Director by the author was 1.2 megabytes. The files had eight-bit color, a dimension of 400 by 280 pixels, no sound, and were about three hundred frames in length.

4. The need to keep transitions "transparent" precluded using scale change techniques like motion-blur exploding insets and other techniques as too distracting.

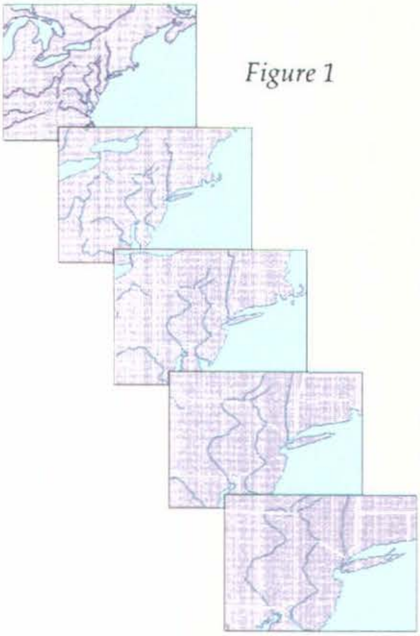

Figure 1

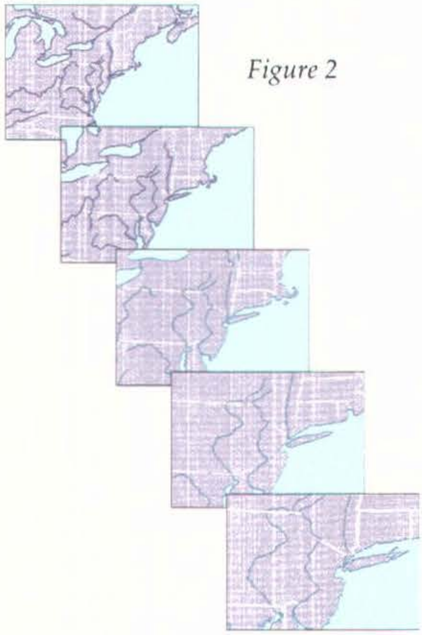

Figure 2

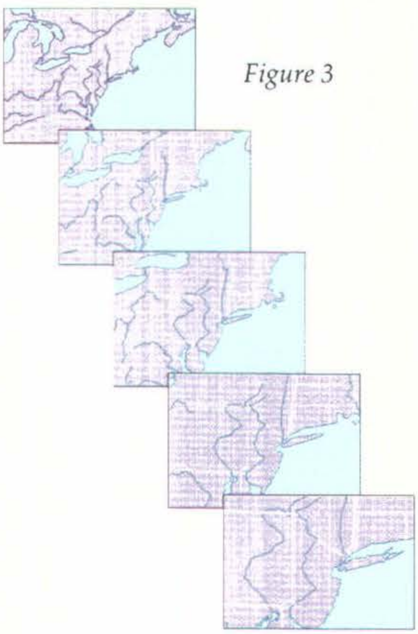

Figure 3

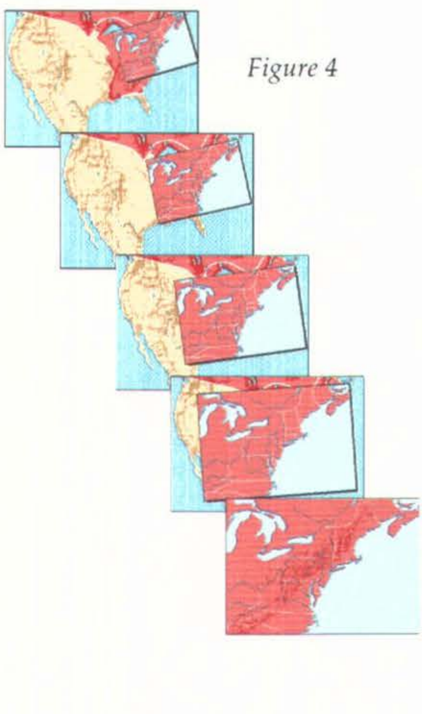

Figure 4

Equation 1 and exemplified with a hypothetical zoom in Table 1 (page 18), are easy to calculate but yield a scale change that is uneven.

When David DiBiase, project manager and director of Deasy GeoGraphics Cartographic Design Studio at Penn State University and I viewed this zoom on a monitor we judged that the zoom was inappropriate. The change in land area covered by the first frames was too great, and it was too little at the end of the zoom. Figure 1, for example, shows a significant leap in size of Long Island between the first two frames, while its size changes only slightly at the end of the zoom-in.

We then drew an exponential curve based on the equation $y=x^2$ on graph paper and read off the intermediary scales for the frames between our known starting and ending map scales (Equation 2). This seemed logical since the equation describes the relationship between the scale and the area covered by any map. But this equation we also deemed inappropriate. The size of New Jersey (see Figure 2) still changed too much at the start of the zoom-in and too little at the end.

Interpolating intermediate scales with logarithmic paper yielded zooms that we judged appropriate. Figure 3 shows how Long Island's size changes at a steady rate when the map scales are determined by Equation 3. All zooms and exploding insets made thereafter were made by drawing a straight line between the starting and ending points of the scale change on logarithmic paper. Zoom-outs were used frequently in the animations when the map scale decreased. They were constructed exactly like zoom-ins but with order of frames reversed.

The exploding inset (Figure 4) is another transition that allows the animation to move to a map of larger scale. Like a traditional inset on a static map, the exploding inset begins with a small-scale map with a box drawn around the area that is to be shown at a larger scale. The small-scale map remains in the background as the large-scale map section of interest increases in size until it is occupying the entire animation window, blocking out the small-scale map. The same logarithmic equation used for zooms describes exploding insets. Whereas map size remains constant while land area changes for zooms, the inverse is true for exploding insets: the land area covered by the map is fixed while the map itself grows (in the case of the exploding inset) or shrinks (imploding inset).

Equation 1

$$scale_n = scale_{beg} + n\left(\frac{scale_{end} - scale_{beg}}{N}\right)$$

Equation 2

$$scale_n = \left(scale_{beg} + n\left(\frac{scale_{end} - scale_{beg}}{N}\right)\right)^2$$

Equation 3

$$scale_n = 10^{\log(scale_{beg}) + n\left(\frac{\log(scale_{end}) - \log(scale_{beg})}{N}\right)}$$

where:
n = the iteration in the scale change
N = total number of steps in scale change
$scale_{beg}$ = map scale at beginning of scale change
$scale_{end}$ = map scale at end of scale change

Tables 1–3 (page 18) track the scales of four intermediate iterations of a six-step exploding or imploding inset. The scale factor represents the relationships between each iteration and the starting map scale. The next column represents the portion of the original map's area taken up by each subsequent map of the same region at a smaller scale. The crucial column is the last one which shows how the size of each map varies from the previous map's size. For the logarithmic equation this number is constant, indicating that a transition that seems smooth is one in which the inset "blows up" or "collapses" at a steady rate.

The production staff and the rest of the Deasy staff were responsible for deciding which zooms were appropriate. The project's commercial nature and short production time–frame meant there was no possibility of having outside reviewers or focus groups. The discovery of constant change of area for the logarithmic equation confirmed our subjective decision that this equation yielded the most appropriate scale change. Ours was an aesthetic judgment that, according to the tables, seemed to have an objective basis in the inherent relationships between map scale and map area.

GENERALIZATION AND PERCEIVED MAP SCALE

Generalization of features and linework as scales change is an important consideration. Some researchers argue that a feature like a city could be represented by three different symbols depending on the scale. "As you zoomed in on the city, its appearance would jump from one representation to the other" (Dorling 1992a, 218). This is acceptable, Dorling argues, because the change is not unexpected, and because it is a very efficient way to show scale changes without having to recalculate images on the fly. Although this strategy is acceptable for an interactive environment where the exact scale that the user chooses cannot be anticipated by the programmer, this solution is neither appealing nor necessary in non-

ARITHMETIC EQUATION

iteration	map scale	scale factor ($scale_1$ / $scale_n$)	map area relative to map_1 area (scale factor^{-2})	map area relative to area at previous iteration
1	1:500,000	1	1	
2	1:600,000	1.200	.694	69.44%
3	1:700,000	1.400	.510	73.47%
4	1:800,000	1.600	.391	76.56%
5	1:900,000	1.800	.309	79.01%
6	1:1,000,000	2.000	.250	81.00%

Table 1

PARABOLIC EQUATION

iteration	map scale	scale factor ($scale_1$ / $scale_n$)	map area relative to map_1 area (scale factor^{-2})	map area relative to area at previous iteration
1	1:500,000	1	1	
2	1:586,277	1.173	.727	72.73%
3	1:679,416	1.359	.542	74.46%
4	1:779,419	1.559	.412	75.99%
5	1:886,285	1.773	.318	77.34%
6	1:1,000,000	2.000	.250	78.55%

Table 2

LOGARITHMIC EQUATION

iteration	map scale	scale factor ($scale_1$ / $scale_n$)	map area relative to map_1 area (scale factor^{-2})	map area relative to area at previous iteration
1	1:500,000	1	1	
2	1:574,381	1.149	.758	75.78%
3	1:659,781	1.320	.574	75.79%
4	1:757,879	1.516	.435	75.79%
5	1:870,563	1.741	.330	75.79%
6	1:1,000,000	2.000	.250	75.79%

Table 3

interactive situations where the scales are predetermined. Increasing viewer sophistication demands that we strive for generalization strategies that are more subtle and draw less attention to scale changes. The time it would take to recalculate images on the fly on the computers that Grolier expects its multimedia encyclopedia to be viewed keep this from being a viable option.

One study (Eastman 1981) suggests that the alteration of the graphic elements on a map plays an important role in the viewer's perception of the map scale. Eastman studied the effects of varying line density, symbol size, and type size, and found that subjects could notice relative scale changes between static maps. Although changing the map elements did not always elicit the same changes in perceived scale, and judgments about how the scales of the sample maps compared were not consistent, generalization levels are nevertheless a factor in the perception of scale.

When maps of different scales appear in animated maps as dynamic insets, therefore, the level of generalization can act as an important second clue. An increase in the amount of detail following a zoom-in to a large-scale map would certainly be expected by the viewer, just as static, large-scale inset maps contain more detail. Our maps, however, were mainly backdrops for the story, a geographic reference locating the story. Zoom-ins were necessary not so that viewers could better see landscape features, but so that the subjects' movements (troops' or ships' routes, for example) could be displayed on a large-scale map. In accordance with Eastman's findings, we used slightly different colors in our insets to suggest a change of scene.

The small size of our animations meant that generalization was determined by the software, not the map scales. Final assembly was done in Director where all lines at all scales needed a width of at least one pixel in order to not become interrupted. Therefore after scaling the maps in Aldus Freehand according to the equation, line weights were made constant in all the maps of the zoom, regardless of their scale. The low resolution of 72 pixel–per–inch monitors limited the amount of detail permissible. As increased computer power and improved compression rates will allow higher resolution, animated map displays will, in turn, increase in size, increasing the need for appropriate generalization levels as scales change. Töpfer's *radical law* (Töpfer and Pilliwizer 1966) is a theoretical proposal that suggests the degree of generalization for different map scales. His equation could be incorporated into an algorithm producing scale changes for animations. Experience from this project, however, would indicate that a logarithmic equation might be more appropriate.

CONCLUSION

Adaptation of traditional cartographic techniques to mapmaking with animated media needs to be considered on a case–by–case basis. While many conventions need to be retained, other elements are redundant and can be eliminated from animated maps. The inset map is an example of a feature common to static maps that serves no useful role in animated maps. Its replacement, the dynamic inset map, appears to be useful and intuitive for the viewer when its transitions are designed well.

Animated maps and interactive dynamic maps can both be enhanced with appropriate scale changes, regardless of the application. Zooms between maps at different scales allow the user to investigate the mapped subject close up, or allow the animation to continue to the next section of the story while the user remains geographically oriented. The logarithmic equation offered in this paper is a useful step in the automation of the design of such scale changes so that these transitions can be the inconspicuous links that make possible a coherent, informative narrative.

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NOTE

An animation comparing zooms made with the three equations is available from the author. The file is in Macintosh format; no special software is required. ❑

cartography bulletin board

GEOGRAPHIC INFORMATION SYSTEMS, IMAGE PROCESSING, AND MICROCOMPUTER LABORATORIES

by Laurie A. Boyer Garo
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The Geographic Information Systems (GIS) & Image Processing Laboratory is a support facility of the Department of Geography & Planning at Appalachian State University. The Lab's functions are: 1) to provide GIS and image processing training to students through coursework and internships, 2) to support research, and 3) to provide services, often in fulfillment of the land planning and management needs of North Carolina's local, regional, and state agencies.

The GIS and Image Processing Lab houses a Sun SPARC station IPX with two remote terminals, five 486 PC computers and three Pentium computers, three large format digitizing tablets, two 8-pen plotters, a color scanner, and a color deskjet printer. Plans are to purchase a Sun SPARC station 20 within the year. The main software used include ARC/INFO and ArcView for GIS, ERDAS for Image Processing, and Mosaic for access to data on the World Wide Web. Aldus Freehand is utilized to produce the camera-ready maps for a syndicated newspaper column, *Geography in the News*. The Research Lab library contains a wide variety of hardware and software manuals and research journals, plus numerous digital map and satellite image data sets on 4 and 8 mm data cartridge and CD-ROM. These digital data include the USGS's DLG's (Digital Line Graphs), the US Census Bureau TIGER Line Files and other Census Bureau statistical data, a variety of full scene Landsat and SPOT digital imagery, plus a growing collection of image subscenes covering North Carolina. Much of the imagery was purchased through grant projects. The satellite image collection will continue to grow now that many summer and winter scenes from Landsat TM are available on the Internet at downloading cost.

The Microcomputer Lab is used primarily for teaching basic computer skills and production cartography, although the Department's full-color Geographic Perspectives map series is produced in this lab as well. The lab contains eleven networked 486 PC's, two A3-size digitizing tablets, two HP Deskjet printers, two Epson printers, one networked HP Laserjet 4 Plus printer, and a Macintosh section with three MAC's, a monochrome scanner, and Epson printer. Software used in the lab include CorelDRAW, AtlasDRAW/AtlasGRAPHICS, and Microsoft Office Programs (Word, Excel, Power Point and Access), and SimCity. Students also learn networking principles on Windows and how to access and download digital cartographic data from the Internet via Kermit.

The Department's research includes nine service projects for counties and development regions. Each project has involved the analysis and classification of either Landsat MSS or TM, or SPOT data using ERDAS, and merging those with ARC/INFO (GIS) vector data for further analysis and mapping. The projects accomplished to date involve land use analysis, water resource inventory, watershed management, industrial siting, new highway siting, and zoning/land use mapping. The Greenhouse Gas Inventory of North Carolina for 1990 is the major product currently underway within the department. The project is funded through a grant from the North Carolina Energy Division and the EPA. Greenhouse Gas (GHG) emissions are being calculated and mapped by county, with projections through to the year 2010. Calculations are being carried out in Excel, while mapping is being done on ARC/INFO and CorelDRAW. The bulk of the project is now complete and provides much of the data needed for the Department's next major research venture, a NASA funded three-university grant entitled Global Climate Change in Local Places. Appalachian's component within this project will provide more detailed analysis of GHG emissions and mitigation strategies for a smaller, twenty-county Blue Ridge/Piedmont region within the state of North Carolina. The analytical work will make extensive use of the Department's digital image processing, GIS, and mapping capabilities. ❑

THE CARTOGRAPHIC SECTION AT THE UNIVERSITY OF WESTERN ONTARIO

by Patricia Chalk
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The Cartographic Section is currently marking 26th year of service to the Geography Department at The University of Western Ontario. Through the vision of F.W. Graves and the support of the Geography Department, the Section evolved from a facility housed in a cordoned-off area at the back of a cartographic lab, to a professional cartographic facility. In 1972 it moved to its current premises–a 830 square foot office with an adjacent 8' x 22' darkroom. Today, the Cartographic Section is home to two cartographers:

Patricia Chalk, Director, and David Mercer.

While each cartographer still retains a light table and drafting table, production for over a decade has been enhanced by computer operations. The transition to computerized graphics began in 1985 with the purchase of a Personal Composition System (PCS) through CompuGraphic Canada Ltd. The PCS software was installed on Apple Lisa hardware. Files were output on photographic paper from a high resolution typesetter on campus. Although purchased primarily for the computerized typesetting capabilities provided by Compugraphic's software and the crisp resolution of the output, the PCS also had additional design capabilities beyond that available from Macintosh software at the time. Among the features cited in the request for funds was a "the capability of mixing text with line work, graphs and diagrams without use of pen and ink." It was an exciting step forward!

Since 1985 our computers have been upgraded several times. Our current system includes a Power PC 7200 and a Quadra 650 with 32 mb RAM/1 gigabyte hard drive and 24 mb RAM/1 gigabyte hard drive respectively. Each system has two color monitors (16" and 14") to provide a multi-screened singular desktop. Initially, the two-monitor system was adopted because it was far less costly than one large 21" color monitor (we already had 2-14" monitors). Once installed, however, additional benefits were revealed. The 14" monitor was found to be ideal for holding menus and software icons. The full 8 1/2" x 11 3/4" image area of the larger, 16" monitor was thus rendered entirely free for viewing the work in progress.

The primary mandate of the Cartographic Section is to meet the cartographic needs for a research-intensive program in the Geography Department. For the most part, this involves the design and production of images for publication which cannot be created using standard computer graphing, mapping, or GIS packages. Production frequently involves compilation of information from several sources (e.g. satellite images, spread sheets, digital boundary files, map sheets, rough sketches, or field notes) into one composite digital product designed to suit presentation in one of an assortment of mediums (e.g., journals, slides/overheads, newspapers, web sites, or large format displays).

The software used in the process of creating final images includes: Adobe Illustrator, Adobe Photoshop, Aldus PageMaker, and Geocart. A familiarity with the DOS world and file formatting options is useful in many undertakings since some files are manipulated in such programs as CorelDraw or IRIS to prepare them for importing to the Macintosh environment. We have benefited from the Geography Department's concerted effort to have all its core facilities connected by ethernet. In so-doing, we developed an efficient network of many peripheral devices required for digital cartography (e.g., scanners, mass storage devices). Hence, our office only contains two computers with the specialized software unique to our responsibilities.

Virtually all images destined for printing are output on a Linotronic imaging system using an off-campus service bureau. Color slides and overheads are sent to an on-campus service bureau for output on either an Imapro Quality Colour Recorder or a Tektronix Phaser Dye Sublimation Printer. Services to the Geography Department are provided at no charge provided that the materials are used for departmental research. Faculty needing graphics for outside contracts are charged on a cost recovery basis.

The diversity of the graphics we create is reflected in the range of journals in which our figures have been published. Over the past year, for example, our graphics accompanied articles submitted to the *Journal of Environmental Management, Great Lakes Geographer, Journal of Soil and Water Conservation, International Journal of the Sociology of Language, Annals of the Association of American Geographers, Environment and Planning A, Radiocarbon, Journal of Atmosphere and Ocean,* and *Earth, Moon and Planets.* Our services also include the illustration of books or chapters of books which faculty are editing or authoring. Cartographic consultation is provided to assist graduate and undergraduate students in designing effective graphics, and in the use of mapping programs in the GIS lab. The Director is cartographic editor or consultant for a number of publications each year and gives invited lectures to graduate classes.

In addition to its responsibilities to the Geography Department, the Cartographic Section provides services to non-departmental faculty and staff. Over the past few years, we have developed both a plan view and 3D map of campus. These maps are updated annually. Custom-made maps are provided for publication in conference material, brochures and flyers. The Section does contract work on a cost recovery basis for researchers from throughout the University. Through earnings, the Section is able to fund some of its material, hardware, and software needs. Requests for our services from non-geography sources are fulfilled as time allows.

The Section has experienced excess demand on its services for several years. Responsibilities of the Cartographic Section have increased with the assumption of responsibility for maintaining and updating of the basic University's campus map and specialized derivatives. Given the likely increase in publications, necessitated by a more pro-active research stance within the department, greater use of the services of this unit by faculty is anticipated.

New trends in our services include: redesigning maps generated at the conclusion of a GIS operation to meet publication standards; becoming more familiar with the graphics components of particular GIS packages in our department so that we may better advise students and faculty regarding the cartographic capability of the software; and designing maps for web presentation in addition to published form . . . and we'll do it all "without the use of pen and ink!" ❑

ARE YOU COMPATIBLE WITH YOUR PRINTING SERVICE BUREAU?

by Joe Stoll
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University cartography laboratory managers often utilize printing service bureaus for color proofing and print production. This requires the cartographic laboratory manager to have an intimate knowledge of the service bureau(s) with which he/she works. This knowledge should include both general knowledge of the printing processes, and specific knowledge of the equipment, software, personnel, workflow, and requirements unique to each individual service bureau.

The University of Akron (UA) Cartography Laboratory produces in-house, individual color prints up to 11 inches by 17 inches. Other printing tasks require the use of off-campus service bureaus. The UA Cartography Laboratory primarily uses two local service bureaus. The first of these is a full-featured commercial printing company located near campus. Printing jobs that require press runs and a size of no greater than 30 inches are taken here. The second service bureau is an engineering/CAD oriented service bureau. Printing jobs requiring individual color prints of more than 11 inches by 17 inches on paper or transparencies are taken here. This CAD oriented service bureau also performs mounting and lamination services.

The relationship of the UA Cartographic Laboratory to both of these service bureaus, while often involving a variety of production processes, different software packages, and variations of desired output, revolves around a central issue of "compatibility." Compatibility is critical during the production process, for the choices of file and font formats, for the desired end result, and in the choice of external media used to transport the from one location to another.

Compatibility in the production process is important since methods and procedures used must result in digital files from which the final artwork can be successfully produced. This remains important whether the production is via a press run or printed individually. Requirements for compatibility differ from one service bureau to another. For example, if the UA Cartography Laboratory uses AutoCAD to create digital files for a large wall-size map, it is important that each different color appearing on the map is created on a separate "layer." Since the CAD oriented service bureau uses specialized software to assign colors to objects in the digital file, it is more efficient to assign colors to each of the layers created during the production process.

Another important facet of production process compatibility, regardless of the service bureau, is proper closure of filled polygons. Improperly closed polygons can at best, appear incorrect on the final print and at worst, cause the file to print improperly, if it prints at all. A thorough mastery of polygon creation commands and methods combined with careful editing and checking will result in fewer printing problems.

Compatibility in the exchange of file formats and fonts between the digital prepress files and fonts and those used by the service bureau is important. The full-featured printing service bureau used by the UA Cartography Laboratory generally requires conformability to the Adobe standard. This means that graphic files should be compatible with Adobe Illustrator and that fonts used should be Adobe Type 1 fonts. It is possible that other formats will work, however, their use increases the risk of unforeseen problems and delays. If there is any doubt about font compatibility, our service bureaus prefers to eliminate the problem by converting all text to curves or to paths. File formats are also important to the CAD oriented service bureau. They support several versions of AutoCAD, Microstation, and CorelDRAW along with other software in order to directly read client files. If the client has produced files with other software, an import/export file format such as the .DXF format must be used.

Another important form of compatibility relates to the desired final product. What is desired must be compatible with the capabilities of the service bureau. For example, it is important to know early in the planning stages of a map sheet with desirable dimensions of 32 inches by 36 inches that the commercial printer is not able to do a press run of material larger than 30 inches by 30 inches. Parameters such as size, type of paper, type of coating, number of colors available on the press per run, etc. are all factors that must be considered early in the project's planning stages.

Upon the completion of a project's production phases the file(s) must be transported to the service bureau. It is important to know the types of external storage media that are compatible with the service bureau's equipment. Most full-featured service bureaus are equipped with a variety of devices and media for transporting and archiving files. Small files are often transported via floppy diskettes, however, since graphic files, especially bit-mapped files can become quite large, other media (including Bernoulli and Syquest cartridges) are used extensively by service bureaus. Other storage media suitable for file transport include CD-ROM disks and data tapes. Recently, magneto-optical disks or cartridges have received a great deal of publicity due to their lower prices, improved performances, and expanding capacities. It is important to consult with your service bureau to find out the devices they use and support.

Finally, personal compatibility is perhaps as important as technical compatibilities. Personnel compatibility evolves through a sincere, business-like, yet cordial relationship of mutual respect and trust. If this type of relationship can be initiated with the service bureau by the cartographer and fostered over an extended period of time, mutual benefits are realized. The service bureau benefits by receiving files that are less likely to be problematic. The cartographer benefits by gaining a better understanding of what the service bureau does and what is required in the production stages of a project to obtain a better result. ❑

map library bulletin board

PATTEE LIBRARY, PENN STATE UNIVERSITY AND THE ASSOCIATION OF RESEARCH LIBRARIES GEOGRAPHIC INFORMATION SYSTEMS LITERACY PROJECT

by Melissa Lamont
Pattee Library
Penn State University

At a quick glance, libraries may appear to be unusual places to find Geographic Information Systems (GIS). Yet, as mapping and GIS software have evolved and become more user friendly, libraries have become more technologically sophisticated. At the same time, libraries in the United States received an added push from the federal government. In theory, government agencies are to furnish copies of their publications to the Government Printing Office for free distribution to some 1400 depository libraries. These depository libraries agree to hold the information and provide it to the public. In practical terms, although a large number of government publications and data sets are deposited with the libraries, agencies use a variety of means to circumvent the law. Traditionally, depository librarians have found it necessary to lobby, hard, to assure public access to government publications. As the Census Bureau developed the TIGER Line Files, librarians strongly encouraged the agency to include the data files in the depository program. Admirably, Census complied. Thus, hundreds of libraries now hold TIGER files.

Unfortunately, the viewing software first issued with the TIGER file disks was slow and inflexible. Librarians began to charge out the disks, like books, to users. The directors at the Association for Research Libraries (ARL) recognized the TIGER Files as an opportunity for libraries. They negotiated a partnership with the Environmental Systems Research Institute (ESRI) and created the ARL/GIS Literacy Project [see the Map Library Bulletin Board , *Cartographic Perspectives* 1993 (14): 18-19]. ESRI provided software and training and the libraries agreed to provide feedback to the company and make the software and data available. The response from libraries was overwhelming. At the present, over one hundred United States and Canadian libraries are involved.

For many libraries, GIS has fit naturally into services already provided. Libraries provide a neutral ground for researchers and casual users. Some disciplines, such as history or economics, may have interesting GIS applications but may not need their own fully operational laboratories on a permanent basis. Likewise, small businesses often cannot afford the hardware or personnel to manage a mapping system. The library can meet the need of the non-traditional GIS clientele. In addition, libraries have always sought and held data–they search out information, provide the documentation or metadata, and make the information available to users. Many libraries view spatial data, and other data sets, as another format to acquire, catalog, and provide to the public.

Of course, the range of services and levels of expertise at each library will be different. At Penn State's Pattee Library we are working with the Center for Academic Computing and the Department of Geography to install a spatial data center. With a server located in the Maps Room, we will actively collect data (at first primarily Pennsylvania based information), and we will make it available for downloading or for use in a public laboratory. Eight PCs, connected to the server, CD-ROM drives, and color, and black and white printers will be available in the Maps Room. We plan to offer mapping software and limited GIS capability. The in-house facility will be open the same hours as the library. To help staff the new lab, the Geography Department will offer a new course spring semester that will require students to staff the lab in addition to their time in the classroom. Topics to be covered include hardware troubleshooting, software skills, reference techniques and data organization as well as dealing with clients.

A few telephone calls, or a visit, to your local library will determine what kinds of services the library can provide. Although librarians are moving rapidly into new technologies, they still value traditional map library services also. Fortunately, paper maps will be with us for a long time. As the new editor of this column, I hope to highlight some of the interesting paper and digital collections various libraries hold, and address some of the current developments in map libraries. Your suggestions are welcome.❑

EDITOR'S NOTE:
I would like to welcome Melissa Lamont of the Pattee Library at Penn State University to the Editorial Board of *Cartographic Perspectives*. Melissa has agreed to take on the responsibility of the Map Library Bulletin Board column. It has been a number of years since this column has been a regularly featured item in *CP* and I am pleased that Melissa is committed to see that this important column appears in every issue.

Sona Karentz Andrews
Editor, CP

reviews

BOOK REVIEW

Map Projections: A Reference Manual
Lev M. Bugayevskiy and John P. Snyder, Taylor and Francis Ltd., 1995, xx and 328 pp., references, appendices, index. $ 105.00. Cased. (ISBN 07484 0303 5); Paper. (ISBN 07484 0304 3).

Reviewed by C. Peter Keller
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University of Victoria
British Columbia, Canada

Here is a reference manual about map projections that combines the best knowledge about the subject by leading experts in Russia and the United States. The book is an extensively revised translation of a Russian text with the translated title *Cartographic Projections - A Reference Manual* written by Lev M. Bugayevskiy and Lyubov' A. Vakhrameyeva (since deceased), published in Moscow in 1992. The preface informs us that John P. Snyder was brought abroad during the translation to "add pertinent Western material for balance and to correct some of the impression inadvertently given in the Russian text Westerns projections."

The book is divided into an introduction, eleven key chapters, an extensive list of references and eight appendices. The introduction sets the tone. It is here that We learn that this book is about mathematical cartography, defined as the theory and mathematical analysis of map projections and their characteristics. We also learn about the history of map projections starting with early Greek works but quickly moving to a who's who in Russian and American map projection research. The introduction concludes with a brief summary of advances in measurement of the shape of the earth.

The first key chapter covers the general theory of map projections. Spanning 48 pages and broken into eight main sections, this chapter lays the mathematical foundation for the rest of the book. We are introduced to mathematical notations and relationships between curvilinear, three-dimensional rectangular, plane rectangular, plane coordinate, and triaxial ellipsoid coordinate systems. Map projections are classified using five criteria. Conditions and mathematical properties of the key characteristics of conformality, equivalence, equidistance, and azimuthal distortion are examined.

Chapters Two through Four introduce the mathematical formulation, characteristics and, wherever applicable, a brief history of a large number of different map projections. Chapter Two focuses on map projections with straight parallels. In 39 pages we learn about the families of cylindrical and pseudocylindrical projections. Chapter Three covers map projections with parallels in the shape of concentric circles. Here, 45 pages introduce us to conic, azimuthal, perspective azimuthal, pseudoconic, pseudoazimuthal, and retroazimuthal projections. Chapter Four concentrates on map projections with parallels in the shape of non-concentric circles, namely polyconic projections.

Chapter Five moves on to discuss map projections for topographic maps, named-quadrangle maps, and projections used in geodesy. We learn about eleven of the most common projections for topographic mapping, including three projections not covered in the previous chapters. Topographic mapping in Russia and the United States is given special attention.

Chapter Six deals with map projection research, argued to be related to "further development of theory and practice, improving the mathematical basis of a map, obtaining new sets and variations which possess definite advantages over known projections, and satisfying new cartographic requirements facing science and the economy." Viewed very much from a mathematical perspective, we are informed that map projection research is about solving differential equations with partial derivatives of the first order involving elliptic, hyperbolic, parabolic, and combined functions. Twenty pages lead us through examples of this type of investigation, however, research into social aspects of map projections and the search for map projections suitable for mapping non-spherical worlds is ignored.

Chapter Seven focuses on best and ideal map projections, examining what projections satisfy given conditions of representation. 'Best' projections are divided into those "minimizing and optimizing distortion of a minimax and variational (least squares) type," or those "satisfying in an optimum way an entire group of requirements for projections in accordance with the particular purpose of the map being designed (e.g. graticule simplicity, distortion values, etc.)." We learn that minimum distortion has been essentially completely solved for conformal projections, but is not yet adequately solved for other types of projections, with no concrete solutions. In 35 pages we are guided through a number of conditions of representation and associated projections, including an interesting section on anamorphous projections, offering a theoretical basis for cartograms. A section on map projections for maps on globes explains projection strategies for pasting map gores onto balls for globe construction.

Chapters Nine and Ten carry on with the theme of what map projection to use where and when. Chapter Nine explores the choice and identification of suitable map projections. Entirely devoid of mathematics, this chapter takes 12 pages to go through suggestions for most suitable projections from mapping of the world and continents through to mapping of, for example, geology, fauna and flora, history, economics, transportation, and communication. We also learn how map projections can be identified from the shape of the graticule. Chapter Ten is devoted to the problems and directions of automation in obtaining and applying map projections. The chapter commences by listing eight problems with automation of map projections, thereafter dealing with each in some detail. Concerns noted include the problem of computerized selection of the best map projections and automated identification of a given projection.

This book is a 'must have' on the book shelves of anybody with a serious interest in map projections. It does not make for easy reading. It is crammed with mathematics and it will frighten most students. However, closer scrutiny will reveal that this book is full of information about the history and mathematics of map projections found in few other texts. It offers an insight into Russian work on map projections hitherto largely hidden from those not fluent in the Russian language. Yes, I was disappointed that this text did not cover some of the social aspects of map projections and that it failed to address map projections for truly non-spherical worlds. However, John Snyder and Lev Bugayevskiy must be congratulated on rising to the challenge of co-authoring a book where neither speaks the language of the other, coming up with what is no doubt a major contribution to the literature on map projections.❑

BOOK REVIEW

The AGI Source Book for Geographic Information Systems 1995
David Green and David Rix, editors. London: The Association for Geographic Information, 1995. 392 pages, diagrams, index. $125.00 Paper. (ISBN 0-471-95580-9)

Reviewed by Jeff Torguson
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University of Wisconsin-Oshkosh

The *AGI Source Book*, formerly the *AGI Yearbook*, is a recent publication in the annual series by the Association for Geographic Information (an organization whose mission is to "spread the benefits of geographic information and GIS to the wider community and to help all users and vendors of GIS"). One of the means by which the AGI accomplishes this task is through the production of this business oriented *Source Book*. The *Source Book* contains two main sections: an articles section (106 pages) which addresses many broad GIS technological considerations, and a trade directories section (208 pages). There is also a 62 page "Miscellaneous Reference Material" section which includes listing of European GIS organizations, GIS standards, a comprehensive GIS dictionary, and other related resource materials. With the exception of several pages of color advertisements, the *Source Book* is a black and white publication.

The first section of the *Source Book* contains a collection of articles by leading GIS business and academic authors from North America and Europe. The aim of this section is to "present a view of GIS futures together with an appraisal of some of the most important GIS technology issues" (p. 17). The fourteen articles in this section address many of these issues of the larger GIS community. Articles include: Michael Goodchild's "Information Highways," Dick Newell's "Where is GIS Technology Going?," and David Maguire and Jack Dangermond's "Future GIS Technology." The breadth of topics within the book is impressive, ranging from cartographic concerns, in David Green's "An Exciting New Role in GIS for the Cartographer of the Future," to remote sensing issues, as in Gordon Petrie's "Photogrammetry and Remote Sensing." Classical issues in GIS are also examined in the context of current technology, as in Robert Laurini's "Distributed Geographic Databases," P.A. Burrough's "Accuracy and Error in GIS," and H. Bishop Dansby's "Access to Digital Data in U.S. Federal Agencies." Other important aspects of GIS are also explored in articles by Duane Marble ("An Introduction to the Structured Design of Geographic Information Systems"), David Rix ("Recent Trends in GIS Technology"), M.J. Ives and K.J. Crawley ("GIS Implementation Issues"), Joseph K. Berry ("Implications of a Humane GIS"), and David Rhind ("Spatial Data from Government"). In addition to the timeliness of the GIS topics, the articles also address technological issues such as the current and changing status of DOS/Windows, Windows NT, and Windows '95 operating systems, and issues involving the Internet and World Wide Web.

The articles are well written and edited, although as with many other compendium works from multiple authors, they exhibit a wide variety of writing styles, from relatively informal but informative, as in Goodchild's article, to a very formal and academic style, as in Burrough's article. Lack of a narrow theoretical focus or topic range amplifies this disparity between writing styles, as do the varying degrees of willingness from the authors to "date" their works with the extremely time sensitive aspects of GIS technology. The articles as a whole are not overly theoretical and include many appropriate illustrations, diagrams, and flow charts.

Although the *Source Book* contains many articles by prominent GIS specialists, the text's business orientation is evident in the second section where about half of the book's 392 pages are dedicated to a set of trade directories. These directories contain listings of businesses and organizations (primarily in the United Kingdom) which use or distribute geographic information. These organizations are listed not only within the context of a single index, but are also under an appropriate subject category, such as suppliers of hardware products, suppliers of software products, transport applications (e.g., navigation and vehicle location), utility applications (e.g., gas and water distribution networks), and providers of training services. In all, there are forty different directories in this extremely thorough section, providing a wealth of information about the organizations and appropriate contact person.

Both sections of the *AGI Source Book for Geographic Information Systems* clearly meet the editors' objectives for a work that GIS users and vendors need, as well as addressing present and future technology issues. The strength of the *Source Book* is its attention to the current GIS business needs. The timely technology specific issues that normally date most theoretical publications, combined with current GIS business information, make this a valuable reference. This temporal sensitivity, however, is also the primary weakness of this text since the trade section will become quickly dated in such a dynamic discipline. By linking the trade section (which is so temporally sensitive) with the articles section (with its breadth of topics), it is possible that the editors may have attempted to do too much within the confines of a single volume. The *Source Book*, does, however, provide access to a diverse number of topics by leading GIS specialists, as well as giving the reader an idea of what is happening with GIS sources in the United Kingdom. In addition, the glossary is among the better ones that I have seen in a work of this nature.

In conclusion, the primary users of this source book will be persons in private sector GIS, particularly within the United Kingdom. Beyond the U.K., larger research organizations, universities, and users of GIS data that are involved with cooperative research projects with United Kingdom counterparts will be able to benefit greatly from this book. Academic readers of *Cartographic Perspectives* need to note that this is not (nor was intended to be) a substitute for a text on teaching the principles of GIS. At $125.00 per copy, most instructors will balk at picking up one for their personal collections, as will North American small business and county governments which focus on large-scale mapping and other more localized projects. Ultimately, I believe that this source book deserves consideration for inclusion as a secondary text, ancillary business resource, or incorporation into a research library collection. ❑

ATLAS REVIEW

A New Social Atlas of Britain
Daniel Dorling
Chichester: John Wiley & Sons.
1995. Cloth. Price approx. $47.95
(ISBN: 0-471-94868-3)

Reviewed by Henry W. Castner
Pittsboro, NC

Daniel Dorling's *New Social Atlas of Britain* is a spectacular and challenging new atlas of equal population cartograms. It is cut from the cloth of Janos Szego's human cartography which asks the question: "How can actual events and processes in the world of man be translated into maps, and how can this translation be made comprehensible and accessible for the human brain?" (Szego 1987, 10). Szego's project was tied to advances in computer cartography beyond the early expressions in the language of that technology which the admits were not very refined or subtle. Unfortunately, he was unable to offer many examples that took us beyond what could be seen in Bertin (1967) or Tufte (1983). But he would, I believe, be pleased with Dorling's atlas which is clearly about human activities and is a splendid realization of the promise of the new technology. Whether Dorling's atlas will be seen as "user friendly, only time will tell. To his credit, Dorling makes every effort to help his readers come to terms with and become articulate about these unfamiliar maps.

Dorling has taken contiguous equal population cartograms as the basis of his atlas. In them, equal areas of space have been allocated to equal numbers of people, rather than to values or rates of some phenomenon. Readers are perhaps more familiar with hand-constructed isodensity maps (Eastman, Nelson, and Shields 1981) or the ball-bearing contrived isodemographic map (Skoda and Robertson 1972). In these images the shapes of the enumeration areas are distorted so that their contiguity and relative positions are roughly maintained and the overall shape retains enough elements of the undistorted geographic area to remain recognizable. For the cartograms in Dorling's atlas, a circle was assigned to each of the some 10,000 wards and its size was made proportional to their population. In a few cartograms he alternatively used the 459 local authority districts or the 633 parliamentary constituencies. Wards are the smallest administrative areas used to elect politicians in Britain. They vary little in population within the same district but may vary greatly from one district to another. Because urban wards tend to have larger populations than rural wards, the location of cities and towns are rather easily discerned. Wards have the added advantage in that their size tends to correlate strongly with land use.

To help his lay readers, Dorling compares the resultant images of his cartograms with sending every person in Britain to a small flat island providing standing room only. Each household is asked to keep together and to stay as near to its neighbors as possible, while allowing everyone equal room. If everyone was given a colored placard to hold overhead in reply to a question, then a bird's-eye view would show a population cartogram of an answer to that question. Obviously such a gathering is an impossibility but it can be simulated by a computer. And Dorling has been writing such programs for some years, starting with a cartogram of British counties in 1989 as part of a student dissertation. The computer program for this atlas moves each ward circle so that none overlap but as many as possible retain their geographical neighbors and their cardinal relationships. As a result, the coastline must be distorted and Britain takes on a new form although it is reminiscent of the true and familiar geographic shape. But because of the concentrations of population in urban areas, viewers must get used to the bulbous Southeast England around London and enlargements in such areas as the West Midlands, West Yorkshire, and Strathclyde.

Atop the image, there is an unintended Britannia-like figure (with shield and sword held aloft) that is Scotland! The circles are filled with a tint of gray or red to correspond to the classes, most often five, into which the census data has been divided. Black is always extreme minimum; red the extreme maximum. In this way, comparisons from page to page are more easily made.

The impetus for this atlas began in 1992 with the first releases of new census data. Numerous short programs were written to transform, store, compress, and retrieve the census and other data used to create the various cartograms. The basic statistics are usually presented in percentages and then the simple differences in those percentages (rather than the percentages of a percentage) are mapped. This procedure diminishes the impact of local changes and allows national comparisons to be more easily made.

The atlas is in landscape format with 11.5 by 8.25 inch pages, divided into two columns usually with two cartograms or with text and statistical diagrams. The text is often used to discuss both the nature of the variable being mapped and characteristics of the data as well as to describe some of the more interesting patterns to be seen. After a lengthy 19 page introduction to the data, the cartograms, and the detailed ward structure of the images, Dorling provides eight full color images. One is a traditional map of population density for 1991 of residents per square kilometer. The key shows what percentage of the land area of Britain is in each of the 15 classes. The other seven images are cartograms of general topics against which the more specialized cartograms to follow can be compared. They include population concentration, the largest ethnic or national minority group, those not working, housing wealth, illness rates, composition of the workforce, and the political party shares of ward voters. These images are overlain with the county boundaries to help relate them to more familiar geographies.

The seven major sections of the Atlas which follow cover topics on population, demography, economic, housing, health, society and politics. In total, 106 topics are treated. Many of them are to be expected: e.g., land use, fertility, occupational structure, household demand, availability of central heating, family type, and electoral registration. Some others are new and refreshing: e.g., residents imputed, early retirement, overcrowding, avoidable death, car availability, and electorate not voting.

Dorling correctly acknowledges that because of the graphic complexity of the images, and, despite all the computer programs and statistical methods employed in the generation of the images, atlas users will need to gain some experience to read them. And the human eye-brain will be the instrument that must detect and interpret the patterns which the cartograms reveal. To assist in this, Dorling does a number of things, some of which have already been mentioned in this review. In addition, all but one of the seven sections is introduced by a traditional land area map juxtaposed with a population cartogram to help readers make the visual transition.

While the images are quite complex, Dorling claims that the simultaneous display of 10,000 circles allows one to see both local and national patterns. A familiarity with the geography of Britain would certainly help in this. For this reviewer it is possible to isolate the patterns of the extreme classes and the overall divisions between lower and higher percentage changes, i.e., between areas of black and red. As one might expect, London and some of the other large conurbations are often dominant features of these images. But the images that attract the greatest attention are those where these urban areas do not stand out.

In his acknowledgments, Dorling pays tribute to the countless people who "diligently fill in census forms, voting slips, birth certificates, mortgage applications, unemployment cards and all the other paper work which is used to organize British society." His hope is that some of that information is being returned in the pages of his atlas. Clearly this return will be useful for those interested in the social geography of Great Britain. But it will also appeal to the much larger audience that is currently exploring the possibilities of graphic visualization for it provides fascinating and challenging examples for thought, reflection, and perhaps even map user research.

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cartographic events

April 10 - 12, 1996
Fourth International GISRUK 96 University of Kent at Canterbury
Kent, UK. Contact: Judith Broom, Computing Laboratory, University of Kent Canterbury, Kent CT2 7NF, UK. +44 (0) 1227 827695, fax +44 (0) 1227 762811, e-mail: gisruk96@ukc.ac.uk.

April 21- 24, 1996
ASPRS/ACSM Annual Convention and Exhibition
Baltimore Convention Center, Baltimore, MD. Contact: ASPRS/ ACSM '96 Registration Coordinator, 5410 Grovenor Lane, Suite 100, Bethesda, MD 20814

June 4-7, 1996
Ninth Annual Towson State University GIS Conference
Towson, MD. Contact: Jay Morgan, Dept of Geography & Environmental Planning, Towson State Univ., Baltimore, MD 21204-7097, (410) 830-2964, fax (410) 830-3888, e-mail:e7g4mor@toe.towson.edu.

June 12 - 16, 1996
CCA/ACC
Toronto, Canada. Contact: Shelley Laskin, co-chair of Organizing Committee, Globe Graphics, 664 Balliol Street, Toronto, ON, Canada M4S 1E7, (416) 481-9513, fax (416) 487-1644, e-mail: shelley@io.org

July 27 - August 1, 1996
URISA 96
Slat Lake City, UT. Contact: URISA, 900 Second Street, NE, suite 304, Washington, D.C. 20002, (202) 289-1685, Fax (202) 842-1850, e-mail: training@urisa.ord, http: / / www.urisa.org

October 2 - 5, 1996
NACIS XVI
see pages 10-11 for details

essay

GEOGRAPHY AND CARTOGRAPHY IN THE TWENTY-FIRST CENTURY

by Mark Monmonier
Department of Geography
Syracuse University

This essay is a short after-dinner address delivered in State College, Pennsylvania, on October 14, 1995, at a banquet celebrating the 50th anniversary of the Department of Geography at the Pennsylvania State University.

When asked to articulate my "thoughts on the future of geography and trends in cartography in the twenty-first century," I found it difficult, if not a bit painful, to disentangle what I think geography and cartography **will** be doing from what I think geography and cartography **should** be doing. The result, then, is two parts "will happen" and three parts "should happen"–or is it three of "will" and only two of "should"? (I don't know. But on with it.)

First, geography. Perhaps even before the year 2000, postmodernism will have run its course. Maybe; maybe not yet. In its defense, the postmodern critique has made us more fully aware that bias is everywhere and that "objectivity" is either nonexistent or impossibly difficult-and that's good. But the history of science and the recent history of our discipline have also taught us that paradigms come and paradigms go, even big ones. If you sense that I haven't really bought into postmodernism, you're right. Even so, I am enthusiastic about the questions it has encouraged geographic scholars and social scientists to ask, and the phenomena and issues it encourages us to examine. What I don't like is its needlessly impenetrable jargon: a dialect devised largely to keep the public (not to mention most undergraduates) out of the discourse. And a jargon that on occasion gets geographers noticed in ways that are embarrassing–as when newspaper columnists cite our intellectual kinfolk whose ludicrously dense sentences must be intelligible only to those who already know what the author is trying to say. Or think they do.

Should geographers be critical? Absolutely. We need to be critical of our data, of what we read, and of what we see. And we must be more critical, both inwardly and outwardly, than ever before. More important, though, we need to recognize that our insights can usefully inform public policy and that we have a moral obligation to publicize our insights effectively, by contributing to public-policy debates on poverty, housing, environmental justice, employment, global climatic change, and many other issues. But to do so effectively allows less time for the elitist whining that often results when we address our insights largely to other social scientists and humanists. They listen, of course, because geography with its integrative powers has much to say about many issues. Yet we ought not forsake the clarity of ordinary language and graphics for the arcane, privileged vocabulary of English professors who write poorly yet seek the elimination of successful creative writing programs.

What I'd like to see, however uncertain I am it will actually happen, is a geography that enthusiastically accepts the challenge of insightfully and reliably describing the Earth. But first we must accept that proposition that insightful and reliable description is never '**mere** description'. If we accept this proposition, geography could become the undergraduate major of choice for the careers in law and public service. And the Joan Didion's, the Joel Garreau's, and the Tony Hiss's, if not professional geographers themselves, would at least trained be in our field.

And now for cartography, which with its extension, geographic information systems, has made enormous strides in the past decade. But there's a long way to go before cartography and GIS achieve their full potential. In the next century I see progress in three principal areas:

First, electronic geoarchives will become much richer in the variety of information, degree of detail, and level of integration. They will not only surpass the map libraries of today in content and coverage but also link maps to representations currently found only in books. And historical geographers, cultural geographers, and social geographers will want to–indeed, they'll have to–use GIS, and in so doing, they'll contribute to the databases.

Second, our electronic cartographic archives will be much more user friendly. By this I mean that–for the user with a good inkling of what he or she wants–the GIS interface of the future will prove no more formidable than the typical library database search system of today. Searches will be quick and customized. Cards carried in wallets (or whatever one carries) will contain user profiles, summarizing the user's training, experience, interests, color preferences, and satisfaction with the system's past performance. In addition to helping the system ferret out highly relevant information, user profiles will support customized guided tours, in which the electronic atlas tells us about itself, about places and spatial relationships, about the quality of its data, and the reliability of its representations-as much or as little as we care to know. And for different insights, we might even borrow someone else's user profile. Customization will be enormously important in helping users find, interpret, and understand cartographic information. And customization will also replace the geographic information paradigm with a focus on geographic understanding.

Third, maps and other visual material will become standard writing tools, readily available and widely used by writers, who will develop the knack of using both sides of the brain. We have seen the effects of earlier representational revolutions, among which I would include printing, public education, photography and photographic engraving, motion pictures, and the current mix of video, computer graphics, the personal computer, and the graphic user interface. Especially promising for geography is the power of dynamic, interactive multimedia to integrate words and pictures and numbers and maps. Already this new technology is having profound effects on writing and public communication. Computer graphics has become just plain graphics. Computer literacy is becoming just plain literacy. And electronic multimedia is sure to become just plain media. For the educated professional geographer, the artificial division of labor between writing and illustrating will disappear.

Helen Couclelis suggested the name "spatial understanding support system," or SUSS, to describe the GIS of the twenty-first century. Development of SUSS technology will, no doubt, focus on and be driven by three closely related problems: energy, population pressure, and hazards. Energy's informational needs are varied: searching for new fuel reserves, managing waste streams and resource recovery, assessing the externalities of fossil fuels, and weighing the benefits and costs of nuclear power, including high-level and low-level radioactive waste. In the area of population, epidemiology might well eclipse traditional concerns with food, housing, and ethnic conflict, as the vast global gene pool of well over six billion human organisms demonstrates its effectiveness as a research and development laboratory for ever more deadly viruses. And because a complexly integrated world economy is especially vulnerable to both natural and technological hazards, mapping will have a key role in efforts to understand hazards as well as manage risk through insurance schemes, remediation projects, land-use regulations, and emergency planning.

As a preview of its key role in SUSS, cartography is an important element of the scientific visualization movement, which should mature early in the 21st century. Within cartography, visualization is attracting the most attention and producing the best research. And that's good for both cartography and its client disciplines.

Unfortunately, cartographers and geographers seem not to recognize their stake in public policy across a broad range of issues, including public access to geographic information, privileged users, biased content, intellectual property rights, and liability–when bad decisions result from incomplete or flawed data, or from sloppy analysis? We can confront these issues head on, or we can talk amongst ourselves, in a closed academic debate of little relevance to what's really happening. ❑

correction

In the last issue of *Cartographic Perspectives* we announce a CD-ROM atlas of U.S. Topography produced by Chalk Butte Inc. (*CP* 22, page 24). Unfortunately, we incorrectly listed the area code in Chalk Butte's phone number. Please note that their correct phone number is 307-537-5283. We apologize for any inconvenience this may have caused. If you are interested in any Chalk Butte Inc. products you may contact them at: Chalk Butte Inc., 137 Steele Lane, Boulder, WY 82923. 307-537-5283 ❑

contributions

NACIS would like to thank the following individuals for their monetary contributions for *Cartographic Perspectives*

Patricia Chalk
Greg Chu
Thomas Hodler
E.L. Lanzer
Henry Norris
Joseph Poracsky
Bret Rodgers
Lawrence Slaughter

announcements

1996 RISTOW PRIZE COMPETITION

Each year the Washington (DC) Map Society (WMS) awards the Ristow Prize for cartographic history and map librarianship to honor Walter W. Ristow, one of America's premier cartographic authors and map librarians. The contest is open to all full or part-time upper level undergraduate, graduate, or first year post-doctoral students attending accredited colleges or universities worldwide. The winner receives $500, WMS membership, and publication of the paper in their journal *The Portolan*. Deadline for submission is June 1, 1996. Details may be obtained for competition from Chairman Huber Johnson, 2101 Huntington Ave., Alexandria, VA 22303 USA, (703) 960-7815.

IBM SELECTS ALTEK CORPORATION AS U. S. FOREST SERVICE PROJECT 615 PARTNER

ALTEK Corporation announces that it has been selected as the supplier of high accuracy digitizers to IBM Corporation for the U.S. Forest Service Project 615 contract. Project 615 will span eight years with a financial expenditure anticipated at $267 million. A Washington, D.C. facility houses the pilot installation which is the prototype model for a network of over 800 field offices using RS/6000 IBM workstations. ALTEK and IBM have previous experience pooling their expertise using RS/6000 workstations, ESRI ARC/Info Software, and ALTEK digitizers during the BLM ALMRS contract awarded to CSC in 1993.

The DATATAB l was chosen as the premier digitizer for Project 615 because it exceeds the high accuracy requirements specified in the U.S. Forest Service contract. The DATATAB I series offers: unequaled absolute accuracy over the active area; a wide range of sizes varying from 24" x 36" to 60" x 120"; models available back lighted with continuous variable intensity, rear projection, or a standard opaque surface. ALTEK digitizers are fully compatible with all GIS and CAD packages.

ALTEK's commitment to the GIS industry is to supply the finest data input and output products available on the market. ALTEK's product line includes: high accuracy digitizers; color and monochrome scanners; electrostatic color printers; and raster to vector software conversion.

LAND INFO, DENVER, COLORADO FORMS PARTNERSHIP WITH MCR DEVELOPMENT, JEDDAH, SAUDI ARABIA

Land Info of Denver, Colorado, the world's largest supplier of color raster georeferenced digital maps has joined into a partnership with MCR Development located in Jeddah, Saudi Arabia which provides extensive international GIS services. This partnership aims at expanding international services and creating a more comprehensive awareness of GIS application development and digital map data products throughout the Middle East. For more information contact: Michael Blakeman at Land Info, (303) 369-6800, e-mail: mbmaps1@csn.net or Paul Bailey at MCR Development at (966) 2 651 2286, e-mail: paul.bailey@saudi.bbs.com.

LAND INFO AND DATA DIRECTIONS INTRODUCES "WORLDREG" FOR MAPINFO USERS

LAND INFO of Denver, Colorado and Data Directions of Eugene, Oregon through their joint agreement have developed WorldReg, a utility program for MapInfo users. This utility program, developed by Data Directions and distributed by LAND INFO, allows all MapInfo users to display, manipulate and read geo-referenced color raster images produced by LAND INFO. The WorldReg MapBasic application runs with MapInfo and automates the Image Registration process required by MapInfo, to display raster images. WorldReg creates a MapInfo Table automatically, which is used to open the georeferenced raster image. From the raster image table MapInfo vector data can be displayed accurately on top of the georeferenced image. WorldReg allows users to create the MapInfo tables on a local drive while maintaining the raster image on CD-ROM. UTM coordinates in meters or feet and NAD27 and NAD83 are supported.

LAND INFO has built the most comprehensive worldwide database of color raster images at the 1:24,000, 1:200,000 and 1:250,000 scales of the United States and the 1:50,000 and 1:250,000 scale internationally. The digital map products are available from the Far East to the Middle East, from North America to South America. Data Directions is an authorized MapInfo Partner providing custom MapBasic applications, development, consultations, data integration and conversion services. For more information, please call LAND INFO, Michael Blakeman at (303) 369-6800, e-mail: mbmaps1@csn.net or Data Directions, Tony Cooley at (503) 345-4627. ❑

NACIS news

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CARTOGRAPHIC PERSPECTIVES

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MINUTES OF NACIS BOARD MEETING
October 25, 1995
Wilmington, North Carolina

The following members of the Board participated: Officers Henry Castner, Keith Rice, Ed Hall, and Craig Remington; Board Members Pat Gilmartin, Barbara Fine, Donna Schenstrom, Carolyn Weiss, and John Sutherland; Board Members Elect Jim Anderson, Jeremy Crampton and Cynthia Brewer; Executive Officer Chris Baruth. The meeting was called to order at 1:05 p.m. and the minutes of the May 20, 1995 meeting were approved.

PRESIDENT'S REPORT
Henry offered a detailed compilation of the Society's operating budgets for the years 1993 through 1996 and a breakdown of costs associated with our past two annual meetings. This effort was made to gain a better understanding of how our funds are spent. Further, this information will be used to establish a more formalized budget process for our future annual meetings.

TREASURER'S REPORT
Ed Hall reports a total balance of \$27,776.26 in all accounts.

CARTOGRAPHIC PERSPECTIVES
The Board discussed the increasing costs of production for *Cartographic Perspectives* and the steps that might be taken to insure its continued success. These costs, along with declining income from annual meetings, demanded attention. The Board will ask the membership to vote for a modest increase in dues at the 1996 Business Meeting in San Antonio. In the interim, a motion was offered by Keith to "limit the maximum number of pages in *Cartographic Perspectives* to 164 for the three issues of the calendar year 1996." The motion was seconded and passed. The possibility of selling advertising space was discussed. It was concluded that a more palatable approach would be to include advertisements sealed in the polybags, rather than placed in the journal itself, if advertising is indeed necessary.

EXECUTIVE DIRECTOR'S REPORT
Chris reported that the written guidelines for setting up annual meetings were nearly complete. He asked that Susan Peschel and Sona Andrews be named Associate Executive Directors to NACIS, citing the help their council provides in his decisions. A motion to that effect was seconded and passed. Another motion was offered "to set up an ad hoc committee to investigate and establish the format of the NACIS Homepage." The motion was seconded and passed. Members of the committee will be appointed at the Saturday meeting. Chris and the Board acknowledged the extraordinary efforts of Liz Hines for her work on the local arrangements of our meeting.

FUTURE MEETING SITES
A number of possible future meeting sites were discussed. A more definitive selection will be made, after a polling of the membership, in the Saturday meeting.

NEW BUSINESS
The only matter of new business was a request by Barbara Fine that new dues be added to the agenda of the Saturday meeting.

The meeting was adjourned at 4:30 p.m.

Submitted
Craig Remington
NACIS Secretary

MINUTES OF NACIS BUSINESS MEETING
October 26, 1995
Wilmington, North Carolina

The business meeting began at 1:00 p.m. with the announcement by Henry Castner of the results of our most recent election. Craig Remington was reelected as Secretary and new Board members include Jim Anderson, Cynthia Brewer, Barbara Buttenfield, Jeremy Crampton and Glen Pawelski. Mike Peterson was elected the new Vice President. Keith Rice thanked those who worked on local arrangements and appealed for the recruitment of new members to the Society. Ed Hall reviewed the status of our accounts and introduced the need for an increase in membership dues. Chris Baruth announced the appointments of Sona Andrews and Susan Peschel as Associate Executive Directors to NACIS. He also mentioned his forthcoming written guides to setting up annual meetings. Trish Chalk reviewed our arrangements with the Menger Hotel for the San Antonio meeting. Henry solicited the membership to offer suggestion for future meeting sites. Sona Andrews thanked the Editorial Board for their help with the success of *Cartographic Perspectives*, asked for the submission of manuscripts, and offered encouragement to those who might be interested in the editorship of the journal. Chris Baruth recognized and thanked Henry Castner for his work as President and Vice President of the Society.

The meeting was adjourned at 1:30 p.m.

Submitted
Craig Remington
NACIS Secretary

MINUTES TO NACIS BOARD MEETING

October 28, 1995
Wilmington, North Carolina

The following members of the Board participated: Officers Keith Rice, Mike Peterson, Ed Hall, and Craig Remington; Board Members Pat Gilmartin, Jeremy Crampton, Jim Anderson, Cynthia Brewer, Glen Pawelski, and Carolyn Weiss; Former Board Members Barbara Fine, Trish Chalk and John Sutherland; Past President Henry Castner and Executive Officer Chris Baruth. The meeting was called to order at 8:30 a.m.

NEW DUES
The Board established a subcommittee to study the Society's fiscal challenges and charged them to submit with justification a dollar amount for new dues. The recommendation will be completed before February 15, 1996.

NEW *CP* EDITOR
Michael Peterson, Chair of the Editorial Board, led a discussion on the preferred qualifications of the new editor. These qualifications include:

a) maintaining an emphasis on relevant and topic articles;

b) knowledge of desktop publishing;

c) a commitment to continue the tradition of graphic quality;

d) ability to meet deadlines;

e) be "well connected" in the cartographic community;

f) attend NACIS as well as other conferences regularly;

g) demonstrate organizational abilities;

h) be prepared to commit to a three year period of editorship;

i) consider the collaboration with an Assistant Editor, preferably at the same institution;

j) receive support for their respective organization for the business aspects of publishing the journal.

There was also discussion of splitting the editorship and production activities between two institutions. This option should be pursued if the potential editor is uncomfortable with the production aspects. It would be preferable to have both editorship and production activities at the same institution.

SELECTION OF 1997 MEETING SITE
The Board has narrowed the 1997 meeting site to Lexington, Kentucky or Akron, Ohio. A final decision will be made by polling the Board after further investigation of these two options.

FINANCIAL ASSISTANCE POLICY FOR BOARD MEMBERS
The Board has on past occasions provided a modest travel stipend for members attending the Spring Board meeting. After a discussion of the equity of this practice and the need to reduce the Society's expenses a motion was offered "to adopt a policy to have Spring meetings held via telephone conference call unless extenuating circumstances warrant differently." The motion had a second and passed.

OTHER BUSINESS
Henry brought the Board up to date on contacts with our friends in Costa Rica. It was the feeling of the Board that the best course of action would be to invite Professor Nunez and his colleagues to our meeting in San Antonio.

NEW BUSINESS
Pat Gilmartin suggested that the Society write a letter expressing our concern with the Chrysler Bill before the Senate. Such a letter will be composed and sent. The final matter of business was the appointment of Jeremy Crampton, Mike Peterson and Chris Baruth to work on the NACIS homepage.

The meeting adjourned at 10:25 a.m.

Submitted,
Craig Remington
NACIS Secretary

EXCHANGE PUBLICATIONS

Cartographic Perspectives gratefully acknowledges the publications listed below, with which we enjoy exchange agreements. We continue to seek agreements with other publications.

ACMLA Bulletin. Published triannually by the Association of Canadian Map Libraries and Archives. Offers article, reviews, and news on cartography and map library related issues. Contact: Colleen Beard, Brock University Map Library, St. Catherines, Ontario L2S 3A1 Canada.

ACSM Bulletin. Published six times a year by the American Congress on Surveying and Mapping. Offers feature articles, regular commentaries, letters, and news on legislation, people, products, and publications. Contact: Membership Director, 5410 Grosvenor Lane, Bethesda, MD 20814; (301) 493-0200.

Baseline. Published six times a year by the Map and Geography Round Table, American Library Association. Contact: Editor Nancy J. Butkovich, Physical Sciences Library, 230 Davey Laboratory, Penn State University, University Park, PA 16802; (814) 865-3716; e-mail:njb@psulias.psu.edu

Bulletin of the Society of Cartographers. Published twice a year, the *Bulletin* features articles on techniques and ideas applicable to the Cartographic Drawing Office. Contact: Pamela Spoerry, Department of Geography, University of Cambridge, Dowing Place, Cambridge, CB2 3EN, England.

Cartouche. A quarterly publication offering news and announcements to members of the Canadian Cartographic Association. Contact: Canadian Cartographic Association, c/o Weldon Hiebert, Geography Department, University of Winnipeg, Manitoba, R3B 2E9, Canada; (204) 786-9483; fax (204) 786-1824; e-mail: weldon.hiebert@ winnipeg.ca.

Cartographica. A quarterly journal endorsed by the Canadian Cartographic Association/Association Canadienne de Cartographie that features articles, reviews, and monographs. Michael Coulson, Editor. ISSN 0317-7173. Contact: University of Toronto Press Journals Department, 5201 Dufferin Street, Downsview, Ontario, M3H 5T8 Canada; (416) 667-7781.

Cartographic Journal. Biannual Journal of the British Cartographic Society. Includes research articles, 'shorter' articles, official records of the Society, book reviews, and a list of recent cartographic literature. Contact: Hon. Secretary, Charles Beattie, 13 Sheldrake Gardens, Hordle, Lymington, Hants, SO4 10FJ, England.

Cartography. Biannual Journal of the Australian Institute of Cartographers. Each issue contains two parts: the Journal proper and the Bulletin. The Journal contains original research papers, papers describing applied cartographic projects, reviews of current cartographic literature, and abstracts from related publications. ISSN 0069-0805. Contact: John Payne, Circulation Manager, GPO Box 1292, Canberra, A.C.T. 2601, Australia.

Cartography Specialty Group Newsletter. Triannual publication of the Cartography Specialty Group of the Association of American Geographers. Features news, announcements, and comics. Contact: Ann Goulette, Editor, Intergraph Corporation, 2051 Mercator Drive, Reston, VA 22091-3414; (703) 264-7141; e-mail: ann@pluto.ne1300.ingr.com.

Cartomania. The quarterly newsletter of the Association of Map Memorabilia Collectors. Offers a unique mix of feature articles, news, puzzles, and announcements of interest to cartophiles. ISSN 0894-2595. Contact: Siegfried Feller, Publisher/Editor, 8 Amherst Road, Pelham, MA 01002; (413) 253-3115.

Geotimes. Monthly publication of the American Geological Institute. Offers news, feature articles, and regular departments including notices of new software, maps and books of interest to the geologic community. Articles frequently address mapping issues. ISSN 0016-8556. Contact: Geotimes, 4220 King Street, Alexandria, VA 22302-1507.

GIS World. Published monthly, this news magazine of Geographic Information Systems technology offers news, features, and coverage of events pertinent to GIS. Contact: John Huges, Managing Editor, GIS World, Inc., 155 East Boardwalk Drive, Suite 250, Fort Collins, CO 80525; (303) 223-4848; fax: (303) 223-5700.

Information Bulletin. Triannual publication of the Western Association of Map Libraries. Contains features, atlas and book reviews, WAML business, and news. Contact: Mary L. Larsgaard, Executive Editor, Map and Imagery Laboratory, UC-Santa Barbara, Santa Barbara, CA. 93106; (805) 893-4049; fax: (805) 893-8799, 4676, 8620; e-mail: mary@wash. uscdic.ucsb.edu.

Mapline. A quarterly newsletter published by the Hermon Dunlap Smith Center for the History of Cartography at the Newberry Library. This newsletter contains notes, announcements, recent publications, calendar, and short essays on topics of interest to the history of cartography. ISSN 0196-0881. Contact: James R. Akerman, Editor, *Mapline*, The Newberry Library, 60 West Walton Street, Chicago, IL 60610.

Perspective. This newsletter of the National Council for Geographic Education (NCGE) is published five times a year in October, December, February, April and June. News items related to NCGE activities and geographic education are featured. Contact: NCGE, Leonard 16A, Indiana University of Pennsylvania, Indiana, PA 15705; bitnet: clmccard@iup.

FEATURED PAPERS

Each issue of *Cartographic Perspectives* includes featured papers, which are refereed articles reporting original work of interest to NACIS's diverse membership. Papers ranging from theoretical to applied topics are welcome. Prospective authors are encouraged to submit manuscripts to the Editor or to the Chairperson of the NACIS Editorial Board. Papers may also be solicited by the Editor from presenters at the annual meeting and from other sources. Ideas for special issues on a single topic are also encouraged. Papers should be prepared exclusively for publication in *CP*, with no major portion previously published elsewhere. All contributions will be reviewed by the Editorial Board, whose members will advise the Editor as to whether a manuscript is appropriate for publication. Final publication decisions rest with the Editor, who reserves the right to make editorial changes to ensure clarity and consistency of style.

REVIEWS

Book reviews, map reviews, and mapping software reviews are welcome. The Editor will solicit reviews for artifacts received from publishers. Prospective reviewers are also invited to contact the Editor directly.

TECHNICAL GUIDELINES FOR SUBMISSION

Literature cited should conform to the Chicago Manual of Style, 14th ed., University of Chicago Press, Chapter 16, style "B." Examples of the correct citation form appear in the feature articles of this issue. Authors of Featured Papers should submit four printed copies of their manuscript for review directly to Dr. Michael Peterson, Chair of the *CP* Editorial Board, Department of Geography, University of Nebraska - Omaha, Omaha, Nebraska 68182. Manuscripts are reviewed by a minimum of two referees. The recommendations of the reviewers and the Chair of the *CP* Editorial Board are sent to the Editor of *CP*. The Editor will contact all authors to notify them if their paper has been accepted for publication and if revisions are necessary prior to publication. The following technical guidelines should be followed for all accepted manuscripts (these guidelines also apply to book, map, and software reviews).

Material should be submitted in digital form on 3.5" diskettes. Please send a paper copy along with the disk. Text documents processed with Macintosh software such as *WriteNow, WordPerfect, MS Word*, and *MacWrite* are preferred, as well as documents generated on IBM PCs and compatibles using *WordPerfect* or *MS Word*. ASCII text files are also acceptable.

PostScript graphics generated with *Adobe Illustrator* or *Aldus FreeHand* for the Macintosh or *Corel Draw* for DOS computers are preferred, but generic PICT or TIFF format graphics files are usually compatible as well. Manually produced graphics should be no larger than 11 by 17 inches, designed for scanning at 600 dpi resolution (avoid fine-grained tint screens). Continuous-tone photographs will also be scanned.

Materials should be sent to: Dr. Sona Karentz Andrews, Editor- *Cartographic Perspectives*, Department of Geography, 3210 N. Maryland Avenue, University of Wisconsin-Milwaukee, Milwaukee, WI 53211; (414) 229-4872, fax: (414) 229-3981; e-mail: sona@ csd.uwm.edu.

COLOPHON

This document was desktop-publishe[d] at the Department of Geography, University of Wisconsin-Milwaukee, using Apple Macintosh computers. Word processing was accomplished primarily with *Microsoft Word 6.0* ; page layout with *PageMaker 5.0*. Graphics not rendered with *Aldus FreeHand , Adobe Illustrator, Corel Draw or ATLAS*GIS* were scanned from paper originals using a desktop scanner. The *PageMaker* document was output at 2400 dpi. The bulletin was printed by offset lithography on Warren Patina 70# text stock. Text type is set in Palatino, a face designed by Herman Zapf.

NACIS membership form

North American Cartographic Information Society
Sociedad de Información Cartográfica Norte Americana

Name / Nombre: ____________________

Address / Dirección: ____________________

____

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Organization / Afiliación profesional: ____________________

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Your position / Posición: ____________________

Telephone Number: ____________________

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Membership Fees for the Calendar Year*/
Valor de nómina de socios para el año:

- [ ] Individual / Regular: $28.00 U.S. / E.U.
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NACIS
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***Membership fees include subscription to *Cartographic Perspectives*.**

The North American Cartographic Information Society (NACIS) was founded in 1980 in response to the need for a multidisciplinary organization to facilitate communication in the map information community. Principal objectives of NACIS are:

§ to promote communication, coordination, and cooperation among the producers, disseminators, curators, and users of cartographic information;

§ to support and coordinate activities with other professional organizations and institutions involved with cartographic information;

§ to improve the use of cartographic materials through education and to promote graphicacy;

§ to promote and coordinate the acquisition, preservation, and automated retrieval of all types of cartographic material;

§ to influence government policy on cartographic information.

NACIS is a professional society open to specialists from private, academic, and government organizations throughout North America. The society provides an opportunity for Map Makers, Map Keepers, Map Users, Map Educators, and Map Distributors to exchange ideas, coordinate activities, and improve map materials and map use. *Cartographic Perspectives*, the organization's Bulletin, provides a mechanism to facilitate timely dissemination of cartographic information to this diverse constituency. It includes solicited feature articles, synopses of articles appearing in obscure or non-cartographic publications, software reviews, news features, reports (conferences, map exhibits, new map series, government policy, new degree programs, etc.), and listings of published maps and atlases, new computer software, and software reviews.

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