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in this issue

Letter from the Editor

I am pleased to announce that Dr. Scott Freundschuh from the University of Minnesota-Duluth, has agreed to take over the editorship of *Cartographic Perspectives* beginning with the first issue of 2001. Scott will be *CP*s fourth editor. David DiBiase served beginning with the conception of the journal in 1989 to 1992. Sona Andews was editor between 1993 to 1996. I have served as editor since 1997 with the help of a number of guest editors. Jim Anderson will continue as Assistant Editor and will be invaluable in the transition. Scott will appoint his own Editorial Board and section editors. The outgoing editors wish the new team good luck on their endeavor.

This 36th issue of *CP* is the longest and most colorful ever published. With 100 pages, this issue reflects the fact that the rate of article submissions has increased over the past few years. All of the featured articles published in this

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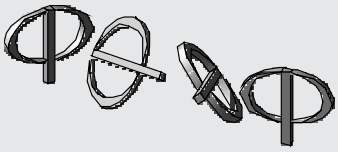
about the cover



The cover design was created by Louis Cross. Louis is a cartographer and graphic artist with the Florida Resources and Environmental Analysis Center at Florida State University. He an active member of NACIS.

If you would like to submit covers for future issues of *Cartographic Perspectives* please contact Jim Anderson, Assistant Editor at the address listed above.

Note from the Editor: This essay was first presented at a plenary session at a conference of the International Cartographic Association in Ottawa, Canada, in August of 1999. Responses to the paper were offered by John Pickles and David Rhind. These will appear in the next issue.

Cartographic Futures On A Digital Earth

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Introduction

This paper is written with some trepidation, since I am not a cartographer, and would certainly not want to be perceived as trying to prescribe cartography's future. But the organizers of the conference have asked me to address the second part of the conference theme, "Touch the Past, Visualize the Future", and I hope what follows will be of some interest. It is written from the perspective of someone who cares greatly about the cartographic aspects of what we do, who like many of us grew to love maps at an early age, and who sees cartography as an indispensable part of any future for my own discipline of geography, and the broader enterprise that we variously know as geomatics, geoinformatics, or geographic information science.

The paper begins by introducing two broad trends that provide a context of vital importance for cartography: the digital transition, which began some decades ago but seems to dominate more and more of our vision of the future; and what appears to be an increasing interest in society generally in geography, the stuff of maps, and in all things geographic. These two themes come together in a discussion of how the digital transition will affect the production, dissemination, and use of maps; the institutions that manage and regulate those activities; and ultimately, the nature of maps themselves. This leads to the identification of a basic paradox between the increasing marginalization of cartography within the larger digital geographic enterprise, and the increasing need for good cartographic practice in visual communication, as more and more people are empowered by new technology to make maps. The final section of the paper discusses the concept of Digital Earth, a popular idea that seems to serve both as a conceptual framework for much of the preceding discussion, and as a 'moonshot' that can mobilize a substantial technical and scientific effort.

"This leads to the identification of a basic paradox between the increasing marginalization of cartography . . . and the increasing need for good cartographic practice in visual communication . . ."

The digital transition

The idea of communicating in code is as old as language itself, requiring only the establishment of standards within a community regarding the code's meaning. An even older code is the alphabet of four bases used to communicate genetic information between parent and offspring; incredible as it may seem, the entire architecture of the human body, and the instruction to a chick to begin pecking after 21 days of incubation, are somehow successfully coded in a permutation of A, C, G, and T. But the explosive growth of digital communication that has occurred in the past 30 years relies on several other factors besides a universal code of zeroes and ones. The code is readily processed at great speed by digital computers; it can be stored virtually indestructibly (although practice often falls well short of theory); modern standards include automatic error-checking; and it can be transmitted at close to the speed of light. Today, virtually

all human communication-at-a-distance passes through a digital coding and decoding at some point. Telephones, FAX, written text, photographs, music, all have associated and generally accepted standards of coding in digital form. Only the mail remains as a predominantly analog method of communication, although most sorting of the packages themselves is now digital. In principle, the entire contents of a major research library in the form of printed text could now be digitized, stored on a device no larger than an average office, and made available to everyone connected to the Internet at a cost roughly comparable to that of a Boeing 747-400.

"Digital technology is already pervasive, but its impacts are only just beginning to be felt in the ways humans organize and conduct their activities."

Digital technology is already pervasive, but its impacts are only just beginning to be felt in the ways humans organize and conduct their activities. Take, for example, the case of geologic mapping. Figure 1 shows the stages of mapping from the work of the field geologist through to eventual use, storage in libraries, and archiving. Each person or group in the chain communicates with the next person or group: the field geologist gives notes and sketches to the cartographer, while the printer sends paper maps to the distributor and on to the library and user.

The first infection by the digital virus occurred among cartographers who were persuaded as early as the late 1960s that the time and cost of preparing and editing maps could be greatly reduced by adopting digital technology, initially by fixing simple encoders to the arms of plotters to capture locations, and later by replacing drafting tables by digitizers. Today, it is hard to find a single drafting pen in many map production operations and cartography classrooms. Then users began to demand digital product, because of the obvious potential of digital analysis and the simultaneous growth of geographic information systems (GIS) as analysis engines for map data. But this second round of infection had a more significant impact, since it created a new path that bypassed the traditional printing and dissemination arrangements. More recently, the World Wide Web strain of the digital virus has further infected the distribution function, as digital spatial data libraries (such as the Alexandria Digital Library, *alexandria.ucsb.edu*) and spatial data clearinghouses (such as the U.S. National Geospatial Data Clearinghouse, *www.fgdc.gov*) provided an alternative to the traditional library as a source of archived information.

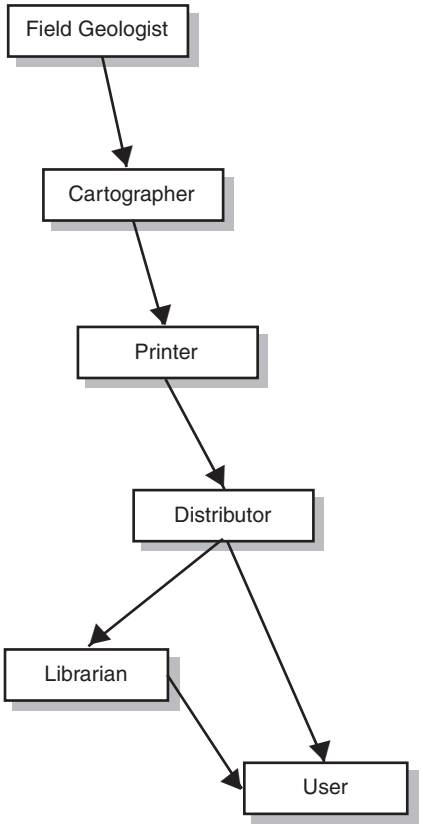

Figure 1. Schematic of the geological mapping process as communication.

Digital technology has yet to infect the work of the field geologist to a significant degree, although it is common today to find laptops at field sites. The sketches and field notes that a geologist passes to a cartographer are still largely in analog form, and suitable software for capturing and processing such information is still primitive. But the technology already exists to allow the field scientist to download images of a project area from the WWW, to annotate it digitally with sketches and notes, and to link digital photographs to field locations. Information technology in the field promises to improve greatly one of the most severe impediments to the various stages of communication shown in Figure 1, and one that underlies much of the subsequent discussion in this paper: the inability of the field geologist to communicate more than a small fraction of what he or she discovers in the field to the eventual end user, because of the highly restricted nature of the traditional communication channels. In the longer term, extensive application of information technology in the field promises to open up novel channels of communication. For example, it will be possible for field scientists to share information remotely as soon as it is collected or interpreted; to communicate directly with end users; and in the long run to bypass entirely the traditional stages of cartographic production.

In recent years, massive investments have been made in digital libraries, metadata (data about data, the digital equivalent of the catalog record), new search mechanisms, and other developments aimed at making

it possible to find geographic data in the massive, distributed archives of electronic networks. Moreover, it seems clear that investments to date are tiny compared to what is to come, as the information economy heats up. Surfing the Web for data is providing an increasingly effective alternative to visiting one's local map librarian.

The digital transition is affecting the *geography* of map production as well, as the traditional arrangements break down or are modified by new technology and changing economics. Much cartographic software is now cheap and affordable, allowing anyone with a personal computer and access to the Web to make maps. Farmers with access to the technology of precision agriculture can build maps of their fields at much higher resolution than traditional soil maps, and can capture and compile detailed spatial information on inputs and yields using devices attached to harvesters and tractors. Local governments can rent vans equipped with GPS units, drive along every street, and produce street maps at higher accuracy and much lower cost than the traditional production arrangements of central governments. In short, changing technology and economics are moving map production from a system of unified central production to a local patchwork, and the old radial system of dissemination is being replaced with a complex network.

"The digital transition is affecting the geography *of map production as well . . ."*

In the early stages of the digital transition much use was made of the new technology to perform operations more quickly, at lower cost. But as the transition advances it is the operations themselves that come into question, along with the organizational structures and arrangements that evolved around them. The survivors in this world will be those who can think beyond past practices, and adapt quickly to new opportunities.

The stuff of maps

As a U.S. citizen I share what is now a widespread feeling of awe for the sublime geographic ignorance of many of my fellow citizens, and nowhere is this better revealed than in U.S. ignorance about Canada. Yet this is a period in political history of devolution of power down the geographic hierarchy. We are encouraged to think globally but act locally; increasing local autonomy makes it more and more difficult to achieve widespread consensus. There are new standards for teaching geography (Bednarz *et al.*, 1994), greater interest in travel, more interest in the diversity of places and less in standardization.

In the past few years many new services based on geographic information have appeared on the Web. Microsoft's Terraserver (*www.terraserver.com*) began as an effort to build and demonstrate a capability to serve information at a massive scale, with geographic data chosen as the content because it was cheap and comparatively unencumbered by issues of intellectual property. But Terraserver has been very successful as a pioneering effort to serve imagery to a vast population of users, many of whom had never had access to easy-to-use Earth imagery before. Microsoft's Home Advisor (*www.homeadvisor.com*) provides GIS-like services in the form of home listings and social data about surrounding neighborhoods. MapQuest (*www.mapquest.com*) is one of many sites offering maps, georeferencing, and optimal routing services.

"One of the greatest impediments to effective use of geographic data has been the inability to integrate information about a place."

One of the greatest impediments to effective use of geographic data has been the inability to integrate information about a place. Our traditional arrangements for production of geographic information emphasized horizontal uniformity; one government program produced all topographic maps, another all soil maps. These arrangements have been largely inherited by the digital world, so that one goes to one site to obtain an image