



cartographic perspectives

bulletin of the
North American Cartographic Information Society

Number 8, Winter 1990-91

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cartographic perspectives on the news

MAPS & WAR

... whatever our politics and social conscience, we cannot deny the strong historical bond between map and soldier, nor can we dispute that much of the present digital cartographic effort is inspired or sustained by a concern for national defense.

Mark Monmonier, Technological Transition in Cartography, 1985

Operating at a wartime pace, the U.S. Defense Mapping Agency says it has shipped 35 million maps to the nearly 300,000 U.S. troops stationed in the Persian Gulf.

Cartographers at the agency's two major production centers in St. Louis and Brookmont, MD, have been working ten to twelve hour shifts, seven days a week since shortly after the United States began sending troops to the Persian Gulf.

All of Saudi Arabia, Kuwait and Iraq have been committed to paper, Black said. The agency has had every country in the volatile Middle East mapped for several years, relying heavily on detailed satellite photos.

Map production already has overstepped what was done

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**North American Cartographic
Information Society**

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ISSN 1048-9058

Cartographic Perspectives
is published quarterly

during the Korean and Vietnam wars.

"During the Korean War, the presses ran twenty-four hours, seven days a week for years," said Otto Stoessel, graphic arts chief of the aerospace division. "We turned out a lot of work, but compared to Operation Desert Shield it was nothing."

"We've done ten times the amount of work in the last two months than we did during all of Korea," he said.

"*Mideast operations draw mapmaker's bottom line.*" R.B. Fallstrom, AP (Centre Daily Times, December 25)

One of the major efforts undertaken by the FSO [Field Support Office of the United States Army Engineer Topographic Laboratories (USAETL)] has been the transformation and dubbing of

Digital Terrain Elevation Data (DTED) from Defense Mapping Agency (DMA) 9-track tapes . . .

So far, USAETL has transformed and dubbed more than 16,000 floppy disks of DTED covering the Desert Shield region and distributed them to various units and organizations . . .

One of the systems that will use some of the data being provided by the FSO is USAETL's Digital Topographic Support System Prototype (DTSS-P). The DTSS-P is made up of terrain analysis software residing on a Portable All-Source Analysis System Work Station (PAWS) . . .

The DTSS-P will provide Desert Shield units with the capability to perform automated terrain analyses such as line-of-sight calculations, cross-country movement analyses, construction support and map background display. These products can provide timely support to field commanders.

TAC [USAETL's Terrain Analysis Center] is working with scientists from USAETL's Geographic Sciences Laboratory (GSL) and RI [USAETL's Research Institute] to develop another way of "seeing" the terrain of Saudi Arabia. This digital terrain data base for simulation networking is funded by the Defense Advanced research Projects Agency.

Using the USAETL data base, a system operator will be able to generate a "flying carpet" fly-through view of the terrain. A mobile "flying carpet" will be placed in the van which previously contained the Terrain Analyst World Station.

"USAETL performs extensive and essential role of support." *Tech-Tran* 15:4, Fall 1990

How good is the Iraqi Army now? A serving soldier observed Iraqi soldiers on a daily basis for four months as the captive of a Republican Guards unit following the

invasion of Kuwait. He considers the Guards "damn good for an Arab force" but no match for the Allied forces . . .

He said that the soldiers were frightened of their officers and especially of their political minders and were instantly obedient. The junior-grade Iraqi officers were much like the old-style Brit officer with a superior elitist attitude complete with batmen and a flunky to carry their maps.

"*Mismatch in Kuwait.*"

Col. David H. Hackworth,
Newsweek, January 28.

MIDDLE EAST CRISIS MAP DETAILED • FULL COLOR HUGE! 25" x 38" WALL MAP <small>Key Dates, Places, Events</small> Pony Mailbox, 219 P. Berlin Road Cherry Hill, N.J. 08034 OR CALL 800-835-2246 EXT. 28 \$9.95 + \$3 Shipping VISA/MC/DISCOVER/24 HRS.

Philadelphia Inquirer, January 27

At one point [General Schwartzkopf] phoned the Navy to ask what Iraqi targets the USS Wisconsin could hit with its sea-launched Tomahawk cruise missiles. The answer came back: zero. The Tomahawks must be programmed with electronic terrain maps to home in on their targets. The CIA and DIA, preoccupied with monitoring the Soviet Union's withdrawal of conventional forces in Eastern Europe, hadn't programmed their satellites to make such maps for Iraq. The maps didn't arrive until the end of August.

"*The road to war.*" Tom Mathews and others, *Newsweek*, January 28.

Since war broke out in the Persian Gulf, television coverage has been shaped by a single question: Who's winning? . . .

Michael Schiffer, a media analyst at the Center for War, Peace and the News Media in New York, said the agenda for coverage is set largely by daily briefings in Washington and Riyadh.

"There's a tendency to treat it like a football game," Shiffer said. "There's a scorecard, whether you're keeping score in tonnage, or in body counts, or maps with tanks and little arrows."

"Military hype weighs down coverage." Marc Gunther, Knight-Ridder Newspapers (Centre Daily Times, February 3).

Notable among the many maps of the Persian Gulf which have appeared recently is the room-sized map used by Peter Jennings on ABC. Mr. Jennings walks across the map, using his feet to point out pertinent locations. The map is large enough to require Mr. Jennings to take several steps between Jerusalem and Baghdad, and it extends up the wall behind him to suggest an impossible proximity to Turkey and the Soviet Union. Somewhat incongruous is the conflict of scale between Mr. Jennings as a pointer moving within the borders of the map.

Amid chants of "What do we want? Peace! When do we want it? Now!", twenty anti-war protestors were arrested from a group demonstrating outside the Defense Mapping Agency in St. Louis, Missouri.

Overheard on National Public Radio's All Things Considered, February 20.

THE CORPORATE WORLD OF MAPS

The following is excerpted from Jennifer Steinhauer's piece "With computers, mapmakers are redrawing the world", which appeared in the "All About" section of the Sunday *New York Times*, December 2, 1990.

"Modern map-making has become corporate, the domain of computer wizards, marketing experts and board room warriors embroiled in legal debates over tax status and copyrights. The International Map Dealers Association estimates that commercial sales in the United States have reached \$200 million annually.

"The major companies, privately held, keep sales figures to themselves. The industry association and many executives consider the Rand McNally Company of Skokie, IL, the largest. Next, by most accounts, is Munich-based Langenscheidt, which owns several American map companies that, combined, are second in sales. Then come Simon & Schuster, a Paramount Communications subsidiary that owns Mobil Road Atlas and Gousha, and then Hammond Inc. The United States Geological Survey and the National Geographic Society are also major producers, but the leading companies regard only the Society as a competitor.

"Increased travel by Americans is propelling industry growth of 10 to 12 percent a year, executives say. Edward W. Patton, sales director for Alfred B. Patton Inc., a map maker in Doylestown, PA said that for American travelers to the Soviet Union and Eastern Europe, 'This whole glasnost thing has really opened up a demand for maps.' Maps of China, meanwhile, are passé.

"When it isn't a pleasure trip that sparks demand, it's a crisis. Anxious oil executives and soldiers' parents are suddenly concerned about the layout of Kuwait. Most map makers and stores say they have sold all their Middle East maps. 'Any time there are cataclysmic events that involve confrontation, you have a tremendous increase in interest in maps of the area,' said Conroy Erickson, a Rand McNally spokesman.

"Maps can be marketed as specifically as food products. The computerized map maker can easily create products with extra detail and features, or no frills. Some companies say they are working on designs for children; Hammond's children's atlases includes a world map with dinosaur fossils pictured where they were found.

"The National Geographic Society, known for detailed and elegant maps, is also known within the industry for its non-profit, tax-exempt status. No fair, say some companies, who demand a playing field as flat and level as their maps.

"Some industry executives say National Geographic is too much of a rival already. 'We view them as a competitor with a big advantage as a non-tax-paying entity,' said Ms. Hammond. Her husband, Dean Hammond, the company's president and chief executive, testified a few years ago at a Senate hearing that the Society should have its non-profit tax status revoked. He got no response. 'They are very well-connected politically,' said Ms. Hammond.

"National Geographic responds that all map makers benefit from its high profile. 'Our campaign to return the study of geography to the American classroom has only helped them,' said Barbara Moffet, a Society press officer. 'We've created a renewed interest in maps and made them more popular than ever. It's good for the whole industry.'"

GERMAN UNIFICATION A CARTOGRAPHIC DILEMMA

The June 1990 issue of *GeoKartenbrief* (GeoCenter, Stuttgart) includes a commentary concerning German unification and its eventual impact on German

(continued on page 31)

LETTER TO THE EDITOR

This letter is to correct misconceptions about the recently revised Office of Management and Budget (OMB) Circular A-16, titled "Coordination of Surveying, Mapping, and Related Spatial Data," discussed in the article "OMB Considers Data Committee, A-16 Revisions" in the Summer 1990 issue of *Cartographic Perspectives*. Specifically, we would like to correct the following misconceptions: 1) that the Federal Interagency Coordinating Committee on Digital Cartography's (FICCDC's) proposal to establish the Federal Geographic Data Committee (FGDC) was separate from its proposal to revise OMB Circular A-16; 2) that the proposal advocated that resource, environmental, cultural and demographic, and ground transportation data would become part of the responsibility of the Geological Survey's National Mapping Division; and 3) that the proposal named the National Mapping Division as the chair of the FGDC.

The revised Circular A-16 expands the breadth of coordination to include other categories of spatial data and assigns government-wide leadership roles to Federal departments for coordinating these data. These categories and lead departments include: digital soils and vegetation data (Department of Agriculture); geodetic and cultural and demographic data (Department of Commerce); base topographic mapping, cadastral, geologic, and wetlands data (Department of Interior); portrayal of certain international boundaries (Department of State); and ground transportation data (Department of Transportation).

The revised Circular also establishes a new interagency coordinating committee named the Federal Geographic Data Committee which replaces the

FICCDC. The objective of the FGDC is to promote the coordinated development, use, sharing, and dissemination of surveying, mapping, and related spatial data. The Circular identifies the following organizations as members of the FGDC: the Departments of Agriculture, Commerce, Defense, Energy, Housing and Urban Development, Interior, State, and Transportation; the Environmental Protection Agency; the Federal Emergency Management Agency; the National Aeronautics and Space Administration; and the National Archives and Records Administration. The Circular also identifies the Department of the Interior as the chair of the committee.

The proposal for a revised Circular A-16 was developed by the FICCDC in response to a request from OMB. The proposal was reviewed and commented upon at a government-wide Forum on Spatial Data Coordination in December 1989.

Written comments from Federal, State, and local government agencies and professional societies were received in early 1990. The Secretary of the Interior formally sent the proposal to OMB in May. During the summer OMB requested that the departments and independent agencies, which are members of the FICCDC, formally review and comment on the proposal. OMB Director Richard Darman signed the revised Circular on October 19, 1990.

If you have any questions about this information, please call me at (703) 648-4533.

Sincerely yours,
Michael A. Domartz,
Executive Secretary,
Federal Interagency Coordinating
Committee on Digital Cartography

cartographic techniques

ANATOMY OF THE INTRODUCTORY CARTOGRAPHY COURSE

Dr. James F. Fryman and Bonnie R. Sines, University of Northern Iowa

ABSTRACT

The principal focus of this paper is to determine whether a common consensus exists among cartography instructors regarding the content of the introductory cartography course. In addition, the research describes the background of instructors and the course context and content. The determination of differences and similarities among introductory cartography courses was facilitated using a questionnaire mailed to 378 instructors at 285 institutions of higher education in the United States and Canada in the Fall of 1989.

INTRODUCTION

Since the introductory cartography course is often students' only formal exposure to cartographic concepts, theory and map production, it is especially important to define essential topics, exercises and techniques. In addition, a strong cartographic foundation is needed for those students choosing to do advanced work in cartography. It is probably idealistic to assume that the population of cartography instructors would be in universal agreement about what should be contained in an introductory cartography course. However, it should not be unrealistic to believe that a reasonable consensus of what is important can be determined.

The intent of this study is to give an overview of the introductory cartography course today. The survey emphasizes the variations and similarities between introductory cartography courses in

structure, context and content. Specific topics examined in the survey are: textbook use, the degree of computer use in course exercises, the types of exercises assigned and the amount and types of equipment required to be purchased by the student. The study includes all four-year institutions of higher education in the United States and Canada offering an introductory course in cartographic methods.

While specific comparisons cannot be made to any previous survey of cartography courses, there are several research articles which have addressed issues and topics raised in this questionnaire. The proceedings of a 1978 symposium on the introductory cartography course in twelve Canadian schools found that most introductory cartography courses focused primarily on the practical components of mapping. It also revealed an absence of computer-assisted mapping in this area (Coulson 1981). Andrew's (1985) survey of cartography textbook usage included all cartography related courses, from introductory to advanced classes. The textbook found to be used by over one-half of the introductory cartography instructors was Robinson, Sale, Morrison and Muehrcke's *Elements of Cartography* (Robinson et al 1984). Several articles by Dahlberg dealing with the state of professional training for cartographers and cartographic education in general stressed that the majority of cartographic training is taking place in a limited number of universities. Furthermore, he stated that the thematic map dominates course content in introductory cartography courses (Dahlberg 1977, 1983, 1984). Kimerling's chapter in *Geography in America* reviews the general state of cartography in the late 1980's (Gaile and Willmott 1989).

INTRODUCTORY CARTOGRAPHY COURSE SURVEY

Name _____ Institution _____
 Title _____ Year Graduated _____ Graduate Institution _____

1. How long have you been teaching introductory cartography? _____ Years

2. How often is the introductory course offered per year? 1 2 3 4 5 6

3. How many credits does the course have? 1 2 3 4 5 6

4. Number of lecture hours per week. 1 2 3 4 5 6

5. Number of laboratory hours per week. 1 2 3 4 5 6

6. Total number of cartography courses offered in your department? _____

7. Under which system does your university function? Quarter _____, Semester _____, Other _____

8. Average size of class <10 _____, 10-15 _____, 16-20 _____, 20-40 _____, >40 _____

9. Do you have a laboratory assistant? Yes _____ No _____

10. Are outside readings required? Yes _____ No _____

11. Is a math background required? Yes _____ No _____

12. Are there prerequisites to introductory cartography?
 If yes, what are they? _____

13. Do you use a computer in your introductory courses? Yes _____ No _____
 If yes, - PC _____, MINI _____, MAINFRAME _____

14. What software programs do you use? (i.e. SYMAP, SAS Graph, etc.)
 A. _____ B. _____ C. _____ D. _____

15. What percent of exercises are constructed:
 A: by hand? _____ %
 B: by computer? _____ %

16. What percent of lecture is devoted to:
 A: theory? _____ %
 B: applied? _____ %

17. Is a textbook required? Yes _____ No _____
 If yes, which one(s)? Please check.
 _____ J. Campbell, *Introductory Cartography*
 _____ D. Cuff and M. Mattson, *Thematic Maps*
 _____ B. Dent, *Principles of Thematic Map Design*
 _____ ICA, *Basic Cartography Vol. I*
 _____ ICA, *Basic Cartography Vol. II*
 _____ J. Keates, *Cartography Design and Production*
 _____ G. Lawrence, *Cartographic Methods*
 _____ P. Monkhouse and Wilkinson, *Maps and Design*
 _____ M. Monmonier, *Technological Transitions in Cartography*
 _____ P. Muehrcke, *Map Use*
 _____ T. Rabinhorst, *Applied Cartography*
 _____ A. Robinson, et al., *Elements of Cartography*
 _____ C. Westfall, *Basic Graphics and Cartography*
 _____ Others (please cite) _____

18. Which of the following map exercises are required?
 _____ Graduated/proportional circle
 _____ Maps to accompany an article
 _____ Stepped statistical surface
 _____ Smooth statistical surface
 _____ Maps from aerial photos
 _____ Large scale survey
 _____ Redesigned published map
 _____ Isometric
 _____ Isoplethic
 _____ Cartogram
 _____ Choropleth
 _____ Dasymetric
 _____ Land use
 _____ Map projections
 _____ Situation
 _____ Dot
 _____ Flow
 _____ OTHERS: _____

19. What equipment is required to be purchased by the student? Please check.
 _____ Drafting pens
 _____ Protractor
 _____ T-square
 _____ Scale (architects, 16ths)
 _____ Compass set
 _____ Ships curves
 _____ Map distance measure
 _____ Gum eraser
 _____ Triangle (45°)
 _____ Curve Irregular
 _____ Masking tape
 _____ Drafting pencils, 6H, 7, 4H
 _____ Beam compass
 _____ Hand calculator
 _____ Screen patterns
 _____ Pencil and ink eraser
 _____ Triangle (30-60°)
 _____ Scale (engineers, 10ths)
 _____ Exacto knife set
 _____ Drafting paper
 _____ Plainmeter
 _____ Flexible curve
 _____ Rub on letters

Figure 1: Questionnaire sent to 378 cartography instructors at 285 institutions in the U.S. and Canada in the fall of 1989.

THE SURVEY

The questionnaire (Figure 1) was designed to acquire specific information about the introductory cartography course. This information included the structure and context of the course, the content of the course, and back-ground information on the course instructor. The questionnaire was limited to the introductory cartography course and designed to be completed within ten minutes.

Two primary sources, the Association of American Geographers' *Guide to Departments of Geography in the United States and Canada 1989-1990* and Schwendeman's 1989 *Directory of College Geography of the United States* were used to obtain the names and addresses of institutions and individuals that provide cartography instruction in the United States and Canada (Monsebroten 1989). Two other excellent sources of information, *Mapping Sciences Education Data Base (MSEDB)* (Dahlberg 1980) and the Association of American Geographers' *Cartographic Specialty Group 1985 Membership Directory* (Carstenson 1985) were determined to be dated.

Questionnaires were mailed on August 27, 1989 to 378 individuals at 285 institutions of higher education. The United States accounted for 257 of the institutions, with the remaining 28 located in Canada. Approximately 51 percent of all questionnaires sent, or 193 questionnaires, were completed and returned by October 2, 1989. An additional fourteen instructors responded that they no longer taught cartography or that the course was no longer offered at their institution. The distribution of responding instructors in the United States and Canada is depicted in Figure 2.



Figure 2: Distribution of responding institutions.

THE RESULTS:

INDIVIDUAL BACKGROUND

Several questions regarding the instructors of introductory cartography courses were included in the survey. Although these questions are not the primary focus of the analysis, they do give a good portrayal of the personnel teaching cartography.

Years Teaching Cartography

The average amount of teaching experience reported by respondents is thirteen years. Figure 3 depicts responses grouped and graphed into five-year categories. In addition, a category for persons teaching longer than 26 years is included. The survey reveals a dominance of neither veteran or novice teachers. However, approximately one-half of the instructors have been teaching less than ten years.

Rank of the Instructor

While the number of instructors is relatively even across levels, the rank of professor is the most often cited (Figure 4). However, the median rank of responding instructors was associate professor.

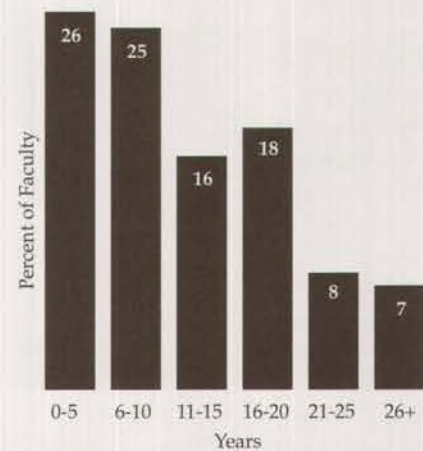


Figure 3: Reported years of cartography teaching experience.

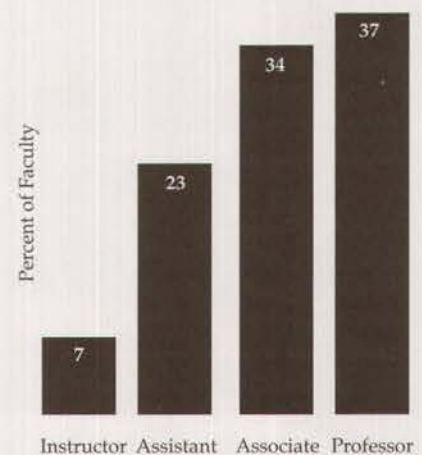


Figure 4: Academic rank of instructors of introductory cartography.

Production of Cartography Instructors

All respondents indicated the name of the institution where they completed their graduate training. All graduate schools cited two or more times are ranked in Figure 5. Of the 73 institutions mentioned, twelve schools (with 5 or more citations) accounted for approximately 45 percent of all instructors. The three most frequently cited schools accounted for almost one-fourth (23 percent) of the graduate training institutions. It should be noted that these three schools — University of Kansas, University of Wisconsin—Madison and the University of Washington — were also cited by Dahlberg (1978) as the three principal centers of cartography instruction. Graduate cartography training continues to be concentrated in a small number of institutions.

COURSE CONTEXT AND STRUCTURE

Course structure and context refers to the design, administration and sequence of the introductory cartography course, relative to the general cartography program at each university.

Frequency of Course Offerings

We asked instructors to quantify the frequency with which the introductory course is offered. Approximately 67 percent of the respondents indicated that an introductory cartography course is offered only once each academic year, while twenty-six percent noted that they offer it twice per year (Figure 6). Interestingly, the frequency with which the introductory cartography course is offered does not appear to be correlated with the number of faculty in the department ($r^2=.320$).

GRADUATE INSTITUTION	NUMBER OF INSTRUCTORS PRODUCED
University of Kansas	18
University of Wisconsin—Madison	13
University of Washington	13
Clark University	8
Pennsylvania State University	6
Louisiana State University	5
University of Illinois	5
University of Georgia	5
University of Iowa	5
Syracuse University	5
University of North Carolina	5
University of Michigan	5
University of Colorado	4
Indiana University	4
University of Pittsburgh	4
University of California—Berkeley	4
Michigan State University	4
Portland State University	3
Oregon State University	3
University of Western Ontario	3
University of Minnesota	3
Boston University	2
University of Utah	2
University of Oregon	2
University of California—Los Angeles	2
University of Maryland	2
Kent State University	2
Florida State University	2
University of Tennessee	2
State University of New York—Buffalo	2
Ohio University	2
Southern Illinois University	2
University of Denver	2
Indiana State University	2
University of Florida	2
Ohio State University	2
University of Oklahoma	2
University of Kentucky	2
Others (one each)	35

Figure 5: Production of cartography instructors by graduate cartography programs.

Number of Cartography Courses Offered

A second survey question asked how many cartography-related courses are offered by each department. The most frequent response was two courses (23 percent) offered by the department, but this was only slightly greater than offerings of three courses (20 percent), one course (15 percent) and, four courses (10 percent). The number of courses offered ranged from one to twenty. Institutions that reported ten or more cartography course offerings are listed in Figure 7.

Number of Credit Hours

Fifty-three percent of responses to the question "How many credits are offered for the introductory course?" was three. Four and five-credit courses were offered primarily by institutions using the quarter system.

Size of the Introductory Cartography Course

The median reported average class size was 16-20 students, and the middle 50 percent of responses ranged from 10-15 to 16-20 students (Figure 8).

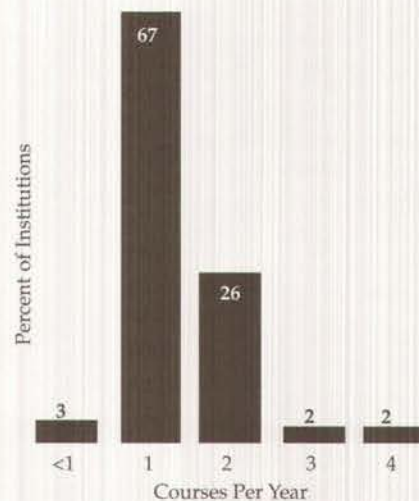


Figure 6: Frequency of introductory cartography course offerings.

INSTITUTION	NUMBER OF COURSES
University of Kansas	20
University of Maryland	12
University of Hawaii	12
George Mason University	12
University of Wisconsin—Madison	11
Memorial University of Newfoundland	10
Clark University	10

Figure 7: Institutions reporting 10 or more cartography course offerings in 1989.

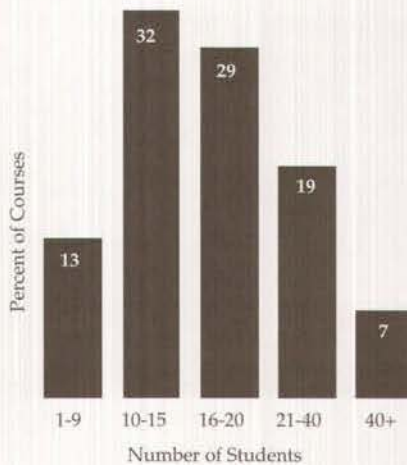


Figure 8: Class sizes for introductory cartography courses.

Hours Assigned to Lecture and Laboratory

Respondents indicated that an average of two hours each is devoted to lecture and laboratory. Forty-four percent of the average introductory course is spent on lecture and fifty-six percent of the time is spent on laboratory work.

Prerequisites for Introductory Courses

Slightly less than one-half (44.5 percent) of the surveys indicate that some prerequisites are required for entry into the introductory cartography course. In general, course prerequisites can be grouped into required geography courses, courses in statistics and computers, map appreciation or map use courses, and restrictions on the year in school and the type of major. The specific prerequisites are given in Figure 9.

COURSE CONTENT

Textbook Usage

Of the 193 respondents, 153 (84 percent) require a textbook. One-half of the respondents indicated that they used Robinson, Sale, Morrison and Muehrcke's *Elements of Cartography* textbook for the introductory cartography course (Figure 10). Similar findings were presented in Andrews' 1984

REQUIRED MAJOR OR CLASS STANDING	NUMBER OF RESPONSES
Geography major	2
Junior status	2
Sophomore status	2
Graduating senior with geography major	1
REQUIRED GEOGRAPHY COURSES	
One previous geography course	8
Two previous geography course	7
Introductory physical geography course	5
Introductory geography course	5
Introductory human geography	2
Geography techniques	2
Physical and cultural geography	2
Three previous geography courses	2
Two introductory physical geography courses	1
Man and environment	1
Environmental and cultural geography	1
Six hours of geography or environmental science	1
Any first year geography course	1
Geography: a systems introduction	1
World regional	1
REQUIRED "MAPS" COURSES	
Map interpretation	6
Map reading	6
Map use	6
Introduction to maps and air photo	6
Maps	2
Remote sensing	1
Maps and images	1
Maps and map reading	1
REQUIRED STATISTICS, MATHEMATICS OR COMPUTER COURSES	
Basic statistics	5
Any computer course	2
Basic collegiate algebra	2
Entry level math course	1
Trigonometry and algebra	1
Trigonometry	1
Quantitative analysis	1
Analytic geometry	1

Figure 9: Prerequisites for introductory cartography courses reported by survey respondents.

textbook survey (Andrews 1985). The second most frequently used textbook was Dent's *Principles of Cartography; Thematic Map Design* at 19 percent (Dent 1985). It should be noted that Dent's book ranked second despite the fact that it was out-of-print during the Spring and Fall semesters of 1989. The third most utilized textbook was Cuff and Mattson's *Thematic Map Design* holding a 12 percent share of the market (Cuff 1982).

Laboratory Exercises

The average number of exercises required in the introductory cartography laboratory is 7.5. However, if semester and quarter systems are separated, the average is 6.3 exercises required for courses on the quarter system and 7.6 for the semester system.

The most common exercise is the choropleth map with 88.2 percent of the respondents indicating it is used in their course. Other exercise topics cited by over fifty percent of the respondents are scaled circle maps (79 percent) dot maps (62 percent), isarithmic maps (61 percent), and map projections (56 percent). As Figure 11 indicates, the thematic map is the most popular exercise assigned in introductory cartography courses. However, the one exception is the map projection, which has had a long history as a required exercise in introductory cartography courses, even though the treatment of map projections today are often relegated to textbook appendices.

Equipment

The question "What equipment is required to be purchased by the student?" was included in the study to determine if the cost of purchasing equipment in addition to the textbook, has a prohibitory effect on student enrollment.

The item of equipment most frequently required for purchase

AUTHORS	PERCENT OF COURSES
Robinson, et al	50
Dent	19
Cuff/Mattson	12
Muehrcke	5
Campbell	4
Rabenhorst	2
Greenhood	2
Others	6

Figure 10: Required textbooks for introductory cartography courses.

MAP EXERCISES	PERCENT OF COURSES
Choropleth	88
Scaled circle	79
Dot map	62
Isarithmic	61
Map projections	56
Map for article	32
Cartogram	28
Redesigned map	28
Land use	26
Smooth statistical surface	25
Stepped statistical surface	24
Flow map	20
Situation map	19
Map from aerial photo	16

Figure 11: Laboratory exercises.

by the student is the drafting pen set (required for more than 60 percent of introductory courses). Drafting pens, because of their delicate nature, are often prone to problems (leaks, breakage, etc.) and they are expensive to replace. Expendable items such as erasers, tape, pencils and paper are also often required to be furnished by the student. Angles, T-squares, and scales are more likely to be provided by the departments.

THE COMPUTER IN THE INTRODUCTORY CARTOGRAPHY COURSE
Computer Use

Perhaps the most significant change in the field of cartography is the continuing adaptation of computer technology to cartography. Prior to the survey we expected that introductory cartography courses would include the computer, either in lecture through demonstrations, or through actual use in completing laboratory exercises. A survey question asked if computers are being used for laboratory mapping exercises. Slightly over one-half (53 percent) of the institutions indicated that they do use computers in the introductory course. A second question asked of those who use computers "What percent of exercises are actually constructed using a computer?" The average response was 16.2 percent,

which is far less than we had expected.

Computer Types

Survey question 13 categorizes computers by 3 types: (a) personal computer, (b) mini computer, and (c) mainframe computer. Respondents were free to check one, two or three of the options, as appropriate. The personal computer is the most frequently used computer in the introductory cartography course, being cited by 68 percent of the instructors. The mini computer was cited by only 4.2 percent of computer users and the mainframe 6.3 percent. The remaining percentage of uses employed some combination of the three.

One assumption we made is that instructors who have been teaching cartography for a long period of time would be less apt to utilize the computer than individuals who just recently obtained a graduate degree. To test this assumption, we used a simple correlation analysis between 'years teaching cartography' and 'the percentage of exercises constructed using the computer. The results indicate that no strong correlation exists.

Computer software

Another aspect of the questionnaire asked instructors who use the computer in the introductory cartography course to list the types of computer software they use. A total of 214 software citations were made, including 15 in-house or generic programs and 78 commercial programs. Figure 12 lists the software programs mentioned at least twice.

COURSE SYLLABUS

Approximately one-third (54) of the responding cartography instructors enclosed a copy of their course syllabus. An analysis of these syllabi allowed us to determine the percentage of the final

course grade based on either testing (exams, quizzes, etc.) or project (drafting or computer mapping). Of the sixty-three syllabi received, thirty contained the grading scheme for the course. The percentage of the final course grade determined by exam and quiz scores was 37 percent, with a range from none (no exams given) to 80 percent of the grade based on testing. Generally, it appears that the final grade in the introductory cartography course is primarily determined by the ability of the student to complete the map and graph exercises satisfactorily.

A second question examined in the course syllabus was the frequency of topics mentioned in the lecture section for each cartography course. Of the 63 syllabi examined, 52 stated the major topic of each lecture session. Those topics mentioned at least 10 percent of the time are listed in Figure 13. Five topics were covered by at least 50 percent of the respondents. Data types and manipulation is the most com-

COMPUTER PROGRAM	NUMBER OF INSTALLATIONS
Atlas*Graphics	29
In-house programs	15
Symap	12
Mapmaker	12
SAS Graph	11
CAD (various vendors)	10
SuperPaint	9
Surfer	9
Idrisi	6
Symvu	5
Cricket Graph	3
Microsoft Word	3
SPSS	3
Map	3
MacDraw	3
PC Map	3
Arc/Info	3
The Map Collection	3
World	3
Atlas *Draw	2
PC Paintbrush	2
Roots	2
Aldus FreeHand	2
Adobe Illustrator	2
MacAtlas	2
Disempla	2
Others (one each)	55

Figure 12: Software used in introductory cartography courses.

LECTURE TOPIC	NUMBER & PERCENTAGE OF RESPONSES	
	NUMBER	PERCENTAGE
Data tapes and manipulation	49	94.2
Symbolism	43	82.7
Map design	39	75.0
Map projections	39	75.0
Lettering	28	53.8
Scale	25	48.1
Grids	24	46.1
Generalization	24	46.1
Choropleth	21	40.3
History of cartography	21	40.3
Computer mapping	19	36.5
Color	16	30.7
Drafting	15	28.8
Graduated circle maps	14	26.9
Point maps	13	25.0
Aerial photos	12	23.1
Thematic mapping	12	23.1
Flow maps	11	21.1
Data analysis	11	21.1
Dot maps	11	21.1
Cartograms	10	19.2
Relief maps	10	19.2
Reproduction	10	19.2
Isarithmic maps	10	19.2
Landform analysis	7	13.4
Communication	7	13.4
Graphs	7	13.4
Sources of information	6	12.0
Base maps	6	12.0
Topographic maps	5	10.0

Figure 13: Most frequently cited lecture topic in 52 introductory cartography course syllabi.

monly cited topic (94 percent), followed by symbolism, design, map projections and lettering.

SUMMARY AND CONCLUSIONS

This discussion of course characteristics is based on a 1989 survey of instructors responsible for teaching introductory cartography courses in the United States and Canada. Out of a total of 378 questionnaires sent to academic cartographers, 193 completed forms (51 percent) were returned. In addition, 63 syllabi were examined and analyzed. Specific subjects covered in the survey were equipment availability and use, required textbooks, types and quantity of laboratory exercises, lecture topics, grading structure and background of course instructors.

General conclusions derived from the questionnaires are as follows: (1) most students of introductory cartography receive

limited exposure to computer mapping exercises; (2) personal computers predominate over the minis and mainframes; (3) a wide variety of software programs are employed; (4) thematic maps, especially the choropleth, dot, isoline and scaled circle map, are overemphasized for mapping exercises, (5) a majority of departments supplying cartographic equipment to the students, with the exception of expendables and drafting pens, (6) a predominant use of the Robinson, Sale, Morrison and Muehrcke's *Elements of Cartography* textbook, (7) a large percentage of instructors graduating from cartography programs in the three traditional schools noted for training cartographers and (8) the final course grade is primarily determined by actual exercises and projects rather than by test scores. ☐

ACKNOWLEDGEMENT

This survey was aided by a research grant from the University of Northern Iowa's Graduate School.

REFERENCES

Andrews, S. (1985) Cartography textbook use. *Surveying the Future*. Proceedings XII National Surveying Teachers Conference, Madison, WI pp. 285-295.

Carstensen, L., editor (1985) *Cartography Speciality Group 1985 Membership Directory*. Cartography Speciality Group of the Association of American Geographers. 83 pp.

Coulson, M. (1981) *The Introductory Cartography Course at Canadian Universities*. Canadian Cartographic Association. 92 pp.

Cuff, D. and M. Mattson (1982) *Thematic Maps: Their Design and Production*. New York, NY: Methuen. 169 pp.

Dahlberg, R. (1977) Cartographic education in U.S. colleges and universities. *The American Cartographer*, pp. 145-156.

Dahlberg, R. (1978) Towards conceptual models of education and training in applied cartography. *Proceedings of Applied Geography Conference*. Binghamton, NY, pp. 43-50.

Dahlberg, R. (1980) A data base for education in the mapping sciences. *International Yearbook of Cartography*, pp. 45-53.

Dahlberg, R. (1983) Structure and context of cartographic education in U.S. colleges and universities. *International Yearbook of Cartography* 23, pp. 151-159.

Dahlberg, R. (1984) Cartographic education trends in the 1980's. *The American Cartographer*, Supplement to Vol. 11, Special Issue U.S. National Report to the ICA, pp. 43-47.

Dent, B. (1985) *Principles of Thematic Map Design*. Reading, MA: Addison-Wesley. 398 pp.

Gaile, G.L. and C.J. Willmott (1989) *Geography in America*, Columbus, OH: Merrill. 840 pp.

Guide to Departments of Geography in the United States and Canada, 1989-1990. Washington, DC: Association of American Geographers. 547 pp.

Monsebroten, D., editor (1989) *Schwendeman's Directory of College Geography of the United States*, volume 38. Richmond, KY: Eastern Kentucky University. 156 pp.

Robinson, A., R. Sale, J. Morrison and P. Muehrcke (1984) *Elements of Cartography*. 5th Edition. New York, NY: Wiley. 544 pp.

USGS RELEASES DLGs ON CD-ROM

In June 1990, the U.S. Geological Survey (USGS) began distributing the 1:2,000,000-scale Digital Line Graph (DLG) data on Compact Disc Read Only Memory (CD-ROM). The CD-ROM contains data for all 50 states, organized in 21 geographic regions. The CD-ROM also contains software to assist the user in selecting and displaying the data.

The data were collected from updated 1:2,000,000-scale sectional maps from the National Atlas of the United States of America, and are current to late 1979. Up to eight categories of data are available for each geographic region. These categories and examples of included features are described in

Figure 1. The CD-ROM contains data in all three formats the USGS distributes at this scale: the DLG-Standard format, the DLG-Optional format, and the Graphic Data format.

The software provides a menu-driven system to assist the user in transferring data from the CD-ROM to a hard disk. The user may select data by geographic region, data category, and data format. The software is designed to run on any class of DOS-based (version 3.1 or later) microcomputer (8088,8086, or 80386) with 512 Kb of free memory and a hard disk. At the minimum, an EGA monitor and display card are required to select the data. The user must have a CD-ROM reader using Microsoft Extensions version 2.0 or later.

The CD-ROM also includes software to display the data. The software displays a preprocessed version of the DLG data. A user may display one of the preselected combinations of data or may customize the display. The software allows the user to display the processed DLG data using up to 16 different colors. It is recommended that this software be run on a system with a VGA monitor.

The software may also be used to process the DLG data on the CD-ROM to produce customized maps. The software allows the user to display the selected data using different colors and line thicknesses in five common map projections.

The CD-ROM is sold at an interim price of \$28. The Government Printing Office is placing the CD-ROM in 800 Federal Depository Map Libraries throughout the United States for previewing by the public.

The data will continue to be available on nine-track computer-compatible magnetic tape. For distribution on magnetic tape, different combinations of data may be ordered by region, category,

CATEGORY	EXAMPLES OF INCLUDED FEATURES
Political boundaries	States and counties
Administrative boundaries	Federally administered forests, parks, and wildlife refuges
Streams	Perennial and intermittent streams and canals
Water bodies	Perennial, intermittent, and dry lakes; swamps; and glaciers
Hypsography	Continental Divide
Roads and trails	Interstate U.S., and primary State highways
Railroads	Mainline and branchline railroads
Cultural features	Airports and the Alaska pipeline

Figure 1: Categories of 1:2,000,000 DLG data and examples of included features

and data format. For example, the cost for the entire data set in one of the distribution formats on magnetic tape is \$531. If a user would like to purchase all the data that are on the CD-ROM on magnetic tape, the cost is \$1,413.

To obtain additional information or to order the CD-ROM contact: Earth Science Information Center, U.S.G.S., 507 National Center, Reston, VA 22092; (703) 648-6045; FTS 959-6045; or (800) USA-MAPS (800-872-6277).

Daniel K. Cavanaugh, FDC Newsletter 12, Fall 1990

FIND YOUR WAY

A 24-hour-a-day toll-free service is available to subscribers who need directions. Telemap Navigation Services has a computerized system to provide step-by-step directions to any destination in 12,000 cities in the United States, Canada, and Mexico. Usually

directional information can be obtained within four minutes. The subscription price is \$24 per year for unlimited calls. Contact: Telemap Services, 1327 N. Main Street, Walnut Creek, CA 94596; (800) 843-1000; (415) 256-1867.

LANDSAT NEWS

The Earth Observation Satellite Co. (EOSAT) and the National Oceanic and Atmospheric Administration (NOAA) have negotiated an agreement to make some remote sensing data acquired by the Landsat Multispectral Scanner (MSS) available to support the international global change research effort and other environmental applications.

In a joint statement, EOSAT President C.P. Williams and NOAA Assistant Administrator for Environmental Satellite, Data and Information Services, Thomas Pyke, Jr. announced that effective immediately, EOSAT will limit its exclusive MSS data distribution rights to two years after the date of acquisition. The agreement will make more than 600,000 MSS scenes dating from 1972 until 1988 also available for distribution through U.S. Geological Survey.

The availability of MSS data will aid researchers in developing new technologies in the application of remote sensing data for global change monitoring. These advanced-technology applications will increase the value and utility of data sets to be introduced by the next generation Landsats and other future remote sensing platforms.

The Landsat 6 satellite will carry the Enhanced Thematic Mapper, a state-of-the-art sensor that will set new standards in commercial remote sensing. Currently, commercial data users must choose between remote sensing data sets offering either multispectral or spatial capabilities. After the launch of Landsat 6, however,

users will no longer have to choose one at the expense of the other because Landsat 6 will offer both multispectral and spatial detail.

EOSAT TO SPONSOR RESEARCH AWARD

EOSAT is pleased to announce that beginning in 1991 it will sponsor a research award in association with the American Society of Photogrammetry and Remote Sensing (ASPRS). "The EOSAT Award for Application of Digital Landsat TM Data" will be given annually to a graduate or undergraduate student engaged in remote sensing research at an accredited college or university. Recipients of the EOSAT Award will receive a grant of Landsat data worth up to \$4,000. The first award will be given at the ASPRS Annual Meeting in March.

Landsat World Update 3:11, November 1990

cart lab bulletin board

This forum is offered to encourage communication among practitioners at a time of rapid technological transition. Questions, comments, and announcements are invited.

SAMPLE CARTOGRAPHY LAB STATEMENT

*William G. Loy,
University of Oregon*

The suggested cartography lab statement given below is an outgrowth of the sample statement distributed and discussed at the NACIS X meeting in Orlando in October, 1990. The paper that introduced the statement 'Communicating With a Cartographer' emphasized the wimpy, 'nice-person' nature of many cartographers. Those in attendance concurred that those who make maps for others should have available a strongly worded statement to give to prospective clients advising the client of the

cartographer's need for certain information **before** map-making can begin.

Discussion of the paper included the issues of hourly rates and copyright concerns. Basically, we habitually undercharge for our services. Each person needs to be sensitive to local expectations, but a minimum of \$15 per hour for cartographic services should be considered.

The matter of copyright for maps that the cartographer may wish to use as a source is not simple. On one hand, companies do include 'hooks' or errors of commission to catch the unwary copyist and they do prosecute some offenders. On the other hand, there is a doctrine of fair use and a person can probably make a copy for personal use. Using copyrighted sources for map making can subject the cartographer to legal action. If possible, use non-copyrighted United States federal sources. If copyrighted sources are needed consult the latest statement from the International Map Dealers Association and apply the rules to your case. If you feel that permission to use is advisable, require the client to obtain the permission and pay the fee, if any. A useful document entitled 'Questions and Answers about Map Copyrights'¹ is available from the International Map Dealers Association, P.O. Box 1789, Kankakee, IL 60901. Also see the copyright discussion in Arthur H. Robinson's *Elements of Cartography*, 5th Ed., pp. 429-430.

The NACIS X roundtable session on automated cartography in the nineties included a statement by John B. Krygier about policies at Penn State's Deasy GeoGraphics Lab. The policy of having a copy of the text of the article in addition to author's draft design of the graphic is good. The informational graphics person is charged with

reading the text and thinking about redesigning the graphic rather than simply constructing the author's design. This is an excellent policy, and I have added two sentences in paragraph three of the draft statement to address this matter. You may wish to put the policy in stronger terms than I have.

Feel free to use the sample cartography lab statement below without acknowledgment, rewriting it to fit your situation. You may wish to expand it to include graphs or other forms of informational graphics, or you may wish to prepare a series of graphic-specific statements to give to clients. In any case, don't be a wimp.

DRAFT — REQUIREMENTS FOR CARTOGRAPHIC WORK

Before we can make a map for you we need to have certain information. First, we need to have a copy of your publisher's 'Instructions to Contributors,' or its equivalent. These instructions or guidelines are normally published annually in journals and they specify such items as image area on the page, acceptable forms of lettering, and the correct form of the final artwork. We cannot proceed without this information. Since editorial practice commonly varies from stated policy, we also need a recent copy of the publication, if in a series. If a copy of a publication is not available, at the very least we need a few photocopied pages — including a full page of text and several pages of maps or illustrations similar to what you wish us to produce for you.

Next, please provide us with the best base map (or maps) available. The primary map should be recent and not more than twice the scale of the final printed map. For example, if the image area on the page is 6 x 9

¹Reprinted in this issue, p. 28.

inches (on 8 x 11 inch paper), then the area of interest on the base map cannot be larger than 12 x 18 inches. The primary base map cannot be smaller than the final map. The ideal size of a base map is about a third bigger than the final map. A 'public domain' map is preferred, that is a non-copyrighted map printed by the U.S. Government. Copyrighted maps may require permission and/or the payment of a fee for their use. The best statement concerning map copyright entitled Questions and Answers about Map Copyrights is available from the International Map Dealers Association, P.O. Box 1789, Kankakee, IL 60901. If in doubt, bring us several recent maps so that we may choose the best ones.

After identifying the best base maps we will work with you to delimit on photocopies your area of interest in the correct proportions. Then you will need to 'red pencil' the photocopy, indicating the information you wish shown on the final map. A copy of the draft text of the article or the relevant pages of a book is often useful to the cartographer during the design and proofing stages. Please provide these if possible. Only after seeing the complexity of the map will we be able to offer a cost estimate. Our costs are based on . . . (fill in). Simple maps cost about \$100. We can normally produce the first draft of a map in one week. Subsequent drafts can usually be produced in three work days. Be sure that we understand both your money and time constraints before we begin.

We will be using an easy-to-change map-making method and we expect the first-draft map to be modified and improved. When we provide you a draft to consider please think about it carefully, proof all information, and either mark it up or approve

it for final preparation. The first draft map will have laser printer lettering; the final copy will have typesetter lettering. Only after you approve our final copy will we prepare a copy for the publisher according to specifications.

Remember that you are the author of the maps as well as the author of the text. The author is responsible for the content of the maps. You, as author, do not expect your word processor person to write your text; similarly, do not expect your cartographer to 'write' your map. Cartographers serve to take your information and use it to produce a well-designed and well-executed product in accordance with the publisher's instructions. Please feel free to call . . . if you have any questions.

POSTSCRIPT

The final paragraph of the sample statement above elicited some discussion. What is the proper role of a cartographer? This paragraph should reflect your own philosophy. In my view, the cartographer exhorts the author to do all of the compilation with a little advice on the best source map and final map proportions and scale. Clients are more-or-less able to accomplish the compilation so the cartographer may need to do much of the actual work. My point is that we should exhort the client, then come to the rescue as necessary to create a product satisfactory to all concerned. None of us wish a bad map to come out of our lab. As professionals we will, of course, do what is necessary.

fugitive cartographic literature

Interesting articles about cartographic information often appear in unexpected outlets. The goal of this section is to bring those publications to the attention of our readership. We invite synopses of papers appearing in journals other than those devoted to cartography, geography, and map librarianship.

Mandel, Robert (1990) *The world according to micros*; *Byte*, July.
reviewed by Will Fontanez,
University of Tennessee

"The World According to Micros" is an informative article written by Robert Mandel of Lewis and Clark College in Portland, Oregon. He opens with what is now the usual description about how little most people know about geography and suggests that "Desktop" mapping packages are the answer. I agree with his view that the recent introduction of electronic world atlases and thematic mapping packages help to address this problem in a big way. On the other hand, I hesitate to agree that microcomputer software packages are necessarily a low cost alternative to the traditional atlas. These mapping packages are tools which can help us know the places in our world better. Some of these packages go a step further and allow the user to display and manipulate current statistical information. I believe this second step requires some knowledge of basic cartographic principles and data display techniques in order to produce useful maps.

The bulk of Mandel's article divides mapping software packages into four distinct categories: fixed maps with data, customizable maps with data, maps without data, and data without maps. Fixed maps with data are the closest in form and function to the traditional hardbound atlas. In most cases these maps and data have already been compiled. You select points or areas which allow information

windows to activate. Custom software allows you the freedom to tailor maps and data to your own needs and many times include more than one thematic data display technique. Maps without data are essentially projection packages which allow the user to work with scale, viewing position, various coordinate systems, rotation, and distance measuring. I'm not sure data without maps should be included, but these packages do provide an extensive amount of geographically-coded data to help keep us better informed.

Mandel does a good job of describing which packages fall into a particular category and the strong points and shortcomings of each. I found his comments about the various packages quite candid and accurate with respect to the (Macintosh) packages I am familiar with. He lets you know about the quality and detail of the maps included, particular technical or hardware problems, data manipulation options and shortcomings, and in some cases, how useful a package is to learning. Also provided is a comparative table of the 24 different packages discussed and their qualities, as well as a list of costs, company addresses, and phone numbers. It would be a good idea to look over this article before your next mapping software purchase if you are a comparison shopper.

Finally, I agree with Mandel that the overall quality of these packages is quite good and gets better with each new release. One thing I would like to see is more input from professional cartographers during software development. For example, I think MapMaker is a very good product and I use it regularly, but its default shaded area (choropleth) maps have some basic cartographic problems such as: categories that overlap, poor light (low value) to dark (high value) progression and it allows

you to use the choropleth technique inappropriately. Of course you can manually correct for these problems, but that assumes some prior cartographic training. There is more to data display on maps than simply merging a data and boundary file. Just because you know how to merge them doesn't necessarily mean you are effectively displaying an accurate geographic pattern or distribution.

Kenji Kimura; Yoshimasa Osumi, and Yoshirio Nagai (1990) CRT display visibility in automobiles, *Ergonomics* 33:6, pp. 707-718. reviewed by Matthew McGranaghan, University of Hawaii, temporarily at the NCGIA—Orono, ME.

The paper does not explicitly address map displays, but the authors (from Toyota Motor Corporation's Human Factors Laboratory) are clearly thinking in that direction. The three experiments reported herein are straight-forward human factors experiments into the display of information on color CRTs in automobiles.

The first experiment addresses foreground-background color combinations to facilitate reading a display in the short time (they measured approximately one second) for which it is comfortable for a driver to look away from the highway. They derive a set of relations between recognition time, luminance contrast and chromaticity difference (in CIE 1976 UCS space).

The second experiment considered the upper limit on background luminance which does not seem "dazzling" to night-time drivers. Subjects "were sufficiently adapted to the same level of brightness as viewing oncoming headlights at night" before looking at a CRT screen. The change in pupillary diameter was measured as well as a subject-

tive impression of "dazzle." A general equation is presented for predicting this luminance given the background's chromaticity.

The last perhaps is the most intriguing of these studies. In it, the authors attempt to define, in information theoretic terms (after Shannon and Weaver 1949), the amount of information which can be read from a display "at-a-glance." Subjects were asked to read "characters (numerals, numerals+hiragana, and alphabets)" from displays presented for one second. Error rates indicated that "... the amount of information which can be read at a glance was less than 20-30 bits."

This article exemplifies both the type of work in which cartographers should be involved for developing advanced automotive displays, as well as the difficulties inherent in reporting this kind of research. Cartographers can use the methods adopted by the authors (measuring pupillary diameter changes and applying information theory are interesting in this regard). However, the piece is disappointing in several respects.

None of the experiments is described in detail sufficient to allow replication. The first experiment considers foreground-background contrast without attention to the contrast's location in the color space, color categorization, or other concerns in color coding. The type and amount of low-light adaptation in the second experiment seems to assume a constant average illumination for on-coming cars. This seems unreasonable. The logic of measuring the information content of displays in the third experiment is sketchily presented at best, and the interpretation of "20-30 bits" is not clear. The result is that the direct application of these findings

(Fugitive Cartographic Literature continues on page 25)

featured article

Recent advances in computer technology present opportunities for the machine visualization of topography. A new shaded-relief map of the conterminous United States is the first one-sheet graphic of U.S. landforms larger than Erwin Raisz's classic 1939 hand-drawn panorama. The 1:3,500,000-scale digital image (about 4.5' long), reproduced here at 1:10,000,000, has greater fidelity and detail than portrayals of this large area by artistic (manual) techniques. The new map also shows synoptic topography more clearly than contoured elevations, satellite images, or radar mosaics. We created the map by processing 12,000,000 elevations (digitized from 1:250,000-scale topographic sheets at a grid resolution of 0.8 km) on a VAX-11/780 computer, using proprietary software, a modified Lambert photometric function, 255 gray tones, and the method of Pinhas Yoeli as implemented by Raymond Batson and others.

Realistic portrayal and mapping of topographic form is a centuries-old problem: to trick the eye into perceiving a two-dimensional graphic as a three-dimensional landscape. All traditional solutions, including those partly implemented by machine, have been artistic (Horn, 1981). Among the cartographic devices invented by illustrators to supply the necessary visual depth cues are hachuring, hypsographic (elevation) tinting, contour density, parallel-profile density, pictorial relief, and shaded relief (*chiaroscuro*). The latter two manual techniques have been particularly successful. Pictorial relief, which symbolizes topography by stylized morphologic types, was most fully developed by the 50 landform classes of Raisz (1931). Shaded relief, or hill shading, shows topography by the intensity of shadows cast by a light source (Imhof 1965). First drafted by pencil, pen, or brush, shaded relief also has been executed by airbrush, dark-plate, and photography of raised-relief models. However, topographic detail at, for example, a one-km resolution is much too complex to be mapped both accurately and economically over large areas by any of these means.

Fast computers, analytical software, digital data, and graphic input/output devices have converged over the last three decades to largely mechanize the craft of map making (for example, Burrough 1987, p. 4-6). This digital revolution has, among its many accomplishments, also solved the problem of mapping topographic form. Machine visualization now frees terrain portrayal from long-standing limitations (Kennie and McLaren 1988). Topography need no longer be mapped symbolically, by discrete hand-drawn morphologic types, or subjectively, by manual shading. Where the necessary information is available in digital format the computer can represent landforms as they actually are — given constraints imposed by data resolution — and portray terrain in the infinite variety of form that constitutes the true landscape. It is no longer entirely correct that maps of landforms are "drawn by men and not turned out automatically by machines" (Wright 1942).

We hasten to caution here that The Millennium has not arrived; it is just now within sight. The effectiveness of machine-mapped topography depends critically upon accuracy of the digital data and their astute manipulation. Wright's admonition that map makers are human beings, not machines, remains unchallenged in its most fundamental sense. Although design and production of landform maps will be increasingly automated and sophisticated, the conception of a map, even a highly computer-intensive graphic as that presented here, is essentially an

Mapping the Nation's Physiography by Computer

Richard J. Pike
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PORTRAITS OF LANDSCAPE

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MACHINE IMAGES OF TOPOGRAPHY

intellectual rather than a mechanical process. The descendants of this map, however technical in execution, will continue to remain the constructs of human vision and ingenuity.

Digital image-processing and computer graphics have largely mechanized the art of landform representation by combining the two most effective traditional techniques, pictorial relief and hill shading. The resulting image is a shaded pictorial-relief (physiographic) panorama in vertical perspective. It is computed from an array of closely spaced terrain heights, usually in grid-cell (raster) format, called a digital elevation (or terrain) model (DEM/DTM). Although digital shaded-relief images can look deceptively like satellite pictures, they are not acquired directly by Earth-orbiting spacecraft, nor are the elevation data from which they are made. Currently, most data sources are conventional topographic maps.

Shaded relief is a complex derivative of terrain height (Figure 1).

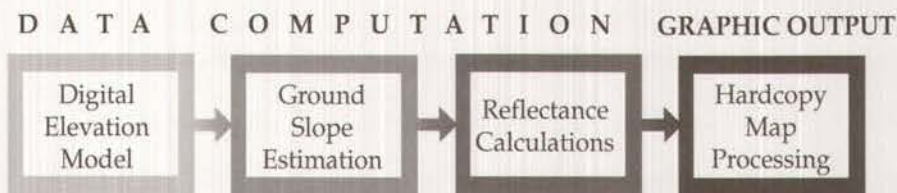


Figure 1: Basic steps in the generation of a shaded-relief map (modified from Brassel 1974 and Horn 1981).

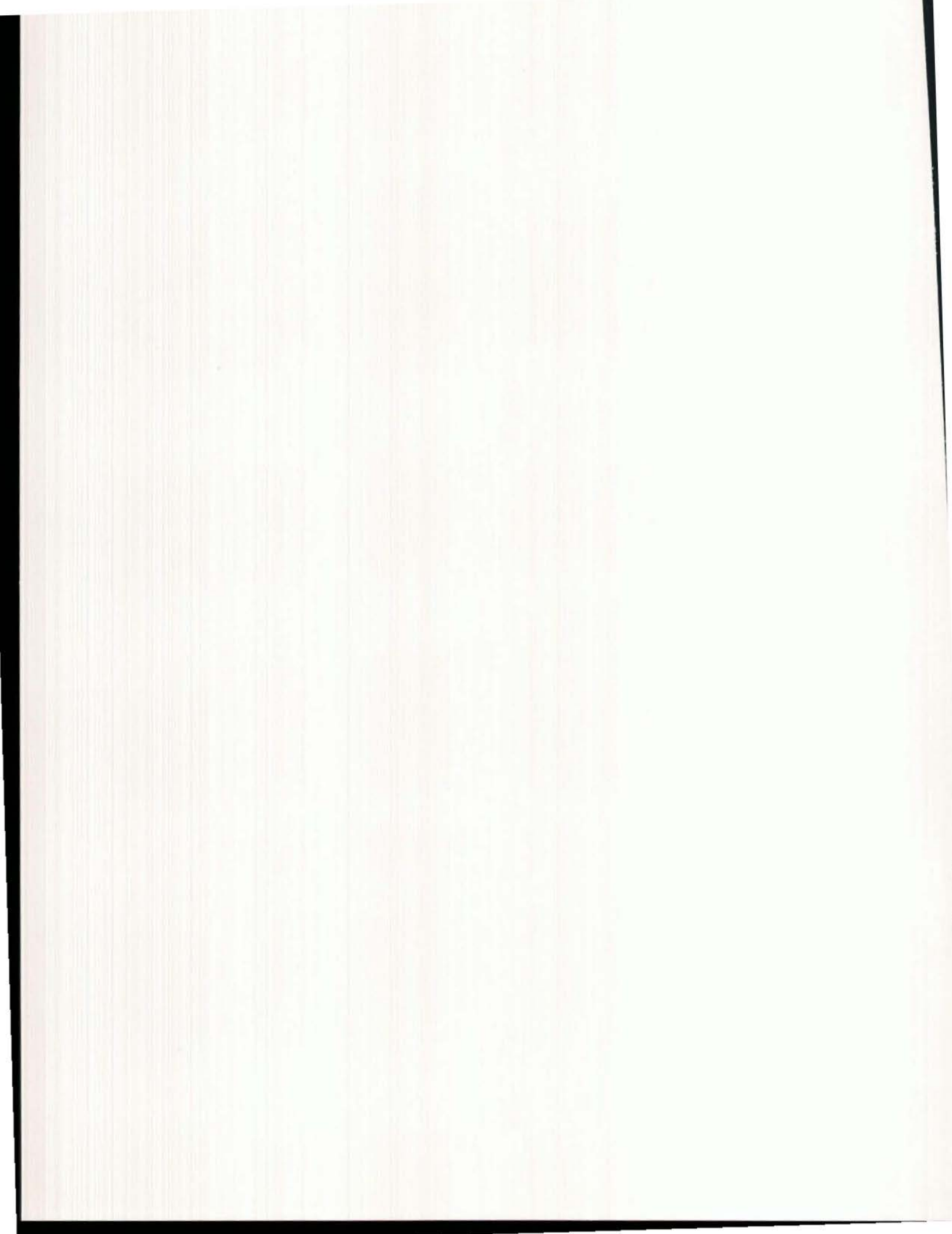
Digitally shaded maps of topography resemble cloud-free black-and-white aerial photographs taken at a low Sun angle, but actually they are large north-south/east-west arrays of minute gray squares (Yoeli 1965). Each square, or picture element (pixel), represents a theoretical reflected-light intensity (brightness

value) computed from a mathematical relation between ground slope, Sun position, and location of the observer (ground slope is estimated from the corresponding point and its neighbors in a DEM). The lightest and darkest tones in the image show the steepest areas; intermediate gray tones represent gentle terrain. The most satisfactory image is obtained by experimenting with location of the simulated Sun (conventionally from the northwest at 45° above the horizon) and illumination intensity. For more information, see the appendix "Technical Details" below.

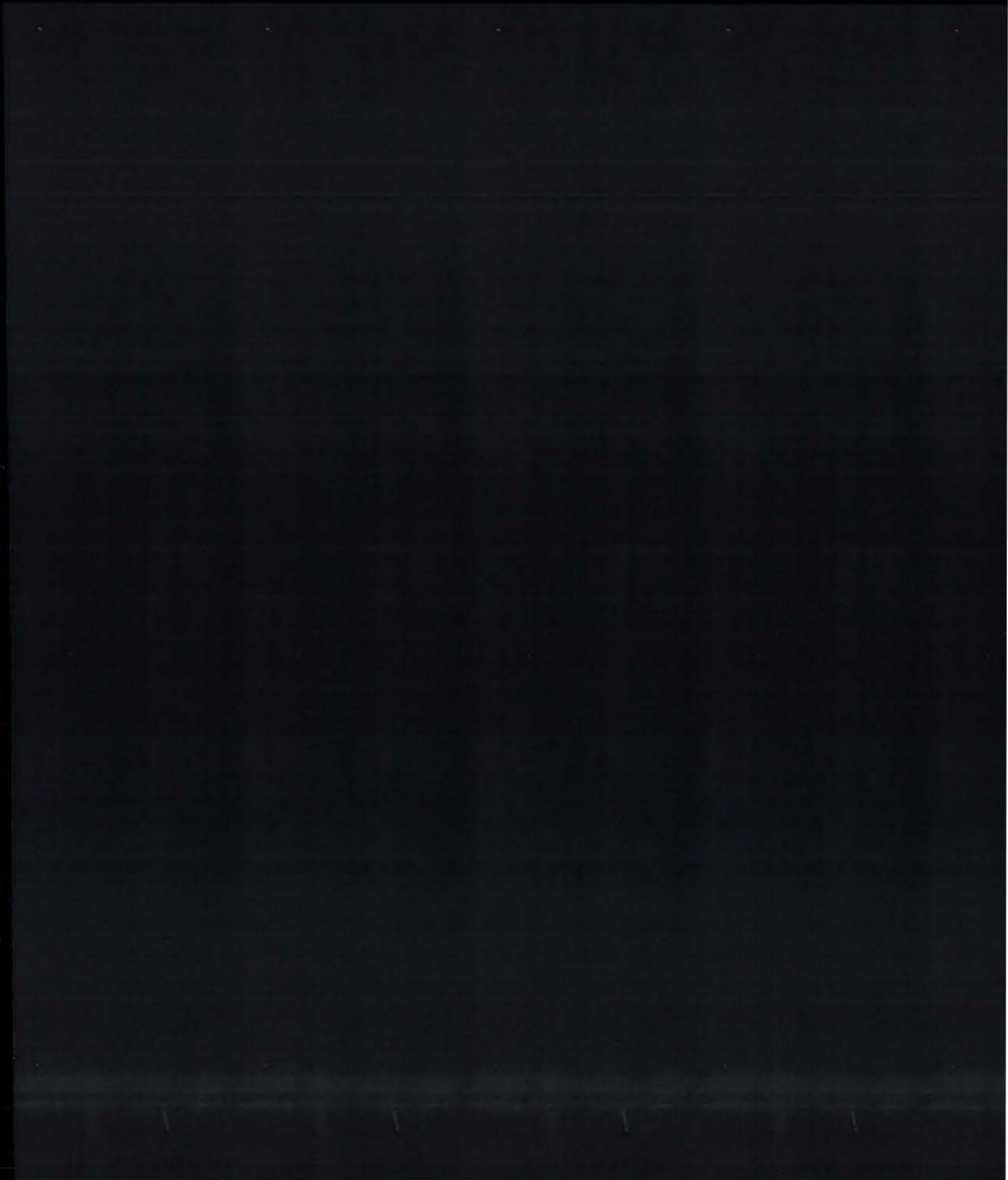
Mechanization of the shaded-relief technique for DEMs, pioneered by Yoeli (1967), has been widely applied. Batson and others (1975) made the first synoptic shaded-relief images for parts of the western United States (at 1:500,000 scale), and Arvidson and others (1982) published the first image to include 48 states (albeit at 1:30,000,000). These were followed by small shaded-relief maps of Australia and South Africa, a larger one of Sweden, and the first shaded-relief map of the Earth (Heitzler 1985). Among the latest synoptic images are those of several states in the American southwest at 1:1,000,000 scale by Kathleen Edwards and Raymond Batson (now available from the U.S. Geological Survey). Experimentation has further refined the technique, which has been equally effective in portraying gravity, aeromagnetic, geoid, and other geophysical data for interpretation (for example, Arvidson and others 1982).

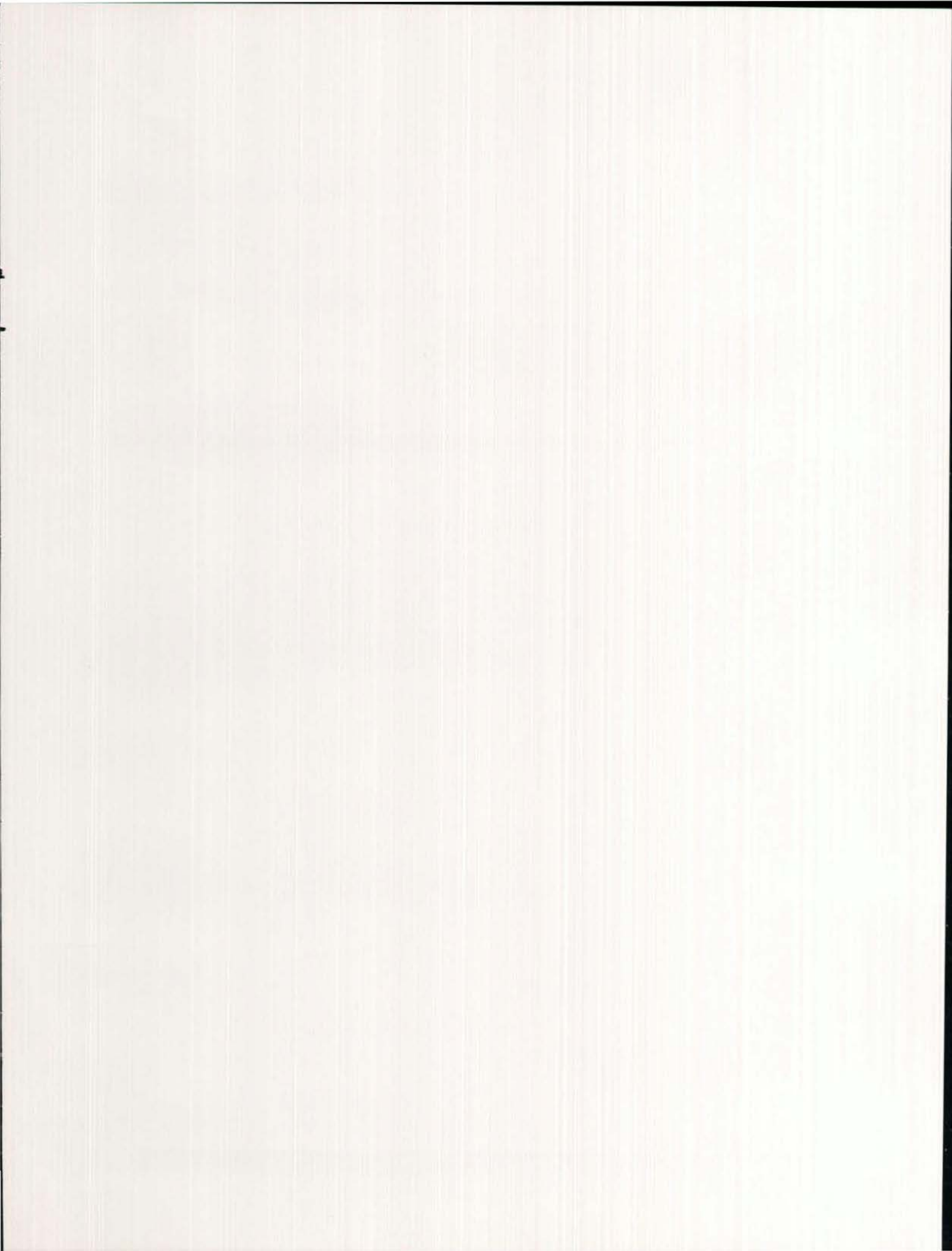
The depiction of topography by digital relief shading is passing from an experimental technique to a method of map production. Although the many steps — from data formatting, editing and processing, through image generation and correction, to preparation of a reproducible master — still are time-consuming and can require much trial-and-error, this long chain of events can be much streamlined, if not wholly automated. Even now, a governmental, educational, or commercial mapping establishment that has the requisite hardware, software, data, and experience could conceivably implement relief shading in a production environment. As databases and output devices improve, we speculate that relief-shaded

As databases and output devices improve, we speculate that relief-shaded images, along with contour maps, eventually will be available on-demand and over-the-counter, from regional and local distributors.









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Computer-generated maps offer several advantages for the visual study of topography. Above all, these images portray landforms accurately and disclose their true complexity (at a given resolution), two properties that often are lost in small-scale sketches, diagrams, or conventional maps. Perhaps equally important, surface features can be viewed in a broad regional context. Unlike aerial photographs, image extent is limited only by size of the DEM. Digital shaded-relief maps also lack the distortion inherent in photographs and radar images. They are free of the vegetation and cultural features that mask topographic form on images from Landsat, SPOT, and other satellites. Stereoscopic pairs in shaded relief can be created digitally (Batson and others 1975) and Sun position can be varied to obtain different views of the the same area. Finally, shaded-relief images can be generated much more rapidly from digital files than conventional relief maps can be prepared by a skilled artist from contour sheets or photographs of the same area.

Computer maps of elevation derivatives have many uses. Applications of relief shading include, but by no means are limited to, resource evaluation and the interpretation of regional and structural geology, global tectonics, and geomorphology. Surface features in shaded relief can be studied by conventional techniques, including aerial photointerpretation. Automated relief shading also provides an excellent cartographic base for mapping cultural and Earth-science information at any scale commensurate with resolution of the source DEM: local (Mark and Aitken 1990) to global (Simkin and others 1989). Shaded relief may be combined with such non-topographic information by machine registration with another digital file, for example, a computer-coded map of the United States highway network.

Relief shading is only one of several ways to map topography by computer. Other derivatives of elevation include slope angle and aspect, slope curvature, local relief, and ridge and stream spacing (Evans 1980). Maps of these measures can be combined statistically to characterize topography over large areas by means of numerical, nonverbal, fingerprints or signatures (Pike 1988). For example, the statistics of slope angle are contributing to the potential revision and elaboration of U.S. physiographic units (Pike and Thelin 1989). We expect that the regional geomorphology of the United States will be refined from these measures, as well as from the new shaded-relief image.

Finally, maps of slope and other derivatives of elevation can be combined digitally with maps of soils, vegetation, climate, and demography, using GIS technology (Burrough 1987), to address practical problems of environmental resource management and land use. Computer-intensive applications include mapping Earth-science hazards, hydrologic analysis, modeling air mass/terrain interactions for climatology and synoptic meteorology, and quantitative refinement of existing qualitative maps of United States ecoregions (Gallant and others 1989).

The full-sized version of the map reproduced here (Thelin and Pike, in press) is the largest single-sheet graphic of relief forms of the United States since the classic hand-drawn oblique map of the same area by Erwin Raisz (1939). In concept and execution it most closely resembles the vertical dark-plate map of United States shaded relief created for the Atlas of the United States by Richard Edes Harrison (Harrison 1969), but is intrinsically more detailed and accurate than either of the above works. The new

APPLICATIONS OF DIGITAL LANDFORM MAPS

THE NEW UNITED STATES MAP

map clearly shows the regional terrain textures on which physiographic divisions of the United States are largely based (Pike and Thelin 1989). It nicely complements Edwin Hammond's (1964) map depicting numerical classes of land-surface form, as well as various satellite-image color mosaics, which emphasize vegetation and hydrography. The Raisz map, which is still available¹ may be used to locate named surface features.

Greater detail is evident in the digital shaded-relief image than could practically be included in synoptic portrayals of the nation's terrain at this resolution by any manual technique. Much of the detail derives from the high density of the dataset (and the computer's ability to rapidly process so many terrain heights), but much of it simply reflects the map's large size, which is more than twice that of its closest predecessor, Harrison's U.S. Atlas plate (Harrison 1969). The 1:3,500,000 scale of the full-sized map also is the maximum consistent with visual merging of pixels into a continuous smooth surface. Map resolution — the length of a pixel edge — is 0.23 mm (0.8 km on the ground), slightly better than the 0.25 mm/pixel maximum value proposed by Yoeli (1965) for shaded-relief portrayal by computer.

The new map shows geomorphic and tectonic phenomena of the United States in unprecedented detail. These features, great and small, are so numerous (Thelin and Pike, *in press*, offer a sampling) that we mention only one here. In commenting that the map "may help redefine the mental images we have of the U.S. which to a great degree are the result of the maps to which we have been exposed," a reviewer gave an example: "the idea of the Great Plains as being featureless is shattered by this map." Indeed, this observation also was one of our first; there are many more. Treatises on regional geomorphology of the Country (referenced in Hammond 1964, Pike and Thelin 1989, or in a good introductory textbook on geography or geology), as well as other physical maps of the United States (for example, Raisz 1939, Hammond 1964), may be consulted for study of the landforms evident on the map.

FUTURE PROSPECTS

Our current shaded-relief image of the United States is not necessarily the ultimate digital portrait of the nation. Like any reconnaissance map, or for that matter a good scientific hypothesis, the map shown here is an ongoing experiment (Yoeli 1965). Because this map reflects a still-evolving technology, various improvements are possible. Foremost among these are restoration of digital elevations for southern Canada and northern Mexico (see following section entitled "Technical Details"; and Arvidson and others 1982), inclusion of Alaska and Hawaii, eliminating or reducing errors in the dataset through further editing and edge-matching of data blocks, and more hydrography. The visual perception of elevation could be enhanced through the use of color.

Changes in the shaded-relief calculation might address some remaining shortcomings of the map, particularly tonal imbalance between steep and gentle terrain. Detail in very mountainous areas is obscured because the steepest slopes are too dark or too light. We have found that the desired balance in tone can not be achieved simply by transforming all elevation or slope values to logarithms or square roots, and then computing brightnesses from the transformed values. The solution is likely to be more complex and may require incorporating special algorithms, called local operators, within the computer software to tailor reflectance values to specific conditions of elevation and slope (Brassel 1974).

Lastly, the information content of this map could be best improved

¹From Raisz Landform Maps, P.O. Box 2254, Jamaica Plain, MA 02130; (617) 522-3091

simply by increasing scale, data density, and image resolution. Such a map would provide the detail needed for a more effective relief portrait in many parts of the United States. An improved map of the entire country, probably at 1:1,000,000 scale and necessarily in several sheets, would require a cleaned-up file of all the original digitized elevations and an image resolution of about 0.1 mm/pixel (130 m on the ground). Multiple editions of this map at several Sun azimuth and elevation settings would further exploit the research potential of digital shaded-relief by accentuating terrain features that follow all the different trends in the country's landscape.

Image Processing and Hill Shading

Our map was made by digital image-processing, a technical specialty related to the broader fields of computer graphics and machine vision (Kennie and McLaren 1988). The technology includes the many spatially-based operations first developed for manipulating Ranger, Mariner, Landsat, and other images that are reassembled from spacecraft telemetry in a raster or scan-line arrangement of square-grid elements (Jensen 1986, Sheldon 1987). These computer procedures have been successfully transferred to landform analysis from remote-sensing applications by substituting terrain heights or sea-floor depths for the customary values of electromagnetic radiation obtained from satellites and stored in digital arrays of pixels (Batson and others 1975).

It is the 1 pixel = 1 elevation equivalence that enables image-processing technology to efficiently map elevation matrices and their derivatives over large areas. Recent examples are given by Arvidson and others (1982), and by Thelin and Pike (in press). Slope angle and other quantitative measures of surface form can be rapidly calculated, compared, and combined for display as shaded-relief and color images or stored as digital files for further study of topography and registration with nontopographic datasets (Batson and others 1975, Moore and Mark 1986, Pike and Thelin 1989).

The image-processing tool applied here — relief shading — is more formally termed analytical hill-shading. Although well known as an artistic and manual technique (Imhof 1965), it was impractical for large areas until Yoeli (1965) developed a modern analytical version for square-grid matrices of terrain elevations and then adapted it to the computer (Yoeli 1967). Analytical hill shading portrays topographic form through variations in mathematically determined intensity of reflected light (I) at each elevation/pixel located on the ground (Figure 2). This relation, known as the photometric function, has many variants (Brassel 1974, Batson and others 1975, Horn 1981). For the simplest case, the cosine law of Lambert,

APPENDIX

TECHNICAL DETAILS

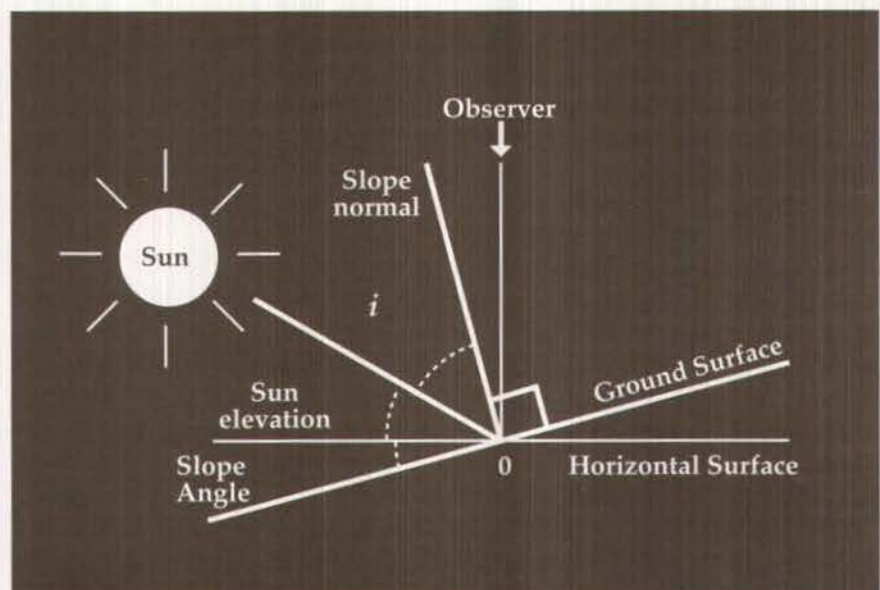


Figure 2: Geometric relation between ground slope and Sun position that is basic to reflected-intensity (brightness) calculations for shaded-relief mapping (modified from Batson and others 1975). See equations (1) and (2) in text. Point O is center terrain height in 5-point sample of digital elevation model (see Figure 3).

$$I = k_d \cos(i) \quad (1)$$

where i is the angle between the incident light (the Sun) and a vector normal to the sloping ground and k_d is a coefficient describing reflectivity of the surface material (here, a perfect diffuser of incident light, Greenberg 1989). Position of the viewer is directly overhead. Ground slope may be estimated from a DEM in several ways, using 3 to 9 adjacent height values (Mark and Aitken 1990). Repetition of these calculations pixel-by-pixel over a large DEM yields a reflectance map, a continuous X,Y array of brightness values (Horn 1981).

Many refinements to the basic approach itself can improve relief shading without having to add data from other sources (such as Landsat). Besides direct illumination, reflectance maps generally include some ambient light, which strikes and reflects from a surface equally in all directions, to improve appearance of the final image (Greenberg 1989). Shadows cast by steep terrain also can be incorporated into the calculation, and even atmospheric effects can be simulated (Brassel 1974). Finally, advanced techniques of computer graphics used in some industries to digitally depict virtually any object with photorealistic quality (Whitted 1982, Greenberg 1989) conceivably could be adapted to take shaded-relief portrayal to even higher levels of realism (Kennie and McLaren 1988).

Source Data

The terrain heights from which our map was made were not remotely sensed by Landsat or other spacecraft. Rather, the data result from the machine sampling — initially by contour-tracing, later by drum-scanning — of available contour maps, some of which were first compiled as early as 1947. These measurements have a complex history that spans a quarter of a century, beginning with the Defense Mapping Agency Topographic Center's (DMATC) creation of a nationwide set of gridded elevations over the years 1964 to 1972.

DMATC digitized and labeled contour lines, and later spot heights and stream and ridge lines, on hundreds of 1:250,000 scale (1° by 2°) topographic sheets covering the United States and much of Canada and Mexico. Digitizing these maps by semi-automated methods at 0.01" (0.25 mm) resolution (3 arc-seconds or about 200' [63 m] on the ground) accounted for 1/6 of the elevations. The remaining 5/6 of the data were interpolated between digitized contours by computer. The entire DEM, containing more than 2 billion elevations arrayed in a square grid of 3 arc-second resolution, has been available since 1974 in over 900 1° by 1° blocks from the U.S. Geological Survey (USGS)².

The original DMATC data were later resampled (thinned) and averaged down (see Godson 1981 for some details) to the more manageable file used here and by Godson (1981) and by Arvidson and others (1982). The resulting 12 million elevations are spaced 30 arc-seconds apart, nominally 0.805 km on the ground, north-south and east-west³. The actual array (6046 x 3750) processed to make our map includes null (black) background values lying between the national boundary and the map border and thus is much larger. Although the initial DMATC data were read or interpo-

² Contact the Earth Science Information Center, Room 1C107, 507 USGS National Center, Reston VA 22092; (800) 860-6045.

³The 30-arc-second DEM is available from the National Oceanic and Atmospheric Administration's National Geophysical Data Center, Code E/GC1, 325 Broadway, Boulder CO 80303; (303) 497-6128.

lated to the nearest foot, the elevations were later rounded to 10 m (map contour intervals were coarse: 100' or more). Accordingly, vertical accuracy of the data for this image may be no more than 30 m in smooth areas and 50 m in rough terrain.

Errors in both the 3-arc-second and the 30-arc-second datasets, in addition to those inherent in the source maps, account for visible flaws in the map, more evident in the full-sized version than that shown here. Most of these errors are systematic. Flattened hills and fine-scale rectilinear and stair-step textures on the map arise from round-off error and also from inaccurate interpolation between widely spaced contours, the result of too large a contour interval and a fast but suboptimal algorithm dictated by the slow computers available 25 years ago. Faint, widely spaced north-south and east-west lines mark defective splices between 1° data blocks.

Computation and Production

We created this map by processing all of the 30-arc-second height data through proprietary software, the Interactive Digital Image Manipulation System (IDIMS; Electromagnetic Systems Laboratory, Inc., 1983), installed on a DEC VAX 11/780 computer. After registering the location of each of the 12 million elevations to an Albers Equal-Area Conic projection (standard parallels at 29.5° N and 45.5° N; central meridian at 96.0° W, and latitude of projection's origin at 23.0° N), we produced a new grid of 0.805-km-resolution pixels from bilinear resampling. Topography beyond the national boundary, in two strips across southern Canada and northern Mexico, was excluded from the dataset by a 1:2,000,000-scale United States outline obtained from a USGS digital line graph.

The SUNSHADE routine within IDIMS computed strike and dip angles of terrain slope, by algebraic manipulation of the four elevations immediately north, south, east, and west of each sample point in the DEM (Figure 3), and from them assigned brightness values ranging from 0 (deeply shadowed areas) to 255 (fully illuminated surfaces) to all 12

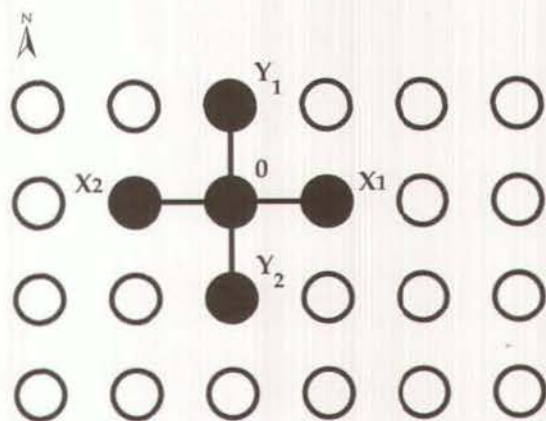


Figure 3: Obtaining values of strike and dip for local terrain slope within a square-grid digital elevation model (subset of 24 heights shown here by open circles) from a five-point sample design (filled circles). Calculation for center terrain height, O (see Figure 2), averages east-west and north-south slope values defined by neighboring heights X_1 and X_2 and Y_1 and Y_2 , respectively (Electromagnetic Systems Laboratory, Inc. 1983). Sample point O is relocated at each height value throughout the DEM and the calculation repeated. Resulting values of strike and dip are used to compute the slope normal and then angle i (Figure 2) for text equations (1) and (2).

million pixels (these calculations took about 17 minutes of CPU time on the VAX 11/780). The algorithm (Electromagnetic Systems Laboratory, Inc., 1983) is built around a much-modified Lambertian photometric function (Horn 1981) that uses diffuse scattering to simulate the effects of solar illumination,

$$I = k_d[L\cos(i)] + A \quad (2)$$

where L is a scaling factor for the intensity of illumination and A is an additive ambient light factor (the remaining terms are defined for equation 1, above). The calculation does not provide for cast shadows. Various parameters to the SUNSHADE routine control image contrast and thus final appearance of the shaded relief. We found that the following values gave the most crisp and visually appealing portrayal overall: vertical exaggeration, 2X; Sun azimuth, 300°; Sun elevation, 25°; scaling factor for the intensity transformation, 1.2 units; ambient-light factor, 0.7 units.

Errors in the DEM were located from both statistical analysis of the elevations (Pike and Thelin 1989) and visual identification of aberrant patterns in the image. We repaired some of the most visible artifacts by editing flawed portions of the DEM and changing elevations on a pixel-by-pixel basis, using a Hewlett-Packard 9000 Series-360 Turbo workstation. To retain maximum local detail in the map, we did not attempt to correct or change any of the erroneous elevations globally, by applying a digital filter to the entire DEM.

Preparation of the final image required several steps. To increase tonal contrast in smooth topography and diminish it in areas of high relief, we remapped the intensity values output from SUNSHADE, using a piecewise linear transformation, to new values based on breakpoints that we defined in the original shaded-relief image from a histogram of its brightnesses. Over 70 of the largest (over 20 mi² in area) natural lakes (20 shown here) were obtained from a vector file of hydrography, converted to raster format, and added to the shaded-relief file as a digital overlay. The image reproduced here was created from a digital file by making a photographic negative on an Optronics C-4500 color scanner and film recorder and enlarging the print to the desired size. The original print was then converted to a plate-ready negative by graphic arts photography through a 150 line per inch halftone screen.

Production of the full-sized map (Thelin and Pike in press) is more complex, requiring three separate reproducibles to achieve the desired tonal contrast and balance. The negative images, each of which emphasizes a different range of brightness, are made on the Scitex Response-300 computerized cartographic system. For each image the full range of 255 light intensities was computed for all 12 million pixels to generate a printing screen of 175 lines per inch on the Scitex system's laser drum plotter. The final map is to be printed from three metal plates made from these screens plus a fourth for the lettering. We expect the map to be distributed in mid-to-late 1991. Its availability will be announced here and in other journals. ◊

ACKNOWLEDGMENTS

We much appreciated the advice on this article from Sean M. Stone, U.S. Geological Survey, David DiBiase, Penn State University, and an anonymous reviewer. Chip Stevens and Victor Badal produced the image.

DISCLAIMER

Any use of trade, product, industry, or firm names in this article is for descriptive purposes only and does not imply endorsement by the U.S. Government.

REFERENCES

- Arvidson, R.E., E.A. Guinness, J.W. Strebeck, G.F. Davies, and K.J. Schulz (1982) Image-processing applied to gravity and topography data covering the continental U.S. *Eos (American Geophysical Union Transactions)*, 63:18, pp. 257, 261-265.
- Batson, R.M., K. Edwards, and E.M. Eliason (1975) Computer-generated shaded-relief images. *U.S. Geological Survey Journal of Research*, 3:4, pp. 401-408.
- Brassel, Kurt (1974) A model for automatic hill-shading. *American Cartographer*, 1:1, pp. 15-27.
- Burrough, P.A. (1987) *Principles of Geographical Information Systems for Land Resources Assessment* (corrected reprinting): Oxford, Clarendon Press, 193 pp.
- Electromagnetic Systems Laboratory, Inc. (ESL) (1983) *Interactive digital image manipulation system User's Guide*, v. 1. Sunnyvale, CA.
- Evans, I.S. (1980) An integrated system of terrain analysis and slope mapping. *Zeitschrift für Geomorphologie Supplementband 36*, pp. 274-295.
- Gallant, A.L., T.R. Whittier, D.P. Larsen, J.M. Omernik and R.M. Hughes (1989) Regionalization as a tool for managing environmental resources. Corvallis, OR U.S. Environmental Protection Agency document EPA/600/3-89/060, 152 pp.
- Godson, R.H. (1981) Digital terrain map of the United States. U.S. Geological Survey Miscellaneous Investigations Map I-1318. Scale 1:7,500,000.
- Greenberg, D.P. (1989) Light reflection models for computer graphics. *Science*, 244:4901, pp. 166-173.
- Hammond, E.H. (1964) Classes of land surface form in the forty eight states, U.S.A. *Annals of the Association of American Geographers*, 54:1, Map Supplement Series no. 4. Scale 1:5,000,000. [adapted version published as Hammond, E.H. (1969) in *The National Atlas of the United States of America* U.S. Geological Survey, pp. 62-63. Scale 1:7,500,000.]
- Harrison, R.E. (1969) Shaded relief, in *The National Atlas of the United States of America*. U.S. Geological Survey, pp. 56-57. Scale 1:7,500,000, .
- Heirtzler, J.R., editor (1985) Relief of the Surface of the Earth, computer generated shaded relief. Boulder, CO: U.S. National Oceanic and Atmospheric Administration National Geophysical Data Center Report MGG-2. Scale 1:39,000,000.
- Horn, B.K.P. (1981) Hill shading and the reflectance map. *Proceedings of the Institute of Electrical and Electronics Engineers*, 69:1, pp. 14-47.
- Imhof, Eduard (1965) *Kartographische Gelandedarstellung*. Berlin: Walter de Gruyter, 425 p. [English translation published as Steward, H.J., ed., 1982, Eduard Imhof, *Cartographic Relief Representation*. New York: Walter de Gruyter, 389 pp.]
- Jensen, J.R. (1986) *Introductory Digital Image Processing — A Remote sensing Perspective*. Englewood Cliffs N.J. Prentice-Hall. 379 pp.
- Kennie, T.J.M., and R.A. McLaren (1988) Modelling for digital terrain and landscape visualization. *Photogrammetric Record* 12:72, pp. 711-745.
- Mark, R.K., and D.S. Aitken (1990) Shaded-relief topographic map of San Mateo County, California. U.S. Geological Survey Miscellaneous Investigations Map I-1257-K. Scale 1:62,500.
- Moore, J.G., and R.K. Mark (1986) World slope map. *Eos (American Geophysical Union Transactions)*, 67:48, pp. 1353, 1360-1362.
- Pike, R.J. (1988) The geometric signature: quantifying landslide-terrain types from digital elevation models. *Mathematical Geology*, 20:5, pp. 491-511.

Pike, R.J., and G.P. Thelin (1989) Cartographic analysis of U.S. topography from digital data, in Auto-Carto 9, International Symposium on Computer-Assisted Cartography, 9th, Baltimore, April 2-7, 1989; Proceedings: American Society of Photogrammetry and Remote Sensing and American Congress on Surveying and Mapping, pp. 631-640.

Raisz, Erwin (1931) The physiographic method of representing scenery on maps: *Geographical Review* 21:2, pp. 297-304.

Raisz, Erwin (1939) Landforms of the United States, in Atwood, W.W. (1940), *The physiographic provinces of North America*. New York: Blaisdell. Scale approximately 1:4,500,000.

Sheldon, Ken (1987) Probing space by camera, the development of image processing at NASA's Jet Propulsion Laboratory. *BYTE*, 12:3, pp. 143-148.

Simkin, Tom, R.I. Tilling, J.N. Taggart, W.J. Jones, and Henry Spall (1989) This dynamic planet: World map of volcanoes, earthquakes, and plate tectonics. U.S. Geological Survey. Scale 1:30,000,000.

Thelin, G.P., and R.J. Pike (in press) Digital shaded-relief map of the conterminous United States. U.S. Geological Survey Miscellaneous Investigations map. Scale 1:3,500,000.

Whitted, T. (1982) Some recent advances in computer graphics. *Science*, 215:4534, pp. 767-774.

Wright, J.K. (1942) Map makers are human: comments on the subjective in maps. *Geographical Review*, 32:4, pp. 527-544.

Yoeli, P. (1965) Analytical hill shading (a cartographic experiment). *Surveying and Mapping*, 25:4, pp. 573-579.

Yoeli, P. (1967) The mechanisation of analytical hill shading. *Cartographic Journal*, 4:2, pp. 82-88.

La Construcción de un mapa fisiográfico de los Estados Unidos por computadora

Extracto

Translation by Juan José Valdés
National Geographic Society

Recientes avances en la tecnología de computadoras presenta nuevas oportunidades para la formación de modelos topográficos. Un reciente mapa de relieve matizado de los Estados Unidos contérmino es el primer modelo gráfico de sola lamina que detalla la topografía Americana en un formato mas grande que el del clásico panorama de 1939 dibujado por Erwin Raisz. El imagen digital, a una escala de 1:3,500,000 (mediendo aproximadamente 11.43 centímetros de largo), reproducido a una escala de 1:10,000,000, contiene mejor detalles y una veracidad superior sobre otras representaciones producidas manualmente. La topografía sinóptica de este mapa es mas detallada que esas de elevaciones contornas, imagenes satélicas, y mosaicos por radar. Este mapa fue producido procesando 12,000,000 puntos de elevaciones (digitizados de laminas topográficas con una escala de 1:250,000, conteniendo una resolución triangular de 0.8 kilómetros) en una computadora VAX-11/780, usando software propietaria, una función fotométrica modificada de la proyección Lambert, 255 tonos grises, y el método Pinhas Yoeli implementado por Raymond Baston y otros.

(*Fugitive Cartographic Literature*
continued from page 14)

in display design is unlikely. Further, the piece reads as if it were heavily but quickly edited, leaving a number of awkward and confusing passages. Judging by the quality of driver interfaces I have seen in Toyota vehicles in the last several years, I suspect that the authors are holding their best material for a different market.

Matthews, Victor and James Moyer (1990). Bible atlases: which ones are best? *Biblical Archaeologist*, December 1990, pp. 220-231.

The article provides a survey of ten bible atlases published in the 1980s. The atlases are divided into two classes: student bible atlases and reference bible atlases. These atlases are reviewed according to the following criteria: visually attractive maps that accurately and easily show the locations of all places mentioned in the Bible, gazetteer, accurate information about the geography, topography, and climate, clear pictures and illustrations with informative captions, up-to-date information that reflects the most recent archaeological discoveries. The two atlases selected as the best are *The Moody Atlas of the Bible Lands* and the *New Bible Atlas* by Tyndale.

cartographic artifacts

BOOK REVIEW

Campbell, John (1991) *Map Use and Analysis*. Dubuque, IA: William C. Brown. 418 pp.
Reviewed by Joseph Stoll,
The University of Akron

John Campbell prefaces his book *Map Use and Analysis* by stating

that its aim is to "serve as an introduction to the fascinating world of maps with an emphasis on clarity of explanation" and assumes that its audience "has no specific prior knowledge of the topic." After thus explaining the purpose and general nature of the book, Campbell proceeds to cover a broad range of map-related topics over the space of twenty-two chapters. These topics include map projections, scale and generalization concepts, locational and land-partitioning systems, characteristics of map features, route selection and navigation, qualitative and quantitative information, remote sensing, computer-assisted cartography, special purpose maps, graphs, and map producers and information sources.

Campbell has produced a volume that deserves high marks for attractiveness, readability and scope. The appearance is clean and well-balanced. Figures are generally crisp and support the text well though the lack of color is noticeable. The somber black, white and gray tones are relieved only by the horizontal red stripes on the cover. The use of color in figures would increase the visual impact and help avoid the problem that occurs in Figure 12.1 where gray and black lines look nearly equally "black". The chapters are well organized, each beginning with a concise statement of its contents and concluding with a detailed summary. In this reviewer's opinion, the uninitiated reader on the subject of map use could justify the purchase of this volume — if only to read the summaries of the chapters.

Campbell inserts "sidebars" in this volume on the following subjects: The Analemma, Dates and Times, Units of Measurement, National Map Accuracy Standards, Levels of Measurement and Names on Maps. These inserts are visually set apart from the main

body of text and provide the reader with explanations of details from the main text much like an inset provides an enlargement of an area on a map. Campbell's use of these sidebars adds interest both visually and intellectually.

Topics covered by Campbell relate to map users in a broad, comprehensive manner. Users of large and small scale maps will find material relevant to their applications. It is refreshing to see unique and less obvious (yet important) topics addressed such as charts, graphs and copyright laws. How many authors on the subject of cartography specifically address the design, application and interdependence of charts and graphs with maps? Regarding copyright law, informing the map user that avoiding penalties for copyright violations requires "scrupulously avoiding making unauthorized copies" (including single photocopies, or copies of copies with no visible copyright identification), leaves little room for misinterpretation.

Of special interest to me are chapters 16 and 17 which cover "Computer-Assisted Cartography" and "Digital Geographic Information Systems." These chapters are quite brief, yet they do address many important aspects in an understandable if general manner. Items addressed in these chapters include implementation of computer-assisted techniques, data capture, output, applications of computer-assisted techniques, data-base availability (including a good summary of United States Geological Survey and Census Bureau products), Digital Geographic Information System components, data forms, manipulation and analysis techniques and applications of Digital Geographic Information Systems. Related to the information contained in these chapters is Appendix C: "Sources of Mapping Programs and Data Bases for Microcomputers." Taken

together, these chapters and the appendix comprise an excellent multifaceted introduction to the most recent trends in automated cartography. Having said this, it should be noted, however, that the chapter on computer-assisted cartography does not mention the use of the computer in map design, nor recent trends in capabilities of presentation graphics software. Since the focus of this book is on map use rather than map production, this does not constitute a glaring omission.

Contained in this volume is an excellent glossary of selected terms which includes several of the acronyms that have invaded our vocabulary during recent years. Examples of these are: TIGER, SPOT Image Corporation (who knew what the acronym SPOT was derived from?), NAVSTAR Global Positioning System and GNIS.

In summary, *Map Use and Analysis* is a readable and current overview of the "world of maps." This reviewer concludes that the aim of introducing this subject with clarity is accomplished and this volume should be a welcome addition to the library of anyone who is at least casually interested in maps.

AN ELUSIVE REFERENCE: THE 1:1 MAP STORY

Jeremy Crampton, Penn State
University

... in that empire, the art of cartography reached such perfection that the map of one Province alone took up a whole city, and the map of the Empire which had the size of the Empire itself and coincided with it point by point . . .

Like many cartographers, I have heard of the "story of the ungeneralized map," i.e., a map that had a scale of exactly one-to-one, so large it covered the entire country. An interesting anecdote that might be worth investigating.

Some versions of the story say it was abandoned, and all that was left are a few rotting remains in the deserts. A similar version comes from Lewis Carroll's *Sylvie and Bruno Concluded*, a minor proselytizing work for children, in which a map's scale is increased until they get a one-to-one map; "but the farmers objected, saying it would block out the sunlight." No rotting maps in the deserts, but perhaps the telling of the quote had distorted it. Muehrcke's *Map Interpretation* includes this version.

For quite a long time I thought this was, in fact, the story. Then, two years ago, I was reading a little book by the French avant-garde cum post-modernist Jean Baudrillard called *Simulations*. Baudrillard begins by recounting "the Borges tale where the cartographers of the Empire draw up a map so detailed that it ends up exactly covering the territory. . . but where the decline of the Empire sees this map become frayed and finally ruined, a few shreds still discernible in the deserts . . ." (p. 1). This sounded more like it — Borges and not Carroll. But where? No reference is given by Baudrillard, but readily found, surely. Thus did I enter the labyrinth (a favorite metaphor of Borges). There can be few authors whose work is more obscurely scattered, more fleetingly published in the original, than Jorge Luis Borges. Searches through his collections like *Ficciones* were to no avail.

Less addicted to the study of cartography, succeeding generations understood that this widespread map was useless and not without impiety they abandoned it to the inclemencies of the sun and winters . . .

Then, in *Cartographica*, 26, p. 116, D.R.F. Taylor used the quote and confirms that it is by Borges, despite a citation in a 17th century book called *Viajes de Varones Prudentes* by Suarez Miranda. Perhaps Borges was quoting from

this book? No; there is no "Miranda" book; Borges had made it up. I could not track it further, and continuing perusal of Borges' work itself was still fruitless. Although I now had the exact quote I had again come to a dead end.

Around this time I heard that a geographer at SUNY Binghamton, Matthew Edney, had coincidentally also searched for this story. From him I learned it was published in a book called *Dreamtigers* (originally *El Hacedor*, "The Maker"). So to the library. Such a book was listed, and was not checked out! Again, the solution seemed to be at hand.

I went to get the book. It was not on the shelves. I checked the availability again; it was not checked out. The book was just missing, stolen perhaps. Not only that; but ditto for the original Spanish version. I began to entertain notions of a conspiracy.

There followed another Borges-like twist. I had mentioned my search to Peter Gould at a pre-semester function over wine and cheese. He had heard of the story but couldn't say where. The next day I saw him at the library. The previous night, he had been reading a French cartography book by Sylvie Rimbert (*Carto-Graphies*, see his review in *CP7*) and found the same quote provided by Taylor that I had been telling him about a few hours previously. We were both amazed at the coincidence. I checked the library again, and noticed that **another** copy of *Dreamtigers* was kept in the Rare Book Room. I put my order in, and sat there with a friend, expecting that the exact page we wanted would have been carefully removed from the book, or that the librarian would come back with a puzzled expression on his face saying that the book could not be found, he was very sorry . . .

But the book did indeed arrive, signed by Borges himself. After

some searching, page 90: under the heading "On Rigor in Science" is one small paragraph with the same quote Taylor and Rimbart had provided, and that I thought was from a larger work (it begins with three ellipse dots as if there is more). Borges says of this book elsewhere ("An Autobiographical Essay," *The Aleph and Other Stories*, 1970, p. 253) that it was made up of odds and ends he found "going through [his] drawers one idle Sunday" in response to a request for a new book. Appropriate: the source of my "Nile" was Borges' drawers.

In the deserts of the West some mangled ruins of the map lasted on, inhabited by animals and beggars: in the whole country there are no other relics of the disciplines of Geography.

Thanks to the following geographers, without whom my search would still be going on: Roger Downs, Peter Gould, Alan MacEachren, John Krygier, and especially Matthew Edney.

BIG GLOBE IDEA

Tom van Saut, a California artist and environmentalist, has all but finished developing what he promises will be the most natural looking model of Earth ever made. He calls his creation Geo-Sphere. It is being made from high resolution pictures taken from satellite photos of Earth. The pictures will be adhered to an acrylic sphere portraying an image of the planet as it appears from space.

The Geo-sphere will rotate on its axis and interior lighting will make cities appear as they do at night. Live images of the world's weather will be projected onto an atmosphere of clear plastic surrounding the globe.

According to van Saut and Van Warren, his collaborator and a computer expert for NASA, the Geo-Sphere will foster understanding of Earth as a whole, including such issues as global warming, the loss of rainforests, desertification

and the depletion of the ozone layer. The pair hope ultimately to be able to produce 12 to 16 inch globes for home and school use at affordable prices. The prototype is 7 feet in diameter. When finished, models like it will cost tens of thousands of dollars. The National Geographic Society has included the flat image in its 1990 atlas. van Saut says that through his globe, he wants to create "... a new understanding of Earth as a dynamic, interrelated, closed system upon which we are having a dramatic impact."

GENIP News, November '90

PACIFIC ISLAND HISTORICAL AND TOURIST MAPS AVAILABLE

Saipan, Mariana Islands: "Tourist Map of Saipan". Pictorial map with notes on World War II, oceanographic information and descriptions of various attractions of interest to the visitor. Published in English and Japanese. Contact: Marianas Visitor's Bureau, P.O. Box 861, Saipan, M.P. 96950.

Saipan: "Saipan Battlefield Map — 1944". Describes the twenty-five day battle, the U.S. route of advance and the Japanese defense of the island. Quite a different map from the above. Contact: Marianas Visitor's Bureau, P.O. Box 861, Saipan, M.P. 96950. Price \$3.50.

Guam, Mariana Islands: "Pacific Explorer's Map of Guam". Pictorial with interesting notes on history, geography and culture. Published in English and Japanese. Contact: Guam Visitor's Bureau, P.O. Box 3520, Agana, Guam 96910.

Pauau & Peleliu, Western Caroline Islands: "Tourist Map of Palau" and "Battlefield Map of Peleliu". Pictorial with description of history, geography and culture of the last remaining Trust Terri-

tory to evolve out of World War II with inset maps of remote outer islands. Peleliu Map describes American attack of 1944 and Japanese defense tactics and cave warfare. Contact: Western Caroline Trading Company, P.O. 280, Koror, Palau W.C.I. 9969940. Price \$4.50.

Truk, Eastern Caroline Islands: "Dive Map of the Ghost Fleet of the Truk Lagoon". Pictorial map describing history, geography and U.S. Navy Task Force 58's aircraft carrier raid on the Japanese fleet in 1944 (Japan's equivalent of Pearl Harbor). Contact: Truk Visitor's Bureau, P.O. Box FQ, Moen, Truk, Federated States of Micronesia, 96942. Price \$3.50.

Kosrae: "Tourist Map of Kosrae". Description of 18th century whaling activities and the great mammal of the sea, early missionaries and traders. Contact: Department of Conservation and Development, Division of Tourism, Kosrae State Government, F.S.M. 96944. Price \$2.50.

Pohnpei: "Map of Pohnpei and the Ancient Ruins of Nan Madol". Description of the culture and the ceremony attending the ritual drinking of sakau, contains note on ruins of a lost Pacific civilization with inset map. Contact: Pohnpei Office of Tourism, P.O. Box 44, Kolonia, Pohnpei, F.S.M. 996941. Price \$2.50.

NTIS CITATIONS

Display Methods for Geographic Data Sets. J. Landrum. Naval Oceanographic and Atmospheric Research Lab., Stennis Space Center, MS. 1989, 6pp. NOATL-PR-89-041-351. Published in Proceedings of Oceans '89, pp. 910-913, Seattle, WA, 18-21 Sep 89. AD-A224 854/0/WNR; price code: PC A02/MF AO1.

A pixel based contouring algorithm is described and used to display three sample world wide data sets. The use of contouring, color coding and hill shading is discussed and related to the spatial frequency content of the data. Contouring has problems in steep areas where the contour lines run together. Color coding brings out the low frequency content of the data. Hill shading brings out the high frequency content or texture. Color coding and hill shading may compliment each other when the data has a mixed high and low frequency content. Reprints.

Canada. Surveys, Mapping and Remote Sensing Sector: Annual review 1988-89. Surveys, Mapping and Remote Sensing Sector, Ottawa (Ontario). c1989, 52pp. SSC-M51-28/1989, ISBN-0-662-57167-3. Text in English and French (Bilingual). MIC-90-05122/WNR; price code: PC E07/MF E01.

First annual review of the Sector, which is responsible for the fundamental surveying and mapping of all of Canada, and for fostering the development of remote sensing technologies and applications. This report gives a summary of the year's activities, and details on the collecting of geographic information, major conferences and activities, advisory committees, awards, and production highlights. Financial data is also included.

Gazetteer of Canada: Prince Edward Island. Third edition. Canadian Permanent Committee on Geographical Names, Ottawa (Ontario). c1990, 57pp. SSC-M86-13/1990, ISBN-0-660-54845-3. Text in English and French (Bilingual). MIC-90-04996/WNR; price code: PC E07/MF E01.

Gazetteer including some 1,900 names of populated places, rivers,

lakes and other cultural and natural features in the form approved by the Canadian Permanent Committee on Geographical Names. In addition, rescinded names are included, as are formerly approved names, cross referenced to their current forms. Each name is identified by lot number, county, map/chart area, and latitude and longitude. A glossary of generic terms and detailed information on establishing of names are included also.

WHERE IN OUR WORLD

"American Airlines has chosen National Geography Awareness Week, November 11-17, to launch a new program to help students learn more about the world in which they live." This quote was taken from a news release sent to NACIS along with a teacher's manual for the project. The teaching materials (which include a colorful time zone map) were created for the airline by Mazer Corporation in Dayton, Ohio. We plan to review these materials for the next issue of *Cartographic Perspectives*. In the mean time, those who would like a copy of the teaching packet should contact: Tracy Backs, The Mazer Corporation, "Where in Our World," P.O. Box 1400K, Dayton, OH 45413-9927, (513) 276-6181.

QUESTIONS AND ANSWERS ABOUT MAP COPYRIGHTS

The following is reproduced (with permission!) from a pamphlet distributed by the International Map Dealers Association, PO Box 1789, Kankakee, IL 60901.

What does "copyright" mean?

The United States copyright law, Title 17 United States Code Section 101, *et seq.*, provides protection to authors of original works. This includes maps. It is unlawful for any firm or individual to reproduce copyrighted works, in whole

or in part, without permission of the copyright owner.

Are all maps protected by copyright?

Yes, essentially all maps (except U.S. government publications) are subject to copyright. This is especially true of street maps, the vast majority of which are produced by private firms, and which are produced at great expense.

How do I know if a map is protected by copyright?

All commercially produced maps are covered by the copyright law. The name of the copyright holder and the word "copyright" or symbol "©" will usually be printed somewhere on the map. However, even if unauthorized copies (without copyright identification) are subsequently reproduced, copyright laws and penalties still apply.

Does the copyright law apply for every use?

Yes, neither a business nor an individual may reproduce copyrighted maps, in any quantity, without permission of the copyright owner. Even a single copy may be considered a copyright violation when the intended use is commercial, whether for profit or not. Specific exceptions have been made for "fair-use" reproductions according to Section 107 of the copyright law.

What are the penalties for violating a copyright?

The penalties allowed by law in copyright violations can be severe, and may include payment of any profits, damages, court costs and attorney's fees.

How may I legally reproduce copyrighted maps?

You should request permission from the holder of the copyright to reproduce a copyrighted map. Permission is usually granted by

a written contract which specifies quantity, royalty fees, and various terms pertinent to the use of the map being reproduced.

I am a printer; if I reproduce copyrighted maps for a customer, who is liable?

You both are liable. The customer and the firm or individual who reproduces copyrighted materials without authorization can both be held liable for copyright violations.

Are royalty fees expensive?

No. Such fees are based on reproduced quantities, area of map coverage, and detail of the particular map being used. In fact, such fees are quite low, considering the skill, time, and effort required to produce a detailed map.

Once a copyright contract is granted, how long is it effective?

A copyright contract gives permission for a specific use and quantity over a particular time. The contract expires when the limited quantity is reached or on the expiration date indicated. Additional reprints will require renewed permission.

Who do I contact to obtain permission to reproduce a map?

Any member of the International Map Dealers Association can provide information relative to requesting reprint permission of copyrighted maps.

new atlases

Atlas of the Least Developed Countries. New York: United Nations, 1990. 43 pp. including 21 maps.

An Atlas of Venice: The Form of the City. London: Architecture Design and Technology, 1990. ISBN 1-85454-003-3. £125.

Chadwick, Henry. *Atlas of the Christian Church.* London: Paidon, 1990. 240 pp. £19.50.

Chaliand, Gerard. *Strategic Atlas: A Comparative Geopolitics of the World's Powers.* New York: Harper Collins Publishers, 1990. ISBN 0-06-096434-0. \$17.95.

Dockrill, Michael L. *The Collins Atlas of Twentieth Century World History.* Glasgow: Harper Collins, 1990. 160 pp. ISBN 0-00-435061-8. £14.95.

Lean, Geoffrey. *World Wildlife Fund Atlas of the Environment.* New York: Prentice Hall Press, 1990. 192 pp. ISBN 0-13-050469-6. \$29.95.

National Atlas of Japan. Tokyo: Japan Map Center, 1990. English ed. 218 pp. \$780. Distributed by Kinokuniya Book Store, 10 W. 49th St., New York, NY 10020.

National Geographic Picture Atlas of Our World. Washington: National Geographic Society, 1990. \$21.95.

Porter, A.N. *Atlas of British Overseas Expansion.* London: Routledge, 1990. ISBN 0-415-01918-8. £45.

Prucha, Francis Paul. *Atlas of American Indian Affairs.* Lincoln: University of Nebraska Press, 1990. 191 pp. including 109 maps. \$47.50.

Roaf, Michael. *Cultural Atlas of Mesopotamia and the Near East.* New York: Facts on File, 1990. ISBN 0-8160-2218-6. \$45.

Wyoming Water Atlas. Laramie: University of Wyoming, 1990. 136 pp. including 55 color plates. \$35. Payable to the University of Wyoming; Wyoming Water Research Center, P.O. Box 3067, University of Wyoming, Laramie, WY 82071.

cartographic events

EVENTS CALENDAR 1991

March 23-29: **ACSM/ASPRS Annual Convention**, Baltimore, MD. Contact: ACSM, 5410 Grosvenor Lane, Bethesda, MD 20814, (301) 493-0200.

March 25-28: **Auto-Carto 10: Tenth International Symposium on Automated Cartography**, Baltimore, MD. Contact: Auto Carto 10, Department of Geography, 105 Wilkeson, North Campus, State

University of New York at Buffalo, Amherst, NY 14260.

April 13-17: **Association of American Geographers 87th Annual Meeting**, Hyatt Regency, Miami, FL. Contact: AAG, 1710 16th St. N.W., Washington, DC 20009-3198.

April 22-25: **NCGA 1991 National Computer Graphics Association**, Chicago, ILL. Contact: Michael Weiner or Sharon Sutton, 2722 Merrilee Drive, Suite 200, Fairfax, VA 22031, (703) 698-9600.

May 6-10: **84th Annual Meeting of the Canadian Institute of Surveying and Mapping and 14th Canadian Symposium on Remote Sensing of the Canadian Remote Sensing Society**, Calgary, Alberta, Canada. For CISM information contact: Dave McLintock, Shell Canada Ltd., 400 4th Ave. S.W., Box 100, Station M, Calgary, Alberta, Canada T2P 2H5; (403) 232-3004, fax: (403) 232-4955. For CRSS information contact: Diane Thompson, Intera Technologies Ltd., 2500-101, 6th Avenue, S.W., Calgary, Alberta, Canada T2P 3P4; (403) 266-0900, fax: (403) 265-0599.

May 26-30: **Annual Conference of the Association of Canadian Map Libraries and Archives**, Ottawa, Ontario at the National Archives of Canada. Contact: Louis Cardinal, Cartographic and Architectural Archives Division, National Archives of Canada, Ottawa, ONT, K1A 0N3; (613) 996-7619, fax (613) 995-4451.

May 31-June 3: **The Annual Conference of the Canadian Cartographic Association**, St. Catharines, Ont. Canada. Contact: Alun Hughes, Department of Geography, Brock University, St. Catharines, ONT, L2S 3A1. Email: ggfhughes@brocku.ca.

June 3-14: **The Visualization Experience**, National Center for Supercomputing Applications, University of Illinois at Urbana-Champaign, IL. Contact: Deanna Walker, 69 CAB 605 E. Springfield Ave., Champaign, IL; (217) 244-1996.

June 22-28: **CG International '91: Visualization of Physical Phenomena**, MIT, Cambridge, MA. Contact: Barbara Dullea, CGI '91 Secretariat, MIT Rm 5-430, 77 Massachusetts Avenue, Cambridge, MA 02139.

July 9-12: **GISDEX: Federal Geographic Information and Spatial Data Exposition and Conference**, Washington, DC. Contact: Brenda Abrams, (301) 445-4400.

September 2-6: **Eurographics '91, Annual Conference of the European Association for Computer Graphics**, Vienna, Austria.

Contact: Eurographics '91 Conference Secretariat, Interconvention, Austria Center Vienna, A-1450 Vienna, Austria; 43(1) 2369-2640, fax: 43(1) 2369-648.

September 23-October 1: **Mapping the Nations - 15th Conference of the International Cartographic Association**, Bournemouth International Centre, Bournemouth, England. Contact: Conference Services Limited, Congress House, 55 New Cavendish St., London W1M 7RE, England, 01-4860531, fax: 01-935-7559, telex: 934346CONFAS G.

October 20-23: **North American Cartographic Information Society Eleventh Annual Meeting**, Milwaukee, WI. Contact: Sona Karentz Andrews, Department of Geography, University of Wisconsin — Milwaukee, Milwaukee, WI 53201; (414) 229-4872.

October 27-30: **GIS/LIS 1991 Annual Conference and Exposition and ACSM/ASPRS Fall Convention**, Atlanta, GA. Contact: ACSM, 5410 Grosvenor Lane, Bethesda, MD 20814, (301) 493-0200; fax: (301)493-8245.

1992

March 22-28: **ACSM/ASPRS Annual Convention**, Albuquerque, NM. Contact: ACSM, 5410 Grosvenor Lane, Bethesda, MD 20814, (301) 493-0200.

Summer: **Fifth International Symposium on Spatial Data Handling, USA**. Contact: Prof. Duane F. Marble, Department of Geography, The Ohio State University, Columbus, OH 43210, (614) 292-2250, telex: (650) 218-4975 MCI.

August 9-16: **27th International Geographical Congress**, Washington, DC. Contact: Anthony de Sousa, 27th IGC, 17th and M Sts. N.W., Washington, DC 20036, (202) 828-6688.

October: **North American Cartographic Information Society**, Twelfth Annual Meeting, Minneapolis, MN.

November 6-12: **GIS/LIS 1992 Annual Conference and Exposition and ACSM/ASPRS Fall Convention**, San Jose, CA. Contact: ACSM, 5410 Grosvenor Lane, Bethesda, MD 20814, (301) 493-0200.

1993

February 15-18: **ACSM/ASPRS Annual Convention**, New Orleans, Louisiana. Contact: ACSM, 5410 Grosvenor Lane, Bethesda, MD 20814, (301) 493-0200.

NACIS news

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EXCHANGE PUBLICATIONS

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

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

Bulletin of the Society of University Cartographers. Published twice a year, the *Bulletin* features articles on techniques and ideas applicable to the cartographic drawing office. Contact: John Dysart, Subscriptions Manager, Room 514, Middlesex Polytechnic, Queensway, Engfield, Middlesex, EN3 4SF, England.

Canadian Cartographic Association Newsletter. A quarterly publication offering news and announcements to members of the CCA. Contact: Canadian Cartographic Association, c/o Jim Britton, Sir Sandford Fleming College, School of Natural Resources, PO Box 8000, Lindsay, ONT K9V 5E6; (705) 324-9144; e-mail: britton@trentu.ca; fax: (705) 324-9716.

Cartographica. A quarterly journal endorsed by the Canadian Cartographic Association/ Association Canadienne de Cartographie that features refereed articles, reviews and

monographs. B V Gutsell, founder and editor. ISSN 0317-7173. Contact: University of Toronto Press Journals Department, 5201 Dufferin Street, Downsview, Ontario, Canada M3H 5T8; (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 list of recent cartographic literature. Contact: Hon. Secretary, Charles Beattie, 13 Sheldrake Gardens, Hordle, Lynton, 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 Speciality Group Newsletter. Biannual publication of the Cartography Speciality Group of the Association of American Geographers. Contact: Ellen White, Editor, CSG Central Office, Department of Geography, Michigan State University, East Lansing, MI 48824; (517) 355-4658.

Cartomania. This 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 six times annually, this news magazine of Geographic Information Systems technology offers news, features, and coverage of events pertinent to GIS. Contact: Julie Stutheit, Managing Editor, GIS World, Inc., P.O. Box 8090, Fort Collins, CO 80526; (303) 223-4848; fax: (303) 223-5700.

Information design journal. Triannual publication of the Information Design Unit.

Features research articles reporting on a wide range of problems concerning the design and use of visual information. Contact: Information design journal, P.O. Box 185, Milton Keynes MK7 6BL, England.

FEATURED PAPERS

All featured papers will be solicited by the NACIS Publications Committee. The goals of the solicitation procedure will be to select high quality papers that provide a balanced representation of the diverse interests of the membership. The primary mechanism for soliciting featured papers will be a paper competition held in conjunction with the Annual Meeting. All papers prepared for the meeting and submitted in written and/or digital form will be considered. Three of these will be selected to appear in *Cartographic Perspectives* during the next year.

In addition to the competition winners, the Publications Committee (in consultation with the editors) will solicit one or more papers each year from other sources. The goal here is to ensure that all aspects of the membership are served and to attract some thought-provoking ideas from authors who may not be able to attend the annual meeting.

Authors of selected papers will be given an opportunity to respond to suggestions of the Publications Committee before submitting a final version. The writing quality must adhere to high professional standards. Due to the interdisciplinary nature of the organization, it is particularly important that papers are carefully structured with ideas presented succinctly. The editors reserve the right to make editorial changes to ensure clarity and consistency of style.

Papers ranging from the theoretical/philosophical to methodological/applied topics will be considered providing that ideas are presented in a manner that will interest more than a narrow spectrum of members.

To be considered for the paper competition, papers should be prepared exclusively for NACIS, with no major portion previously published elsewhere.

TECHNICAL GUIDELINES

Cartographic Perspectives is designed and produced in a microcomputer environment. Therefore, contributions to CP should be submitted in digital form on 3.5" or 5.25" diskettes. Please send paper copy along with the disk, in case it is damaged in transit.

Text documents processed with Macintosh software such as *WriteNow*, *WordPerfect*, *Word*, and *MacWrite* are preferred, as well as documents generated on IBM PCs and compatibles using *WordPerfect* or *Word*. ASCII text files are also acceptable.

PostScript graphics generated with Adobe *Illustrator* or Aldus *FreeHand* for the Macintosh or Corel Systems' *Corel Draw*, *MicroGrafx Designer*, or Computer Support Corporation's *Arts and Letters* are most preferred, but generic PICT or TIFF format graphics files are usually compatible as well.

For those lacking access to microcomputers, typed submissions will be tolerated. 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.

Submissions may be sent to: David DiBiase, Department of Geography, 302 Walker Building, Pennsylvania State University, University Park, PA 16802; (814) 863-4562; email:dibiase@essc.psu.edu

COLOPHON

This document was desktop-published at the Deasy GeoGraphics Laboratory Department of Geography, Penn State University, using an Apple Macintosh IIcx. Word processing was accomplished primarily with *WriteNow 2.0* and *WordPerfect 1.03*; page layout with *PageMaker 4.0*. Graphics not rendered with Aldus *FreeHand 2.02* were scanned from paper originals using an HP 9190 ScanJet desktop scanner. The *PageMaker* document was output by a Linotronic 300 at PSU Printing Services. 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. The featured color is PMS 5545C.

(continued from page 3)

cartography. The dilemma is that there is one Germany with two cartographical systems. The dissimilarity of the two mapping systems reflect dissimilar political patterns. The former GDR's topographical and geological mapping system was oriented to the COMECON standard, one which is hardly compatible with the Federal Republic's standard. How is cartographical unification going to be achieved? "Probably, it will end up in GDR's cartography assuming the Western norms. . . Surely the German cartography, complicated enough at present, will turn more intricate in the future, and cartographers will have a lot of work to do."

NACIS membership form

North American Cartographic Information Society Sociedad de Informacion Cartografica Norte Americana

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*Membership fees include subscription to *Cartographic Perspectives* and are due January 1.

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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