NACIS XV

North American Cartographic Information Society

Fifteenth Annual Meeting

October 25-28, 1995
Hilton Hotel
Wilmington, North Carolina

Welcome to

NACIS XV

The Fifteenth Annual Meeting of the
North American Cartographic Information Society

October 25-28, 1995
Wilmington, North Carolina

A hearty welcome to Wilmington!

The NACIS XV Local Arrangements and Program Committee has put together a diverse and extensive group of poster & paper sessions, workshops, field trips, and social events that we believe you will find both interesting and stimulating.

We are also fortunate to be sharing the Hilton with the North Carolina URISA (Urban Regional Information Systems Association) group who are concurrently holding their annual conference. They have agreed to a reciprocity arrangement in which any NACIS or URISA conference attendees can attend either NACIS or URISA paper sessions and exhibits.

Everyone should take time to explore Wilmington. The Hilton is located on the waterfront in the heart of the historic district. Restaurants, specialty shops, a riverside promenade, and several museums are all within easy walking distance of the hotel. It is a city rich in history & culture and presents an optimum setting for energizing your cartographic psyche.

Keith Rice
Vice President
and Program Chair

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	Carolyn C. Weiss Statistics Canada

WEDNESDAY, OCTOBER 25

11:00 am - 1:00 pm **Registration**
5:00 pm - 7:00 pm

Noon- 6:00 pm **Workshop** (held at the University of North Carolina-Wilmington, workshop participants meet at South Parking Lot [bus loading area])

Distributing Maps Through the Internet
Organizer: Michael P. Peterson
University of Nebraska at Omaha

3:00 - 5:00 pm **Workshop** (held at the University of North Carolina-Wilmington, workshop participants meet at South Parking Lot [bus loading area])

Introduction to ATLAS*GIS for Windows
Organizer: Jan Mersey, University of Guelph

1:00 - 3:00 pm **NACIS Board Meeting** (Board Room C)

7:30 pm **Opening Session** (Garden Room)
Keynote Speaker: Frank Ainsley,
Univ. of North Carolina - Wilmington

9:00-11:00 **Poster Session/Exhibits & Reception**
(Carolina/Tidewater Room)

Organizer: Donna G. Schenström
University of Wisconsin-Milwaukee

Poster Session Participants

James Anderson, Jr.
Florida State University

Ken Arsenault
Natural Resources Canada
National Atlas Information Service

Raymond Brod
University of Illinois-Chicago

Patricia Chalk
University of Western Ontario

Gregory Chu
University of Wisconsin-La Crosse

Jan Coyne
Institute of Community and Area Development
University of Georgia

Nathanael Evans
Michigan State University

Will Fontenez
University of Tennessee

Laurie Garo
Appalachian State University

Jeffrey McMichael
Georgia State University

Henry Norris
Florida Marine Research Institute

Tom Patterson
National Park Service

Donna G. Schenstrom
University of Wisconsin-Milwaukee

Marc Toloczko
U.S. Geological Survey

Commercial Exhibit Participants

LSC 2+1, Inc.
(Jacques Fournier)

NOAA
(Ron Bolton)

U.S. Geological Survey
(Marc Toloczko)

THURSDAY, OCTOBER 26

7:30 am - 3:30 pm **Registration**

9:00 am - 5:00 pm **Exhibits Open** (Carolina/Tidewater Room)

8:30 - 10:00 am

SESSION A (Garden Room)

Cartographic Method and Theory

Chair: Jeremy Crampton, George Mason Univ.

Spectral Schemes: Controversial Color Use on Maps
Cynthia A. Brewer, Alan M. MacEachren, & Linda W. Pickle, Penn State University

Cartographic Testing: Postmortem of an Experimental Project
Charles P. Rader, Univ. of Wisconsin-River Falls

The Meaning of Map Interaction
Michael P. Peterson, Univ. of Nebraska-Omaha

SESSION B (Cape Fear Room)

University Cartography Labs - Current Trends and Future Directions

Organizer and Chair: James R. Anderson, Florida State University

From Printed Maps to the CD-ROM to the Internet: The Atlas of Florida Experience
James R. Anderson & Christopher D. Wilkes, Florida State University

Prepress Production Issues of Importance to Cartographers
Joseph Stoll, Univ. of Akron & Donna Schenstrom, Univ. of Wisconsin-Milwaukee

CVNRA Map: Trailblazing, Politics, and Cartography
Claudia James & Thomas Nash, Univ. of Akron

10:00 - 10:30 am **BREAK**

10:30 - Noon

SESSION C (Garden Room)

Cartographic Animation

Chair: Michael P. Peterson,
University of Nebraska-Omaha

A Cartographic Animation of Portland, Oregon's Annexation History: Discrete Areal Change at Disjunct Times
Alison E. Philpotts, Michigan State University

Searching Maps Using Color and Motion
Robert Lloyd, University of South Carolina

Cartographic Animation on the Internet
Michael P. Peterson, Univ. of Nebraska-Omaha

SESSION D (Cape Fear Room)

Map Copyright Issues

Chair: Cynthia Brewer, Penn State University

Copyright and Cartography Labs, Questions of Map Ownership
Will Fontanez, University of Tennessee

U.S. Copyright and Multimedia
Trudy Suchan, Penn State University

Copyright and Maps
Dennis McClendon, Chicago CartoGraphics

Thursday continued

Noon - 2:00 pm **Luncheon & Annual Business Meeting**
(Magnolia Room)

2:00 pm - 5:00 pm **Tours**

Wilmington Adventure Walking Tour
Meet in the Upper Lobby (2nd floor)
Departs at 2:00 pm
Group will be lead by Bob Jenkins

American Geographic Data
Meet in South Parking Lot Bus Loading Area
Departs at 2:00 pm

U.S. Army Corps of Engineers
Meet in South Parking Lot Bus Loading Area
Departs at 2:30 pm

7:30 - 10:00 pm **Dinner on your own**

FRIDAY, OCTOBER 27

8:00 - Noon **Registration**

8:00 - 2:00 pm **Exhibits Open** (Carolina/Tidewater Room)

8:30 - 10:00 am

SESSION E (Garden Room)

Cartographic Education

Chair: Charles Rader, Univ. of Wisc.-River Falls

Anatomy of the Introductory Cartography Course Revisited
James R. Fryman & Bonnie R. Sines,
University of Northern Iowa

Cartographic Education in Germany: State and Recent Developments
Ulrich Freitag, Freie Universitat Berlin

Teaching ARC/INFO as a Cartographic Tool
Zehdreh Allen-Lafayette,
New Jersey Geological Survey

SESSION F (Cape Fear Room)

Microcomputer Mapping Round Table Discussion

Organizer and Chair: Dennis McClendon - Chicago CartoGraphics

Panel Members:
Will Fontanez, Director, Cartographic Services Laboratory, Univ. of Tenn.
Thomas H. Patterson, Cartographer, National Park Service, Harpers Ferry, WV

Friday continued

10:00 - 10:30 am **BREAK**

10:30 - Noon **SESSION G** (Cape Fear Room)

Panel Discussion on Cartographic Education

Organizer and Chair: Keith Rice,
University of Wisconsin-Stevens Point

Dissecting the Identity and Direction of Cartographic Education
Keith Rice, Univ. of Wisc.-Stevens Point

Panel Members:
Jeff Patton, Professor, Univ. of N.C.-Greensboro
Charles Rader, Professor, Univ. of Wisconsin-River Falls
Larry Kirkpatrick, American Geographic Data

SESSION H (Garden Room)

GPS and GIS

Augmented GPS to Benefit All Phases of Aircraft and Vessel Navigation
Ronald M. Bolton, NOAA - Aeronautical Charting Division

Generation of Digital Base Maps for Preparation of Thematic Maps
Cidney J. Freitag, USGS

Noon - 1:00 pm **LUNCH on your own**

Noon - 1:15 pm ***CP* Editorial Board Meeting**

1:30 - 3:00 pm

SESSION I (Cape Fear Room)

Mapping in a Child's World

Organizer and Chair: Henry W. Castner - Pittsboro, NC

An Educational Taxonomy for Maps in a Child's World
Henry W. Castner - Pittsboro, NC

Designing Maps for the Elementary Grades
Karen M. Trifonoff, Bloomsburg University

Children's Cognitive Processing and Understanding of Thematic Map Symbolization
James E. Young, Appalachian State University

Terrain Models: A Tool for Experiential Learning in Geography and Mapping
Sam Brian, Bank Street College of Education, Geography and Mapping Institute

1:30 - 3:00 pm

SESSION J (Garden Room)

Automating Map Resources & the Internet

Chair: Sona Andrews, Univ. of Wisc.-Milwaukee

World Wide Web Resources for Cartographers
Jeremy Crampton, George Mason University

Putting Cartography on the Internet: The Alexandria Digital Library Project
Barbara P. Buttenfield, Christopher Weber, Ming-Hsiang Tsou, Patricia Trawinski & Victor Ricci, NCGIA

Bending the Rules: Creatively Adapting Library Systems to Automate the Map Collection
Paige Andrew & Melissa Lamont, Penn State University

Friday continued

3:00 - 3:30 pm **BREAK**

3:30 - 5:00 pm **SESSION K** (Cape Fear Room)

Mapping in a Child's World II

Organizer: Henry W. Castner - Pittsboro, NC

Map Skills in Quebec's Elementary School Curriculum

Jacqueline Anderson, Concordia University

Round Table Discussion on Mapping in a Child's World: Implications for Cartographic and Geographic Education

3:30 - 5:00 pm **SESSION L** (Garden Room)

Panel Discussion - Impact of Federal Budget Cuts on Mapping Within Government, Academic Institutions, and the Private Sector

Organizer and Chair: Ronald M. Bolton, NOAA - Aeronautical Charting Division

Panelists:
Patricia Gilmartin, Professor, University of S. C.
Barbara Fine, President, The Map Store
James Anderson, Laboratory Director, Florida State University
Christopher Baruth, Curator, AGS Collection, University of Wisconsin-Milwaukee
John Sutherland, Curator, Map Library, University of Georgia

6:30 - 10:00 pm **ANNUAL BANQUET** (Magnolia Room)

Speaker: Denis Wood, North Carolina State University, "*Living With Maps*"

SATURDAY, OCTOBER 28

8:30 - 10:30 am **NACIS Board Meeting** (Board Room C)

11:00 - 6:00 pm **NACIS Sponsored Field Trip Excursions**

Henrietta II - Cape Fear River Sight-seeing Cruise

1:45 - 4:15 pm. Meet on the Riverwalk (west side of Hotel near boat dock)

Bald Head Island Junket

11:00 am - 6:00 pm. Meet in the South Parking Lot Bus Loading Area. Be prompt!

ABSTRACTS

Thursday (8:30 - 10:00 am)
SESSION A: Cartographic Method and Theory

Spectral Schemes: Controversial Color Use on Maps
Cynthia A. Brewer, Alan M. MacEachren, & Linda W. Pickle,
Penn State University

Spectral color schemes on maps present a rainbow of colored symbols (e.g., red, orange, yellow, green, blue). These schemes are becoming ubiquitous in mapping, satellite image display, and scientific visualization, yet cartographers have warned against their use for well substantiated reasons. A Spectral scheme was one of eight schemes we evaluated on choropleth maps of age-adjusted death rates using experimental assessment of human-subject performance on a variety of typical health-analysis tasks. Our overall goal was to assess guidelines for designing color schemes for the mortality atlas to be produced by the National Center for Health Statistics. Three of the tested schemes were sequential (single lightness progressions; Red-Yellow, Purple-Blue, and Grays) and four were diverging (two lightness progressions of different hues away from a light midpoint; Red/Blue, Purple/Green, Pink/Yellow-Green, and Brown/Blue-Green). The Spectral scheme was designed with a lightness structure similar to the diverging schemes; light yellow, for the median death-rate class, ranging to dark red and dark blue for extreme high and low death rates respectively. Map reading performance was similar for all of the schemes tested, and the primary differences were in preference ratings. Subjects rated the Spectral and Purple/Green schemes most pleasant and easy to read and they rated Gray schemes least pleasant and most difficult to read. We can tentatively recommend use of well designed spectral color schemes that use the saturated yellow midpoint to highlight a critical level in the mapped data.

Cartographic Testing: Postmortem of an Experimental Project
Charles P. Rader, University of Wisconsin-River Falls

Cartographic Testing: Postmortem of an Experimental Project
In this paper, an experimental project on the cartographic representation of regional information is dissected in order to examine the impacts that different test design decisions have on an experiment's outcomes. The project involved an examination of differential understanding of several regional concepts as communicated by five different map types (nominal,

choropleth, isarithmic, continuous-tone, and dot density) presented in a hypermedia format. In undertaking this project, a number of vagaries in the process of cartographic testing and methods were exhumed. Issues of map type, map design, presentation, question phrasing, and methods of analysis are discussed in order to develop a better understanding of the role that these decisions play in the results obtained and the interpretation of these results. Finally, the methodological implications of these issues are put into a conceptual framework that should aid those who perform experimental work on map design.

The Meaning of Map Interaction

Michael P. Peterson, University of Nebraska at Omaha

It is likely that the first map ever created was interactive - drawn in sand and with features added based on questions posed by the first map user. In the many thousands of years since, cartography has developed methods of communicating about space that do not involve interaction. A major consequence of the computer in cartography has been the re-incorporation of interaction in the display of maps. Again user-driven, cartography now faces a challenge of identifying those aspects of cartographic abstraction that are a function of the medium on which maps are displayed. How has the medium of paper influenced how we represent and conceive of space? The question is examined through the concepts of spatial and temporal resolution.

Thursday (8:30 - 10:00 am)
SESSION B: University Cartography Labs - Current Trends and Future Directions

From Printed Maps to the CD-ROM to the Internet: The Atlas of Florida Experience

James R. Anderson & Christopher D. Wilkes, Florida State University

Until recently, most university cartography labs prepared work for some form of print media whether it be illustrations for a book, maps for a journal article, or a published atlas. Alternative ways of displaying cartographic products have evolved which include videodisc, CD-ROM, and now the Internet. Cartographic methods for generating these maps have also changed dramatically. In 1992, the Florida State University published the Atlas of Florida as a four-color printed volume. Shortly after publication, a cooperative agreement between Florida State University, the Florida Department of

Education, and IBM was signed to prepare a CD-ROM version of the atlas for distribution to schools in Florida. After distribution of the CD, the question was asked if the computer map images prepared for the CD could be placed on a World Wide Web (WWW) site for use by businesses in Florida and other interested users. In cooperation with the Florida Communities Network, administered by the State Department of Management Services, this has been done. In making the transition from the original published version to the Internet, numerous problems arose as well as numerous opportunities.

Prepress Production Issues of Importance to Cartographers

Joseph Stoll, Univ. of Akron &
Donna Schenstrom, Univ. of Wisconsin-Milwaukee

The rapid pace of technological change affects the cartographer, not only as a result of the evolution of hardware and software, but also as a result of the evolution in the technologies utilized by bureaus providing quick printing and conventional printing services. Since cartographers must often work closely with these service bureaus, it is important to become aware of the effect of recent technological developments that directly affect the way printing service bureaus work. This report will address issues of concern to both quick printing and conventional printing service bureaus with whom the presenter has recently worked.

CVNRA Map: Trailblazing, Politics, and Cartography

Claudia James & Thomas Nash, University of Akron

In January 1994, a map retailer, a former university professor, now a park ranger, and the University of Akron Cartography Lab got together to discuss production of a large scale map of a local recreation area, the Cuyahoga Valley National Recreation Area (CVNRA). The map would be sold at the map retailer's store, at park locations and other pertinent stores near the park. The map would fill a niche that current park maps did not: it would be large enough scale to show trails accurately, topographic features of the park would be highlighted, and important cultural features would be shown. Rather than discuss the technical production of this map of the CVNRA, I'd like to explore the evolution of the map from its original idea to its final form. What appeared at first to be a 6 month project turned into a 1-1/2 year project with an interesting evolution of ideas concerning the 'what' and 'how' of communicating the 'where' of park features. The number of people deciding what should appear on the map, the technical constraints given the original purpose, and the map's broad scope have all molded the final form of this map. The factors which will be examined

include the original concepts and ideas for the map, and how they have been changed and/or compromised due to the variety of the players involved, the technical limitations, and cost constraints of producing a map for retail sale. Hopefully by the time of the conference, a final map will be printed and we will have some indication of its success.

Thursday (10:30 - noon)
SESSION C: Cartographic Animation

A Cartographic Animation of Portland, Oregon's Annexation History: Discrete Areal Change at Disjunct Times

Alison E. Philpotts, Michigan State University

A typology of cartographic animations is developed and established, followed by a description of how data classification and display outputs affect the visual representation of geographic phenomena. Rather than an animation producing a fluid-like motion to show change over a given time period, this paper addresses the effectiveness of a temporally disjointed animation portraying change at discrete time periods. Portland, Oregon's boundary, from 1851 to 1994, changes as discrete areal units at disjunct times. An animation displaying such growth must reflect this spatial and temporal dimensionality. Creation of the animation is divided into four categories. Data collection is the compilation of primary source materials gathered from several organizations. Data input involves transferring all information into a working format and registering it to a given scale. Visual enhancement employs a drawing package to increase the map's communication potential and aesthetic value. Programming utilizes a slide show type computer program to display the annexation history. A slide show is not the only type of program capable of showing such changes, but it is effective at producing an animation of discrete time periods. Significantly, a slide show type program is relatively inexpensive and easy to use, indicating that certain types of cartographic animations are indeed accessible to a large audience of map makers.

Searching Maps Using Color and Motion

Robert Lloyd, University of South Carolina

One of the most common activities related to map reading is searching for a known target symbol among other symbols that differ from the target. Cognitive search theories argue that a target will attract immediate attention or "pop out" of a display if it has a characteristic, e.g., color, shape, size, orientation or motion, that makes it unique. Since cartographers want to

produce symbols for maps that can be processed quickly and accurately, they need to investigate search processes and symbols that produce the desired "pop out" effect. The purpose of this study was to compare cognitive search processes using target symbols that were defined by motion. The results of two experiments are reported. The first experiment had subjects search maps of South Carolina for a target symbol that was a particular shape and color and was moving either left and right (horizontal motion) or up and down (vertical motion). The results indicated that targets defined by a unique color were processed more efficiently than targets defined by a unique motion. The second experiment considered whether the efficiency of a search is effected by how the symbols are distributed on a map. Results indicated that maps with symbols distributed in clusters were searched slightly faster than those with random distributions. Subjects, however, made more errors when searching maps with clusters of symbols. The results indicated that a "pop out" was achieved when targets were defined by color, but not when they were defined by motion.

Copyright and Cartography Labs, Questions of Map Ownership

Will Fontanez, University of Tennessee

University cartography shops tend to do a lot of 'repeat' mapping. This is especially true regarding geographic areas around their campus, city and state. Many times clients coming from within or outside the university may require similar maps of the same area. So, there is a great need to be able to use all, parts and variations of previously drawn areas for other projects. The University of Tennessee has reviewed its contract for cartographic work and established policies for electronic file usage and ownership. The purpose of this paper is to discuss these policies and stimulate discussion and opinions from the audience.

U.S. Copyright and Multimedia

Trudy Suchan, Penn State University

U.S. copyright law is intended to accommodate public access to published work and an author's rights of control. Implementation of the law, however, often lags behind technology; such is the case with multimedia works. Change, key to effectiveness of multimedia, is not addressed adequately in federal law. This paper describes federal copyright law, examines U.S. copyright laws and practices as they apply to multimedia works, and presents Penn State policies regarding copyright as an example of institutional implementation of federal law. Suggestions are presented for copyright compliance in cartographic multimedia work. This discussion is bi-directional, considering use both of copyrighted material and protection of original multimedia work.

Copyright and Maps
Dennis McClendon, Chicago CartoGraphics

What is the law regarding copying features from others' copyrighted maps? Where is the distinction between copying facts, which are not protected by copyright, and copying expression, which is protected? Is tracing streets from a commercial street map legally gathering facts or illegally copying expression? What about copying a generalized coastline? A 1991 Supreme Court case substantially lowered the copyright protection given to compilations of facts. How does that affect maps? The speaker, a lawyer by training, will discuss recent cases and what guidance courts have given in this area.

Friday (8:30 - 10:00 am)
SESSION E: Cartographic Education

Anatomy of the Introductory Cartography Course Revisited
James R. Fryman & Bonnie R. Sines, Univ. of Northern Iowa

The field of cartography has undergone considerable change within the past two decades. These changes reflect technological advancements and shifts in emphasis within the profession. Furthermore the introductory production cartography course has changed considerably, reflecting the 'state of the profession' and recent changes in technology and emphasis. This presentation will present the results of a 1995 survey of cartography instructors who teach introductory production cartography courses. The primary purpose of this survey is to determine the current content and structure of the introductory cartography course. Specifically the survey focused on such course characteristics as textbook usage, types of exercises, degree of manual/ computer production and the place of the introductory course in the context of the total cartography offerings. The survey was sent to institutions offering cartography courses in both the United States and Canada. In addition, the paper compares the survey results with a similar survey conducted in 1989. The comparison of responses over a six year period of time was done in order to identify changes in course structure and content.

Cartographic Education in Germany: State and Recent Developments
Ulrich Freitag, Freie Universitat Berlin

Due to the long tradition of cartography, cartographic education developed into an open system with three distinct layers: cartographic technician, engineer of cartography (cartographic technologist) and scientific cartogra-

pher. They are based on different curricula and are taught at different institutions: official and private institutions, polytechnical universities, universities. Regional differences are apparent as a result of the federal organization of education. During the last decade major revisions of all curricula occurred. They were generated by the increasing use of computers in all stages of cartographic production, by the integration of cartographic presentations (visualization) into geographic information systems, by the attempts of standardization in cartography, and by the intensification of research based on theoretical concepts. The publications of new textbooks and the conceptualization of a new cartographic dictionary reflect the recent changes of cartographic education in Germany. The paper will present details of curricula of all levels of cartographic education and of some German textbooks.

Teaching ARC/INFO as a Cartographic Tool

Zehdreh Allen-Lafayette, New Jersey Geological Survey

Employees trained to utilize GIS at state agencies commonly have their expertise in areas other than geography, such as geology or botany. When the time arrives to output the data as hard copy, either as a figure for a report or as a poster or slide for a public forum, the GIS success story becomes a cartographic disaster failing to deliver the desired impact. This paper describes a method for teaching GIS, specifically ARC/INFO, as a cartographic tool, in a one-semester format. It starts with the preparation of manuscript maps and progresses through data entry, editing, use of the analytic capabilities of the system, and finally, to the digital creation of a publication-quality map. This method involves four steps: a) Introduction, which includes the collection of data, basic cartography and manuscript-map creation; 2) the GIS process, data entry and editing; 3) working with the analytical abilities of the system while developing the concept for a publication map; and 4) the Map Composer unit of the ARC/INFO system. These steps can easily be adapted to a business environment, and they enable businesses and colleges to train students in the basics of a GIS while building a digital data base.

Friday (10:30 - noon)
SESSION H: GPS and GIS

Augmented GPS to Benefit All Phases of Aircraft and Vessel Navigation

Ronald M. Bolton, NOAA - Aeronautical Charting Division

The Global Positioning System (GPS) users are aware of its extraordinary capability for navigation. When used alone, the GPS basic signal provides very accurate navigation positioning — down to ±100 meters. Used with assistance from geostationary satellites, local area differential systems, and wide area augmentation systems, GPS can provide sufficient integrity, accuracy and availability to support enroute, landing and departure aircraft operations as well as enroute vessel positioning/tracking and harbor navigation. Navigators worldwide are clamoring for implementation. Major benefits are expected to be obtained from reduced travel time, more efficient travel paths, and reduced delays (especially in poor weather conditions) — all of which are made possible by procedures supported by more accurate navigation systems and more reliable, improved surveillance equipment. Augmented GPS could mean an end to the purchase and maintenance of ground-based navigation and landing systems. The Department of Transportation's Strategic Plan is built around GPS as a cornerstone of all future vessel and aircraft navigation. The Secretary of Transportation is pursuing methods of accelerating the application of GPS technology for achieving earlier user benefits — the Coast Guard, FAA, and DOT Volpe Transportation Center research efforts will make this happen in the next 2 to 5 years. Illustrations of the success of these accelerated research efforts are:

1. The Volpe Center differential GPS (DGPS) guided vessel experiments that place buoys in the Saint Lawrence Seaway (SLS) to an accuracy of 15 to 30 feet.
2. Automated GPS vessel tracking systems that track and display vessel positions and geographic features of SLS on computer displays to an accuracy of 100 meters or better 95% of the time.
3. The Coast Guard's DGPS tests at Groton, Connecticut demonstrated that DGPS can meet harbor navigation accuracy requirements in the 8-20 meter range.
4. The FAA tests of its nationwide Wide Area DGPS for aircraft yielded maximum errors in the vertical of 9 meters and horizontal errors of 6 meters — far more accurate than necessary for enroute flight and non-precision landing.

5. Recent Ohio University and Stanford University augmented GPS Landing Tests for FAA demonstrated that automated landings can be achieved with total systems errors of between .1 meter and 2.0 meters. This led the FAA to begin an acquisition program for Local Area Augmentation Systems (LAAS) to provide enhanced DGPS for all types of landing operations.

There is no question that augmented DGPS will provide cost savings to the aviation and maritime industries. It will allow the Coast Guard and FAA to save substantial amounts of money; less ground-based employment will have to be procured and maintained. The greatest benefit will be the more accurate navigation that will be available in all types of weather conditions which will increase safety in the air and on the water nationwide.

Generation of Digital Base Maps for Preparation of Thematic Maps

Cidney J. Freitag, USGS

The Cartographic and Publication Program of the U.S. Geological Survey, Water Resources Division, has implemented procedures using a Geographic Information Systems (GIS) or a combination of a GIS and a vector-based drawing program to produce publication-quality base maps. Thematic overlays can be added by digital or analog methods. Use of a base map derived from the same data base used for scientific work allows smooth transition from analysis to publication stages of a project. The base map generation process begins with the acquisition of digital data and ends with prepress film products. Steps in the process include (1) analytical data processing to combine and register layers of data into a continuous dataset useful for scientific work; (2) cartographic processing to add annotation and generalize the data for small map scales; and (3) cartographic refinement to assign symbology and choose base information appropriate for project publications. Thematic-data overlays may be generated digitally as part of the analytical process and included as part of the data base. Projects not using GIS can still enjoy some of the benefits of digital-map production by importing a GIS-derived base map into a drawing program where thematic data can be incorporated.

Friday (1:30 - 3:00 pm)
SESSION I: Mapping in a Child's World

An Educational Taxonomy for Maps in a Child's World

Henry W. Castner - Pittsboro, NC

When we talk about mapping in a child's world, what kinds of maps are we talking about? What problems are children given to solve with maps? What perceptual and intellectual skills should they have for solving such problems? Perhaps it is time that we had better answers to these questions. One way is to be more specific about what we mean when we use the world map. Some criteria are discussed by which an educational taxonomy could be developed that distinguishes different generic types of maps, the problems they solve, and thus how they could be used in classrooms. The criteria suggest a logical sequence for introducing maps to children and some specific map types that are not commonly identified.

Designing Maps for the Elementary Grades

Karen M. Trifonoff, Bloomsburg University

Maps currently used in elementary texts involve large scale maps of local areas; for example, a simple neighborhood map with streets, houses, a school, park and playground. Cartographic research, however, continues to suggest that these maps may be too simple for the sophisticated mapping behaviors of early elementary children. One way to challenge the mapping abilities of elementary students is to expand the maps currently being used to include thematic maps, or maps that start with a base or outline map, and then add layers of data. For example, the population of an area, number of houses or number of ice cream cones consumed annually could be separate thematic layers. In order for these maps to be included in the early elementary grades, cartographers and geographic educators need to evaluate student performance on new and more challenging map materials. A mapping module is being developed to evaluate first graders' reactions and responses to such thematic maps. The module includes three sections: map instruction, map analysis and map construction. In the instruction phases students will be introduced to mapping terminology and symbolization. Map analysis will allow students viewing completed maps and answering questions regarding scale, symbols and data. Map construction will give students the opportunity to design their own maps by guiding them through the mapping process and providing them with a variety of scale, data and symbol choices. Continued testing of new map designs will help us provide maps appropriate to the early elementary grades.

Children's Cognitive Processing and Understanding of Thematic Map Symbolization

James E. Young, Appalachian State University

Children encounter a large number of thematic maps in school, usually in their social studies textbooks. Research in cartography and psychology (based on the theories of Jean Piaget) suggested that children might not have some of the cognitive abilities necessary to understand and use thematic maps. Cartographers have little knowledge about the types of thematic maps that children of different ages and abilities can understand. Children, ranging in age from eight years, nine months, to fourteen years, seven months, examined several different thematic maps (dot, graduated circle, isoline, choropleth, and bounded area symbolizations), then answered questions about the maps. The children improved their abilities to understand thematic maps as they grew older, but even the youngest children could use the various thematic maps to answer questions. As children aged, they also improved in their abilities to answer inference questions about the maps (questions that could not be answered only with facts obtained from the maps). Analysis of test scores indicated differences in children's understanding of different thematic map symbolization: the children scored highest on area symbol maps (choropleth, bounded area), followed by the point symbol maps (dot, graduated circle) and the line symbol maps (isoline). No difference was found between the thematic map understanding of girls and boys in any of the age groups. The results suggested that children develop some of the cognitive abilities necessary to understand thematic maps at a younger age than Piagetian theory would predict. Educators should be able to introduce thematic maps to children as young as eight years old.

Terrain Models: A Tool for Experiential Learning in Geography and Mapping

Sam Brian, Bank Street College of Education, Geog. & Mapping Institute

This paper will present a cognitive model for understanding how elementary school children come to associate the graphic symbols of maps with the concepts and phenomena of physical and human geography. Terrain models will be presented as a tool with which teachers can develop certain geographical concepts, including landforms, compass direction, elevation and drainage. Map making projects will be presented as a means to connect the three-dimensional and dynamic phenomena of the terrain model with the graphic symbol language of maps. There will be a slide presentation of student work with terrain models and map making projects.

Friday (1:30 - 3:00 pm)
SESSION J: Automating Map Resources and the Internet

World Wide Web Resources for Cartographers

Jeremy Crampton, George Mason University

Cartographers and geographers have an opportunity to take advantage of an exciting capability that can be of benefit to both research and teaching. This opportunity is provided by the world wide web; a highly interconnected set of multimedia information. The advantages of the web lie not only in its ease of use and multimedia capabilities (text, graphics, movies, audio and interaction) but in its basis on hypertext. Hypertext is most easily described as non-sequential, reader-guided browsing of information as compared with linear, author-guided reading of traditional texts (e.g., books). This paper first describes and explores the implications of the web before going on to review some of the burgeoning resources for cartographers. I have provided a cartography resources web site for users to browse <URL: 'http://geog.gmu.edu/gess/jwc/cartogrefs.html'> which is registered with the MIT-based W3 Consortium's Virtual Library (a project to catalog a wide variety of resources). Lastly, I'd like to introduce two exciting web projects; the Geography Virtual Department (UT-Austin) and the Bosnian Virtual Fieldtrip (GMU). The Virtual Department is nothing less than a project to make an entire geography curriculum available online (including cartography), while the BVF is a web-based, map-intensive virtual fieldtrip to learn about and encounter the situation in Bosnia.

Putting Cartography on the Internet: The Alexandria Digital Library Project

Barbara P. Buttenfield, Christopher Weber, Ming-Hsiang Tsou, Patricia Trawinski & Victor Ricci, NCGIA

To service those who need digital data, new products appear with increasing frequency, and one can access increasing quantities of geographic data on the Internet. Paradoxically, as more data become available they become more difficult to locate, to download, and to certify as valid. A major challenge in the coming decade will be to enhance the accessibility, communication and use of geographic ally referenced data. The Alexandria Digital Library Project is implementing a software testbed delivering comprehensive library services to browse and retrieve maps, imagery, historical air photos, and other georeferenced digital data distributed on local, and wide-area (Internet) networks. A working prototype of the Library is complete, and user evaluation plays an important role in testing the effectiveness of current software functions. The current interface design embeds online

user evaluation mechanisms, including object oriented interactive logging and user dialog functions. Every time a user clicks on a menu item, button or tool, the action is recorded and time-stamped. Users are informed of the logging and provided a questionnaire to critique the Library software and interface. Logs and response s are analyzed to guide interface refinement. The intention is to create a working Internet map library environment, to monitor use patterns and use error patterns, and to increase the response rate by collecting questionnaires via Internet protocols. At the conference we will demonstrate the system, showing how logging and questionnaire data are collected and analyzed. In addition to presenting a paper, we intend to set up a working version of the system, to get feedback from conference participants. If Internet connectivity is not available, we can arrange to bring a snapshot of the software running on CD-ROM to demonstrate the Library.

Bending the Rules: Creatively Adapting Library Systems to Automate the Map Collection

Paige Andrew & Melissa Lamont, Penn State University

Map collectors have struggled to establish and maintain efficient storage and retrieval methods for large map series. The U.S. Geologic Survey's series of 7.5 minute topographic quadrangles is a particularly compelling case. Organizing and accessing a series comprised of more than 53,000 individual current sheets, and countless historic editions, is a monumental task. Even with the incorporation of computer technology, the maintenance of this widely used set has remained something of a problem in many map collections. At the Pennsylvania State University Library's map collection we have utilized the Innovacq Serials Control System, a subset of the Innopacq computer catalog program, to automate acquisitions and historic holdings of this unwieldy series. Penn State's map collection includes nearly 150,000 1:24,000 scale topographic sheets, and numerous other topographic sets including other USGS map sets, and Canadian and European topographic sets. Innovacq allows us to record both sheet level and edition information, potentially for all large map sets. This presentation will feature the arrangement of the on-line catalog and check-in records created for the project, overall system functions, and personnel requirements. Longterm impact and planning for a project of this size and complexity will also be discussed. This is the first use of Innovacq software for organizing large map series, a unique solution to an old problem.

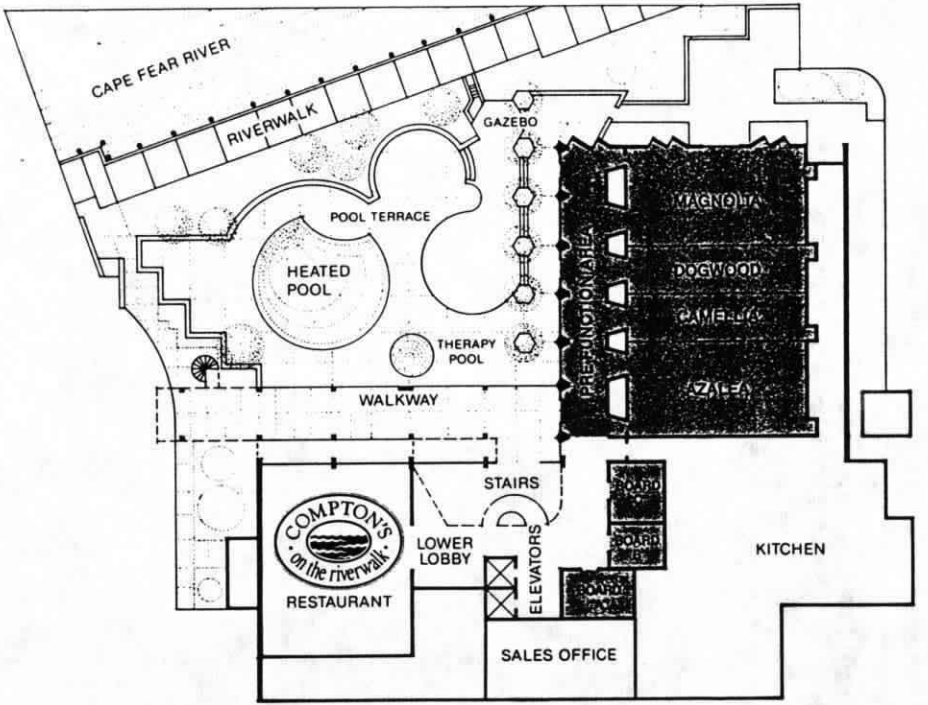
Friday (3:30 - 5:00 pm)
SESSION K: Mapping in a Child's World II

Map Skills in Quebec's Elementary School Curriculum

Jacqueline Anderson, Concordia University

In the context of the elementary school curriculum in Quebec, Canada, this paper examines how educators have approached introducing, teaching, and reinforcing the concepts required to enable children to work with the various maps the children are expected to use between Kindergarten and Grade 6 (5-12 years of age). The investigation looks at the stated curriculum objectives and provides an overview of their translation into classroom activities and associated teaching materials. The strengths and weaknesses of the current approach are also examined.

FIRST FLOOR



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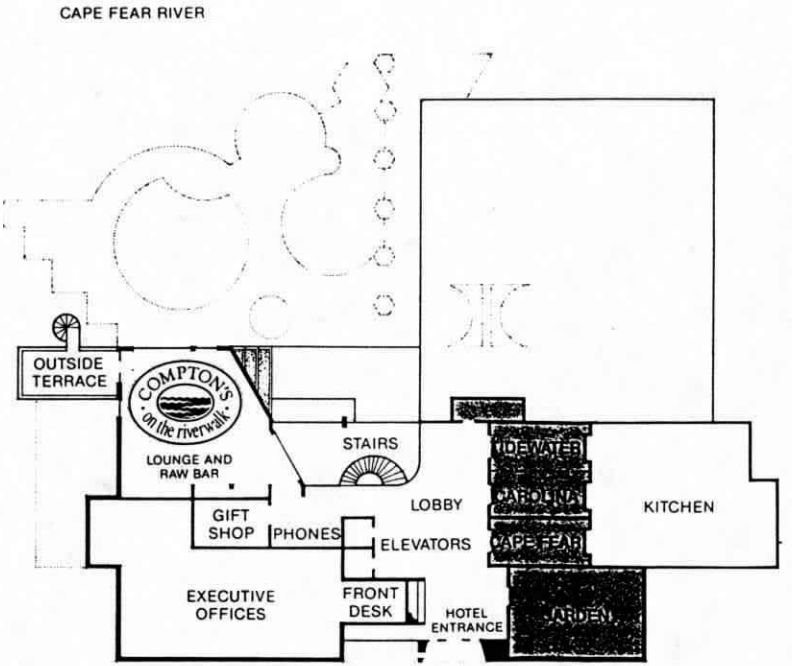
SECOND FLOOR



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