

in people's lives, describing one vision of space without allowing responses. Aberley seeks to reverse this situation, imagining a future world in which "reinhabitants will not only learn to put maps on paper, maps will also be sung, chanted, stitched and woven, told in stories, and danced across firelit skies." The use of maps for local empowerment that Aberley advocates deserves attention.

The difficulty we have with Aberley's book, however, lies in the extremeness of his bioregional philosophy and the inherent contradictions and inconsistencies which are pervasive throughout the text. He is not calling for a multiplicity of maps but for a specific, bioregionally appropriate kind of map. Mapping is supposed to help reinhabitants locate where the status quo has control over the environment and how that control may be undermined. Maps of reinhabitants and native people are good and have value, and those of the status quo are evil and of value only to the extent that they may be appropriated to create bioregional maps. Likewise, the "natural" environment is good and should be protected, and the artificial, built environment is harmful (the only essay which doesn't seem to adhere to this is the section on "Common Ground mapping"). Technology is good only when it is in "the right hands." Further *a priori* assumptions exist with regard to data and its interpretation (Aberley, throughout the mapping primer, tells us how we should be feeling while making our maps) and the route of action that must be taken when the maps are made (as demonstrated by an activist interpretation of the gap analysis technique).

What makes Aberley's agenda particularly frustrating to read is that he simultaneously advocates projects and philosophies which

directly contradict his bioregional dogma. For example, all of the mapping projects rely on either government base maps, professional cartographers, or GIS experts for their mapping needs; in other words, the same egghead scientists against whom Aberley has warned us. When Aberley bemoans the "specialists who wield satellites," then lists an atlas of satellite imagery in his compilation of inspirational texts, we are left wondering what to think.

These types of contradictions are most prevalent when the subject is GIS. Both Snyder and Doig mention specifically that they are working with ESRI products for their GIS. This strategy seems particularly antithetical to the bioregional philosophy because it requires high-end and expensive hardware and software. The contributors do not seem to make the connection that the industrial infrastructures that they seek to replace, the "incessant development juggernaut," are the same institutions which have made GIS possible and continue to support it. Further, the maintenance of a GIS does not always encourage immersion in the bioregion: Snyder reports in the Yuba Watershed study that Arc/Info comes with a watershed boundary definition tool. If Arc/Info is defining the extent of the bioregion, who is doing the mapping in this project?

Despite these criticisms, *Boundaries of Home* fills a need for cartographic information in the bioregional movement, and in this task, it is successful. It promises to be an inspiration for some interesting mapmaking. For those of us outside bioregionalism, it remains a thought-provoking book. Obviously, this is not the first time that cartography has been brought to task for its oppressive nature, and it probably will not be the last. It is, however, one of the few instances in which the charges have

come from outside the academic walls. We as cartographers should consider seriously the charges levied against us. How can we make mapmaking more accessible, less intimidating? How can we encourage people to define their own cartographic voices? How do we find our own?

At the same time, Aberley's book might have some unintended consequences. The maps which Aberley inspires may portray other versions of reality: complexities of responsibility and connection that were once believed simple, shades of gray where formerly only black and white were perceived. The lines of power and disempowerment may turn out to be as difficult to disentwine as the lines determining the bioregions, and the web that supports the status quo may lead, unsettlingly, to every bioregional doorstep. □

BOOK REVIEW

Visualization in Geographic Information Systems

Hilary M. Hearnshaw and David J. Unwin (eds.). Chichester: John Wiley and Sons. 1994. 243 pp. Cloth, price \$89.95. (ISBN: 0-471-94435-1)

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Visualization in Geographic Information Systems is an explicit attempt to link developments in cartography and visualization to geographical information systems (GIS). The editors define visualization as a mental process as well as a set of methods which aid the process of visual data analysis. Cartography serves as a precursor

of and foundation for visualization in this context. *Visualization in Geographic Information Systems* is a somewhat unusual hybrid. It arose out of a workshop/conference held in 1992, but it is not a typical conference proceedings. Contributors, which included geographers, cartographers, and computer scientists, submitted working papers to all attendees before the conference for comments, presented the papers at the conference, and then split into working groups (which mimic the four main sections in the book) to further critique and modify the original papers. The results of these modifications (including introductory comments for each of the sections) were then re-presented at the end of the conference and modified after the conference. The result is this book, which is much more coherent than most conference proceedings and even many edited collections of papers. Considering the fact that the territory covered in the book—the relations between visualization, cartography, and GIS—is largely unexplored, the manner in which this book was conceived and executed is both creative and innovative. *Visualization in Geographic Information Systems* provides a viable point of departure for cartographers grappling with an expanding role in geographical analysis and for experts in GIS who are beginning to seriously consider the advantages of visualization as an analytical method in GIS.

Visualization in Geographic Information Systems is divided into four main sections: "Visualization in GIS," "Advances in Visualizing Spatial Data," "Visualizing Data Validity," and "Human Factors in Visualization." Each section is preceded by a jointly-authored introduction that summarizes trends and developments in the topical area and introduces the papers which follow. The first

section, "Visualization in GIS," seeks to relate traditional cartographic knowledge to current issues in visualization, link general visualization issues to GIS, and review available visualization software. M. Wood's paper opens the section with a plea to recognize that the traditional paper map has long served as a mental visualization tool and that there is existing cartographic knowledge that is of value to current research on visualization methods for GIS. M. Visalingam reviews the somewhat confusing terminology that pervades the topic of the book (visualization, ViSC, visualisation, visual representation, visual display, etc.), suggests how cartography is related to current issues in visualization and GIS, and concludes with a list of problems which are limiting the use of visualization in GIS. A. Turk introduces the idea of cognitive task analysis in optimizing GIS visualizations, reviews a number of different taxonomies that can be used to organize and guide visualization design, and suggests that research needs to focus on developing such taxonomies as guides to selecting appropriate GIS visualizations. K. Brodlie summarizes a computer-science-oriented approach to the process of visualization, which he terms "the visualization pipeline"—the flow from raw data, through data filtering and enhancement, modeling, and rendering of the visualization. J. Gallop concludes the first section of the book by classifying a variety of visualization software packages.

The second section of *Visualization in Geographic Information Systems* seeks to review advances in visualization methodologies, including issues of audience, abstraction, interactivity, and new technologies (sound, multimedia, virtual reality). I. Bishop reviews the role of visual realism in GIS visualizations, discussing benefits

and some applications of realistic simulation and modeling in geography. A. Gatrell reviews available methods for transforming distributions of point (x,y) data into continuous surfaces and describes a method for performing such a transformation in the context of GIS visualization. I. Bracken critiques the dependence on zonal (choropleth) maps in cartography and suggests the georeferenced grid as a more viable method for visualizing socioeconomic data. D. Dorling critiques the traditional plan map as an "equal-land" cartogram that is not particularly appropriate for visualization in human geography and details several methods that incorporate both cartograms and complex multi-variable symbols (Chernoff faces, trees, etc.). J. Dykes describes methods for maximizing spatial association on choropleth maps and visualizing autocorrelation. A. MacEachren reviews and elaborates research on time as a cartographic variable, describing a set of dynamic variables and a series of applications that incorporate the dynamic variables. S. Openshaw, D. Waugh, and A. Cross conclude the second section of the book with a review of map animation and its application to visualization in GIS.

The third section of *Visualization in Geographical Information Systems* focuses on the visualization of data validity in the context of visualization in GIS. An introductory chapter by M. Goodchild, B. Buttenfield, and J. Wood summarizes important definitions, ongoing research, and future directions for research on the visual display of data validity. B. Buttenfield and K. Beard build on this introductory chapter by describing a conceptual framework for guiding research on the visualization of data validity. M. Goodchild, L. Chih-Chang, and Y. Leung describe the concept of "fuzzy classification" and provide

methods for visualizing fuzzy maps from such classifications. J. Wood reviews methods for visualizing the accuracy of contour interpolation in digital elevation models, concluding that many useful techniques for such visualization exist in currently available GIS software. P. Fisher concludes the third section of the book with a discussion of how animation and sound can be used to represent data uncertainty.

The final section reviews psychological and philosophical issues which surround the use of visualization in GIS. C. Davies and D. Medyckyj-Scott provide a succinct review of research within and outside of the context of visualization and GIS which may assist in evaluating the human aspects of visualization, including human factors, graphic design, psychology, and ergonomics. H. Hearnshaw provides an overview of psychological literature on the physiological, perceptual, and cognitive aspects of visual displays. D. Medyckyj-Scott applies ideas from the field of human-computer interaction studies to visualization and GIS. J. Petch concludes this final section of the book with a discussion of some philosophical issues that underpin visualization as a method and a means of knowing (epistemology) in geography.

Visualization in Geographic Information Systems seems appropriate for several audiences. On one hand, it could be used in an advanced undergraduate or graduate course on visualization and GIS. The succinct chapters are, for the most part, straightforward, easy to read, and raise numerous issues for research and discussion. The cost of the book, however, may preclude it from being adopted as a course text. On the other hand, an academic audience should also find the book useful. Interesting points of contention arise between different

authors and raise interesting questions. For example, while Bishop contends that the value of realism in visualization is that such realism is "the nearest we can achieve to direct experience" and that it is "more orientation free" and objective than more abstract data and ideas, Dorling asserts that such "physical" realism is at odds with "human" realities which are better represented with abstract cartograms and multi-variate symbols.

Another conflict is revealed in Goodchild, Chih-Chang, and Leung's chapter on "Fuzzy Maps." The authors argue that the cartographic processes of generalization, abstraction, exaggeration, simplification, and classification cause uncertainty. Goodchild et al. conclude that cartographers have not paid attention to representing uncertainty because of the "desire not to confuse the process of communication" and "a willingness to portray the world as simpler than it really is." This contention is contradicted by other authors in the book (such as when Fisher reviews traditional cartographic methods for representing uncertainty) but raises a serious issue: the power of maps arises out of their ability to generalize, abstract, exaggerate, simplify, and classify the "real world." Goodchild et al. imply that such cartographic manipulations are somehow deceptive and impede understanding of the complexity of the "real world." Such differences between GIS practitioners and cartographers will obviously have to be explored in more detail.

Finally, Petch's chapter on epistemological aspects of visualization provides a somewhat peculiar end to the book. Petch closes his chapter with the supposition that, as geographic ideas, theory, and laws are at best poorly developed, attempts at formalizing spatial thinking and logic in the

context of visualization and GIS will be difficult if not impossible. Petch concludes that the "progress of GIS visualization . . . rests principally on developing geographical ideas." While I agree wholeheartedly, it is strange to finish a book so focused on particular techniques, technologies, computer algorithms, equations, graphic taxonomies, abstractions about data validity, and psychological methodologies with the call for a focus on geography. Petch thus raises an important issue that is left relatively unexplored in the book: namely, how does the method (visualization and GIS) relate to its substantive context?

Visualization in Geographic Information Systems serves as point of departure for cartographers who are coming to grips with new technologies in geography—such as GIS—as well as the expanding role of visual methods in geographical analysis. For the most part, the book's authors are open and fair to cartography's past and are quite willing to borrow and apply traditional cartographic methods within the context of visualization and GIS. Yet, most of the chapters suggest that visualization is not necessarily what cartographers have always done, that visualization is more focused on the process of geographical analysis rather than the process of communicating a given message, and that this difference implies many new research challenges. At the same time, the book can serve as an introduction to experts in GIS who are beginning to seriously consider the advantages of visualization as an analytical method in GIS. The value of traditional and emerging research in cartography in shaping visualization in the context of GIS is made clear, and GIS experts who have been primarily concerned with non-visual analysis will undoubtedly find something of value in the book. □