Talking in the Tree House: Communication and Representation in Cartography

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John Sherman was a teacher. He was tireless and patient in the classroom, and always approachable for one-on-one discussions of cartography in a cluttered fifth floor office whose windows opened into the crowns of a leafy wooded quadrangle. John's office had the feel of a tree house to me, and I learned as much sitting with John in his tree house as I did in lectures or working with him in the darkroom. One day he said that cartographic representation must be based in communication. I misheard him, and asked how representation could be biased by communication. He was thoughtful for a moment, and then came that wonderful ear-to-ear grin and the comment "Well, yes, in cartography both statements are probably true".

The communication basis for representational principles in mapping is easy to demonstrate. Take the example of assessing a representation's fitness for use. Fitness for use can be established inferentially by assessing positional accuracy, attribute accuracy, logical consistency, etc. (Guptill and Morrison, 1995) Fitness for use can be established empirically by determining response time and percentage of correct answers to a specific task. In both cases, the point is to document that the represented information is communicated as the map user expects it, for a given application.

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Shannon and Weaver's (1963) determinist model establishes the effectiveness of a representation by measuring 'information loss in the communication channel'. In contrast, Kevin Lynch's (1960) model is behaviorist: errors in a navigational representation don't matter in the end, so long as the communicated information is 'sufficient to get a person home'. John Sherman embraced both as operable models in his lectures on compilation, symbolization, and generalization. But his perspective was humanist: to insure effective communication, cartographers might purposely introduce measurable flaws of size and shape and color, positional displacements, or texture exaggeration, in order to compensate for map readers' documented perceptual and cognitive limitations.

Clearly, John was not the first to recognize that map communication can be improved by biasing the representation strategy. A long history of literature reporting task performance studies in the very short cognitive bands (microseconds) threads back to numerous experiments by S. S. Stevens (1946). The advent of disciplines such as Cognitive Science and Human-Computer Interaction has extended studies of task performance into longer cognitive bands (seconds to minutes). The point of John's comment (that communication forms a basis and a bias in map representation) underscores the paradox of cartographic design. Communicative bias can in fact improve the effectiveness of a map representation. I didn't fully appreciate his comment then, but subsequently, I have come to realize that we cartographers are in a business of deceit. Moreover, it is our responsibility to deceive as many map users as possible, and as often as possible. No wonder John was grinning!

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This particular tree house talk changed direction, to consider generalization of map features. What relationships can be established between representation and communication, what biases? Generalization differs from symbolization with respect to scale; that is, the point of a generalization strategy is to carry a map representation across a range of scales, preserving either geometric information, topologic relations, or visual logic (i.e., the information by which a feature is recognized). It may help readers if I narrow the focus of my recounting to specific types of cartographic features. Three currently prioritized cartographic data themes in the United States mapping community are hydrography, terrain, and transportation (Clinton, 1994).

Traditional (manual) cartographic depictions of hydrography and terrain relied heavily upon an understanding of the underlying geographic (particularly geomorphic) processes that had formed them (e.g., Imhoff, 1982; Raisz, 1948; Pannakoek, 1962). Representational criteria were intuitive, and required a good deal of artistic talent. The objective was clear, however. Features compiled on a map at a given scale must represent the spatial processes that should be evident if one viewed the real landscape from a distance producing a view at that scale. With changing scale, different spatial processes become evident, and the criteria for feature compilation must vary accordingly. Features are represented on the map to communicate the evidence of process within a particular range of map scale.

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As digital storage of geographic features came of age, strategies to automate feature representation drew from theories in computer science (e.g., Ballard, 1981), applied mathematics (e.g., Mandelbrot, 1982; Carpenter, 1980), and computational vision (e.g., Davis, 1980). Theoretical approaches tended to lose sight of the context of scale in developing representational strategies, although they still prioritized communication. For example, Nackman and Pizer (1985, p. 187) distinguished 'a representation' from 'a description' of an object on the basis of how much information is encapsulated and thus available for communication. "An object representation contains enough information from which to reconstruct (an approximation to) the object, while a description only contains enough information to identify an object as a member of some class of objects."

However clever our computational skills become, without acknowledgment that geometry, topology, and appearance vary across scale change, any representation strategy will be biased for some depictions. This is because a representation cannot communicate evidence of different spatial processes utilizing a single set of details over and over again. Scale-dependent map compilation remains one of the most important challenges for automated cartography, is what John said. He encouraged me to work on scale-dependent bias for dissertation research (Buttenfield, 1984), and invited Tom Poiker (Peucker, 1975) to join us for computational advice and vision. John's statement was true in the late 1970's, and nearly twenty years later, it is still true, in spite of great progress by many cartographers around the world. It's a very difficult problem. I believe that John understood that, and understated it. I'm so grateful for both. It's easy to stay on a difficult path once some forward progress has been made.

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So here is a recollection of one tree house talk with John Sherman. It did not occur in the space of a single day, or week. It surfaced and disappeared through discussions about other topics, and led me in those and following years into the literature of fields that some would argue lie well beyond the confines of map design and generalization. My recounting of this particular tree house talk is embellished by subsequent readings (I left Seattle in 1982), and by a decade and a half of reflection, collaboration with other colleagues, and my own continued learning. What has not been embellished is my awe and affection for John's ability to let our tree house talking wander all over the place, without losing sight of the prophetic theoretical thread. His ideas have guided my research all these years; and there is much more to work through yet. Yes indeed. John Sherman was a teacher.

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