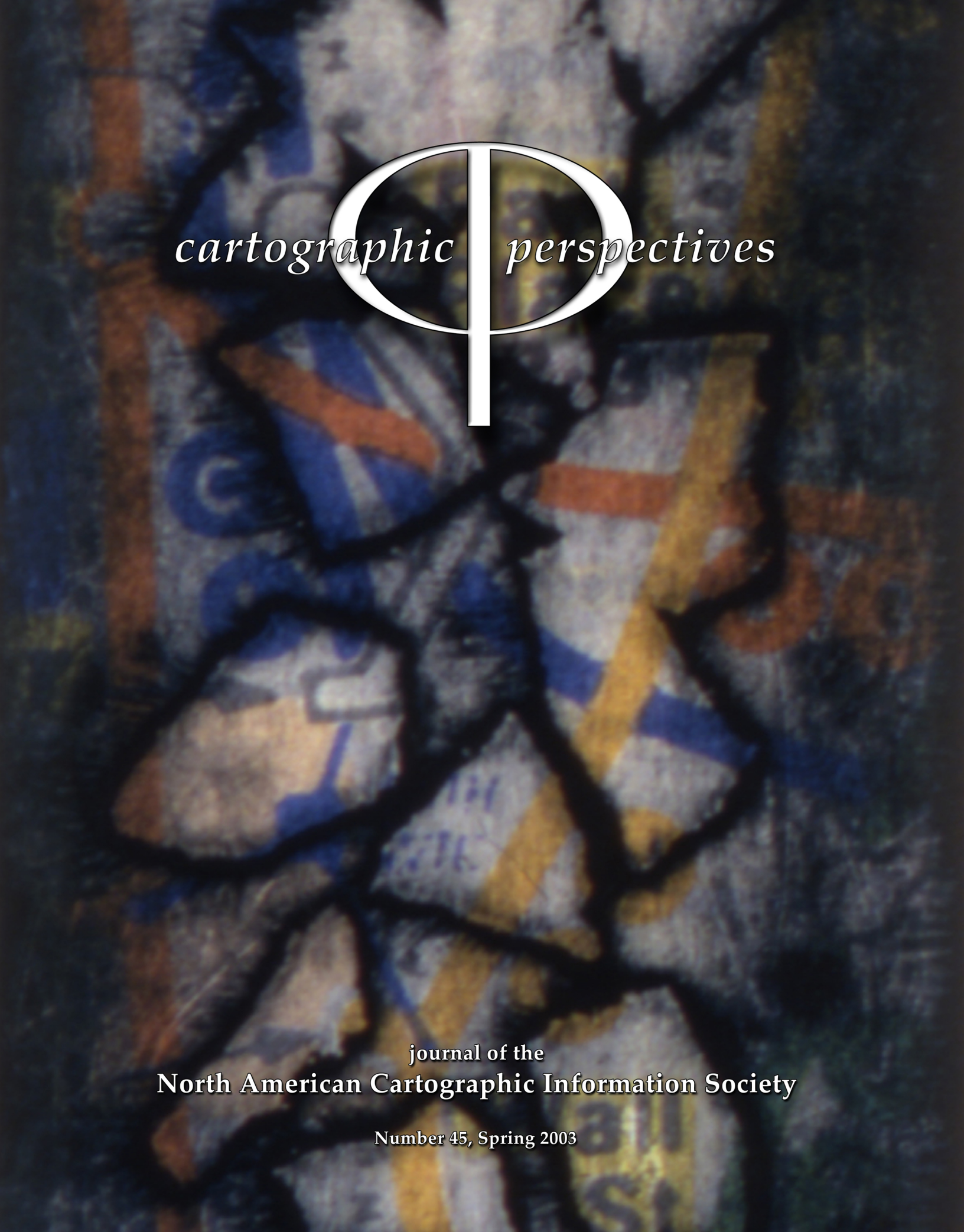

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Number 45, Spring 2003

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cartographic perspectives

Number 45, Spring 2003

in this issue

Letter from the Editor

Dear Members of NACIS,

The last issue of *Cartographic Perspectives*, the Atlas Issue as we so fondly call it, sported a new look for its cover. Matt Knutzen from the New York Public Library (NYPL), and NACIS member for the past three years has agreed to publish his artwork as the cover of *CP*. Matt has a BA in geography from UC Berkeley and an MFA in art from Pratt in Brooklyn. Between his BA and MFA, Matt worked at Eureka Cartography and Benchmark Maps. Matt's current position at the NYPL is Assistant Chief of the Map Division, which taps into his broad knowledge of practical cartography and of modern and historical printmaking and bookbinding. In his words, Matt "draws inspiration for [his] artwork from numerous wells; from intellectual sources; i.e. semiotics and deconstruction as they apply to the dissemination

(*continued on page 3*)

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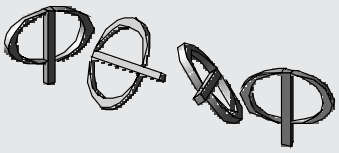
about the cover



The cover image, titled Subway Map was created in the spring of 2000 by Matt Knutzen, artist, cartographer and Assistant Chief Librarian of the Map Division of the New York Public Library.

In this image, the chaotic is superimposed onto the rationalized. The dark foreground was created using traditional copperplate etching taken to an extreme: the usually controlled technical processes were allowed to run their natural course, resulting in a deeply etched, corroded abstraction. The plate was printed onto a NYC subway map. The image is a meditation on the ever-changing, transmutable nature of geography, and simultaneously a challenge to the authority of the map.

of geographic information ([he] like[s] to invert the

"cartographic gaze") to the non-rational; i.e. the map as metaphor for finding one's way on the path (life/spiritual)…the map as symbolic of the process of self understanding". These covers will be unique to *CP*, and will only serve to enhance the uniqueness of our journal.

I am excited about this particular issue of *CP* for a number of reasons. First off, it carries an opinion column from Denis Wood. The title of his piece is *Cartography is Dead (Thank God)*. I sense that you are all sitting up a bit straighter now. It is a piece that is sure to challenge most anyone's thinking, especially those who cling to the label of "cartographer". Grab yourself a stiff brandy and give it a read.

Second, this issue of CP departs from tradition in that it has only one paper—one long paper—that I am guessing will be provocative to the readership of *CP*. The title of the paper, *Cartographic Design: Rhetoric and Persuasion*, comes to us from Mark Denil at the GIS and Mapping Laboratory, Center for Applied Biodiversity Science at Conservation International. Rather than trust what I might have to say about this paper, let me instead share comments from the reviewers of this piece for you to consider:

"I think this is the right time for something like this. The combination of edginess, and hands-in-practice and head-in-theory and pride, and wistfulness make for a really fresh attack on the space where making maps and thinking about them collide. I really welcome this voice…because it's free of the suspicious, ironical, cautious, sophisticated, superior tones that came to academia on the postmodern wave. It's: "I make maps. How can this stuff speak to me?"

and:

"It makes a strong argument for the integration of Gestalt Psychology, semiotic theory, communication theory more broadly, and the theory and language of art and art appreciation as on overarching framework for understanding and guiding cartographic practice… what is interesting and new about this paper is that it brings together other insights, from [these] quite different disciplinary traditions to say something more specific and detailed about [map design]."

Those comments really do say it all. Mark's paper, I suspect, will be a welcome addition to the cartographic literature. I hope that you find this paper as thought provoking as I, and the two reviewers did.

We are putting together the 3rd and final issue of CP for 2003, and the first issue for 2004, the Practical Cartography issue, is well underway and should be completed and off to the printer by the end of February, 2004.

As always, I welcome all comments about *CP*. Please consider *Cartographic Perspectives* as an outlet for your work.

Warmest Regards,

Scott Freundschuh

Cartography is Dead (Thank God!)

Denis Wood
Independent Scholar

Cartography Is Dead (Thank God!)

Let's admit it. Cartography is dead. And then let's thank our lucky stars that after **the** better part of a century mapmaking is freeing itself from the dead hand of academia.

That's the crux of the matter: even as cartography was shanghaiing mapmaking, university geography departments were shanghaiing cartography. Some mapmakers were happy to "upgrade" their calling by shedding the craft implications of "making" and taking on the title of "professor," but in general mapmaking imperatives were too universal to be constrained this way and so, no matter how badly university-based cartographers demanded it, few noticed, and even fewer paid attention to the attempts to make mapmaking a profession. Throughout this period - which we might call the Age of Cartography - people with every kind of background continued to make every conceivable kind of map. Today it's harder and harder for even cartographers to pretend they have much relevance.

How many people attended NACIS XXIII? A hundred-fifty? I've been told that *11,000* people took part in the most recent ESRI user's conference. Mapmaking? *By all means!* Cartography? *What's cartography?*

But then, easy come, easy go.

When I tell people cartography's not much better than a hundred years old they stare at me like I'm crazy. Pointing to words like "prehistoric," "ancient," and "medieval" in, for example, the title of the first volume of the Harley and Woodward *History of Cartography* they ask me, "What are you talking about?" The facts are simple enough: as far as we know "cartography" was coined as a Portuguese neologism ("cartographia") by the Viscount de Santarem in 1839. Helen Wallis and Arthur Robinson say that the word "was quickly picked up and applied to the making of maps," and that "mapmakers were soon calling themselves cartographers." In fact, "cartography" is not attested to by the Oxford English Dictionary until 1859, "cartographer" not until 1863, "cartographic" not until 1880 (in the phrase "the cartographical art being only in its infancy"), and "cartogram" not until 1890 (and not in its modern sense until 1934). The word seems only gradually to have caught on, in fact, precisely as the subject to which it referred was making its way into the halls of academe. Imagine trying to justify a faculty position in "mapmaking." "Cartography" sounds *so* much more respectable.

In 1962 Erwin Raisz pointed out that, "In 1920 there were only two universities giving courses in cartography. At present the number is well over a hundred." As we know, the number continued to rise into the early 1990s, when it began to decline. The signs are everywhere that this decline will accelerate. I'm betting that none of the positions currently occupied by cartographers will be filled with them once they fall vacant. Cartography will turn out to have been a mid-twentieth century phenomenon.

The *field's* dead. We're just waiting for the death rattle. The *word* will stick around a while (words do), but its day is passing too.

It has to. Take its use in phrases like "the history of cartography" or "cartographical innovations." Applied to mapmaking prior to 1839 - to pick the earliest *conceivable* date - the word is at best anachronistic, at

worst unpardonably presumptuous. Conflating the history of mapmaking with that of cartography is like conflating the history of walking with that of the automobile. Were the history of the automobile written like we write the history of cartography, volumes of it would be devoted to the invention of sandals, of shoes. It's not just silly, it denies the novelty of the innovation when it arrives. If "cartography" does survive, it will only be to refer to the practice of academic cartography in the twentieth century.

Not the nineteenth?

No, the word was too new then. It was still searching for its proper subject and form. It had yet to entrench itself. This only happened once those calling themselves cartographers entrenched themselves in universities and the related government bureaucracies.

Mapmaking didn't endure this professionalization alone. What happened to mapmaking happened to a range of practices as part of a general professionalization, an "embourgeoisment," of what we might call the "white collar" trades. Apprenticeships vanished to be replaced with schooling. Names were changed. They were Latinized. Gravediggers became morticians. Newshounds became journalists. Teachers became educators. Sawbones became doctors. Mapmakers became cartographers. Ivan Illich refers to the middle of the twentieth century as The Age of Disabling Professions, "disabling" because the professionalization of so much life-work tended to disable non-professionals from imagining they could ... bury a body, start a newspaper, teach, care for their own health, make a map.

To give a perfectly parallel example, it was in the middle of the nineteenth century that Frederick Law Olmsted and Calvert Vaux coined the phrase "landscape architects" for themselves. "Landscape architect" caught on as a way to designate those who designed gardens, parks, campuses, residential precincts, even cities. In 1900 Harvard created the first landscape architecture department. The number of departments increased only slowly, but it exploded after World War II. Soon enough histories of landscape architecture were being written. Need I say that these historians discovered prehistoric, ancient, and medieval landscape architecture? Today landscape architects too are falling on harder times as civil engineers, architects, city planners (who broke from landscape architecture in the 1920s), park and playground designers (from new schools in forestry and natural resources), gardeners, earth artists, and others take on the design of gardens, parks, playgrounds, subdivisions, cities.

Strong professions organize to prevent the practice of their mysteries by outsiders - Illich thinks about professions as cults - by conning legislatures into passing licensure laws. Weaker professions settle for certification programs. The weakest get along as they can. It's against the law to practice law or medicine without a license. Public school teachers and accountants need to be certified. *Anyone* can call him- or herself an interior decorator or a cartographer. But all professions alike repel threats to the integrity of their professionalism by denigrating nonprofessional work as at best incompetent, and at worst as dangerous, threatening, even evil. Since the plain fact is that almost all maps are, and always have been, made by nonprofessionals (at least nonprofessional *cartographers),* cartography as a profession has been comparatively quiet about the quality of nonprofessional work. It has generally contented itself with encouraging what it has seen as good. But when threatened, it has responded with full professional hauteur.

Classic was its reaction to the Peters' map. Arno Peters' map was ignored until its prominence and sales soared. Then it was attacked on all

fronts: the map was ugly, the projection was stolen, and Peters wasn't a cartographer but (gasp!) a journalist-propagandist for (double gasp!) leftist causes. When this strategy failed to stem the map's growing popularity, the American Congress on Surveying and Mapping issued a fatwa against not just the Peters' but all rectangular world maps. This had the useful effect of damning the Peter's along with the Mercator (which Peters was using as a straw map to advocate for the superiority of his own projection), while seeming to attack neither. The feint fooled no one: *in order to castigate the Peters ' and the Mercator, the ACSM was prepared to excommunicate an entire class of projections.* Nearly the entire profession endorsed this idiotic resolution. Signing on were the American Cartographic Association, the American Geographical Society, the Association of American Geographers, the Canadian Cartographic Association, the National Geographic Society (but not NACIS). The resolution's complete lack of effect - its *laughable* lack of effect - demonstrated to one and all *how little authority the profession had.*

This was in 1989. It was, in its way, the death knell of the profession. GIS and ESRI just rolled the corpse over the cliff.

The whole episode in its rigid prissiness - whose holier-than-thou tone attracts professional apologists even today! - made it really clear why the profession had to go: it was in the way. *Of what?* Of the ongoing evolution of human - not cartographic -mapmaking. The thing is, when it comes to mapmaking *there are no outsiders,* no more than there are outsiders when it comes to speaking or writing English. These are birthrights of the members of our society, who acquire the ability to speak and make maps as they grow up in it. Speaking and mapmaking are not like open-heart surgery or professional basketball which do require specialized training and years of practice. You can't just step into the shoes of an NBA player and expect to score. You can't just claw your way into your friend's chest and repair her heart no matter how insistently her situation calls for it. But when a communication situation calls for speaking or making a map, you can just open your mouth (or attack the keyboard) or pick up your pen (or your mouse).

I have no interest in denying that specialized training and years of practice can transform stumbling speech into eloquence, or a crude sketch map into a penetrating analysis; but surprisingly, training and practice are no guarantee of either. What seems to promote both are situations that call for them and people who are willing to rise to the challenge. I'm thinking at the moment of Gwendolyn Warren's need to map where Detroit commuters ran over black kids on the Pointes-Downtown track, but I could just as easily be thinking of John Snow grappling with the nature of cholera or Tom Van Sant with the fragility of the earth. I could be thinking of Joseph Minard's compulsion to map Napoleon's losses on his Russian campaign or of Woody Sullivan's to map the earth's electromagnetic radiation (and so produce the first map of the earth at night). I could be thinking of Buckminster Fuller's Dymaxion Map to which he was driven by his conviction that "spaceship earth" required a new way of being seen if its global reality were to be grasped, but I could as well be thinking of William Smith's "Delineation of the Strata of England and Wales with Part of Scotland" to which *he* was driven by *his* conviction that the earth required a new way of being seen if its *geologic* reality were to be grasped. I could be thinking of Kevin Lynch's "mental maps" of Boston, or of Harry Beck's map of the London Underground, but just as easily -

It's a long list, this of landmark maps made by people who were anything but professional cartographers, who were, in the cases above, "a black person of Detroit," a man of medicine, an artist, an engineer, an astronomer, a designer/engineer/architect/ visionary, "a canal digger,"

an urban planner, an engineering draughtsman ... The communications situations they found themselves in called for maps and, as humans in map-immersed societies, they made maps in response. Thousands and thousands and thousands of mapmakers, trained in anything but cartography, do this everyday, many of them making their living at it, and many of the maps they make are as fine as any that have ever been made. Some of them, like the examples above, are sure to change the way we think about the world, and about maps.

There's a lot that cartographers have learned that is useful and valuable -1 have no interest in belittling the positive contributions made by the generations of academic cartographers - but there's a lot that was dead wood to begin with, and is so rotten today it's threatening the rest of it. All the prescriptive bullshit, every map must have a legend and a scale - all that - ignored in fact on a gazillion effective, useful maps, all that has to stop. And design! Academic cartographers have never understood a thing - *not a thing* -about design. God knows that, as a group, the *least* interesting, *least* attractive, *least* significant maps have been made by university cartographers: all that design *talk, from design illiterates,* that's got to stop. And the hectoring of committed, driven people —*you can't change scale in a Xerox machine* - that's not helpful either. What would be helpful would be to offer professional *assistance,* on bended knee if necessary, to all the people trying to ameliorate their situation by mapping it: the First Peoples who have come to realize it's map or be mapped; the impoverished locals trying to grapple with the impact of transnational mining, logging, and industrial development; people concerned about the rapid deterioration of their environment; people trying to get a handle on the concept of place ...

Cartographers played a significant role in making the world safe for colonizers, mining conglomerates, and the military. We need to pay a little back. There's no saving the profession. *It's* over. But as it fades away there's still an opportunity to leave a legacy we could contemplate without shame. That can't be beyond our reach.

For twenty-five years Denis Wood taught landscape architecture design studios and the history of landscape architecture as a professor in the School of Design at North Carolina State University. His Five Billion Years of Global Change *was just published by Guilford Press.*

Cartographic Design: Rhetoric and Persuasion

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I. INTRODUCTION

My concern is with maps. Maps, that is, in general and in particular with their physical manifestation, with ink on paper. It is my intention to come to a broad, workable understanding of the nature of maps, mapping and cartography. Not perhaps anything so grand as a theory but instead a convention, usable and useful in daily practice.

Maps, in our society, are ubiquitous; they enter into our lives and affect us all in ways and on occasions that are obvious and hidden, overt and subtle. We all recognize maps when we see them, and in fact we recognize such a range and variety of things as maps as to render a comprehensive definition based on typologies or outward appearances problematic. For many people maps are objects of delight and wonder, and for others they are a terror. In any case, maps are but vaguely understood by the great majority of the populace, even by those people who make almost constant use of them. This is in part traceable to the manner in which map literacy, if it is taught at all, is limited and rudimentary. As Mark Monmonier (1977) wrote, "almost all people in developed countries are consumers of maps, but they receive little formal training in map reading" (from preface). Obviously, too, this situation is not new; Thomas Blundeville (1589) wrote that "I daylie see many that delight to looke on Mappes […] but yet for want of skill in Geography, they knowe not with what manner of lines they are traced, nor what those lines do signify nor yet the true use of Mappes" (from "To the Reader").

Some parallel can be found in the words of Ezra Pound (1960, in a treatise on metre): "fortunately or unfortunately, people CAN write stuff that passes for poetry, before they have studied music" (p 197). This same lack can be discovered, perhaps surprisingly, in more than a few mapmakers. John Belbin (1996 p 253), formerly of the College of Geographic Sciences in Nova Scotia, has observed that there seem to be two groups of people involved with cartography, groups which I will call the academicians and the workers, with most of the activity of the former little touching the toils of the latter. Much of my own professional activity as a cartographer is carried out as guide and resource to a pool of worker types, people for whom mapmaking is little more than a job of pleasing their customers; clients who themselves in turn have very little notion of what should be expected from the maps they commission. The map literacy of most people is of a very low order and even many makers of maps seem to be unaware that there is a language and vocabulary, highly developed and of long standing, associated with construction of map texts. Much is required of maps, much from the makers of the maps, and much from the map users.

What I am attempting is to come to an understanding or convention which will allow and promote the production of high quality map products, and in that way both raise the expectations of the users and make it easier for map making technicians to produce good maps than otherwise. In keeping with Samuel Johnson's (1765) dictum that "part [of any skill]

is infused by precept, and part is obtained by habit" (p 351), my aim is to provide a precept to guide the habit of the map maker. In this attempt to define the activity in practical terms, terms understandable and acceptable in a working environment not much impressed with theory, I have to begin with basics.

Maps are constructed in order to carry meaning, that is, to carry or convey some sort of information to some one. The map is not the mapped thing itself, not the territory, but instead it stands for that thing in some *limited* way (but *not* in *all* respects) for some person. Maps are signs and collections of signs, laying out in graphical form indications of spatial relationships or placing into spatial context other information with a locational attribute. They often employ representational devices (which may or may not be depictive), yet maps remain only a signification of the feature, configuration, relationship, or context. The strong identification with the thing signified may lead to confusion in the mind of the observer, a confusion similar to that which Jean-Paul Sartre (1962) calls "the naïve metaphysics of the image" (p 4). One is reminded of René Magritte's 1926 painting *Ceci n'est pas une pipe*, (*This is not a pipe*), where, although the imagery references enough aspects of pipe-ness, that in looking at it one's initial reaction is to recognize the image as a pipe, one cannot ultimately confute the validity of the inscription. Indeed, it is *not* a pipe, no more than Whistler's (1871) *Arrangement in Grey and Black* is Whistler's Mother, or a map of New York is New York. A map of the earth is not the earth, nor (incidentally) is it a homologue of the earth. A map of the earth is a *sign* for the earth; that is, it stands for the earth in some particular respects (but, again, and critically, not in all respects) to someone (and not necessarily to just anyone). In other words the map is a visual text, which can be read by those literate in that visual language.

"Maps are constructed in order to carry meaning, that is, to carry or convey some sort of information to some one."

It is important not to become alarmed at this use of the term *text*. A text is, in this context, any form in which a message can be devised. Sometimes we encounter literary texts, sometimes bodily, musical, visual, or other texts, and while each type is quite distinct and unique, each is in its nature and operation a message charged with some sort of meaning which must be read or in some manner interpreted for that meaning to be revealed.

As has been mentioned, the definition of what can be called a map is extremely broad. Individual maps can be as simple as a sketch of the route to the druggist's, as gaudy as a geological map, or as dense as a National Geographic insert, but nonetheless each one can be identified, used, and accepted as a map by users who can identify, use, and accept it as such. Arguably, maps are the most complex of graphic products and their function too is very complex. A map exists operationally on a variety of levels, both independently and interdependently, and these levels determine and control our attitude towards, and our understanding and use of, the map. The operational levels range from the immediate and physical to other levels more subtle and discrete.

Perhaps the most immediate level, that experienced from the first moment of encounter and thereafter, is the physical embodiment of the map as an object. This is an aspect I identify as a sculptural concern: the relationship of this object to my body. Its size, shape, and material, the way it folds or rolls and if I hold it in my hands or place it on a table or hang it on a wall all plays a part in this experience. It is about what the object is, and the way in which I encounter and interact with it. There are also mechanistic aspects of paper, ink, printing, and packaging which enter our consideration. A book or map badly printed is unreadable and less than it might otherwise be, and although the printer's craft itself is not within the purview of my project, such details of process and materi-

als use are not unimportant factors in consideration of any individual example.

The graphic complexity of the map has already been touched upon, and the existence of the map as graphic is another operational level. One source of the complexity here is the relationship between figuration and image, and the density of marks on the surface. Another is a function of the hierarchy of information, and the complex manner in which the different sets of data interact, compete, and separate on the page. There can be several very different types of thematic and contextual data displayed simultaneously, and the display of what is shown is governed by the symbolization and generalization employed, as well as by other factors.

Typographic text work can make or break a map, and it is one of the most difficult and often mishandled graphic aspects of the map. Usually there is both lettering on the map face itself and blocks of contextual or supporting text, and each must be handled competently if the map is to work as well as it can.

There should be a concern with the veracity of the data on a map. That statement is deceptively simple, but, like one of Humpty Dumpty's portmanteaus, there are two meanings here packed into one. On one level it refers to what I will call measurable truth: can one or can one not drive from Brunswick Street to Lower Water Street down George Street? On another level is the question put by Pontius Pilate: what is truth?

Maps are accepted as truthful presentations of 'reality' very readily; much more readily than, say, writing or speech, but the justification for this touching faith is a bit thin. When confronted with a map it is imperative for the reader to ask: where did this data come from? why was it generated in the first place? who chose to place it on this map? why in this way? why has it been shown at all? and conversely, what has been left out? Since any map can, at best, present only a version of a distortion of the truth (much like history, which, as Napoleon is said to have remarked, is simply a lie agreed upon), it is one task in map making to determine just what truth will be preserved; *whose* truth will be preserved; what can usefully or innocuously be distorted; in what manner; and what inconvenient or irrelevant data will be left out. The reader is presented, of course, with the converse conundrum, and s/he must in some manner decon-struct the map to try to interpret it. All maps are editorial, that is, they are rhetorical; they place before the reader a(n) (persuasive) argument. The mapmaker is trying to induce the reader to take the map on faith, to believe in the completeness of the information, the disinterested selection and presentation, the *truth* and *reliability* of the map. While this attempt is most often recognized in advertising or in political maps (usually in studies of an enemy's propaganda maps) it is an inherent aspect of all maps.

Finally then, I would mention the vehicle for delivery of all this; the means by which the text of the map is presented for examination and the way that 'all available arguments' are marshaled is in a context that is, or should be, familiar: it is the language of visual art. These are just a few of the levels on which an individual map can function and just a few of the questions and concerns which attend any map. There are more, and of course the few I have mentioned can be elaborated.

What ties these levels of operation together is that any particular map makes use of these operative levels to convey ideas with reference to an audience. In other words, a map seeks in some manner to convince someone of something. Significantly, the conveyance of ideas with reference to an audience is how Francis Bacon defines rhetoric. While it is not unusual

for a rhetorical aspect to be recognized in mapmaking, I am proposing that rhetoric is the central and defining aspect of the map. Recognizing the centrality of rhetoric, that is, of the persuasive impetus, to the map allows us to view cartography as an activity without specific subject matter: there is no 'definitive map' but instead one or more 'appropriate maps' for a given situation. Rhetoric, understood in this manner is not 'the dress of thought' in the sense of 'the *fancy dress*' but rather the '*embodiment* of thought', or 'the *word* made *flesh*'.

I propose to show how the operational levels referred to above function in support of the map as a rhetorical entity, and how the rhetoric of the map is realized through the operation of the map on the various levels. Taking the topic as a whole, I have categorized the concerns attendant to the operative levels into three main registers of approach: the *cognitive*, the *semiotic*, and the *artistic*. These registers are of course somewhat artificial and overlapping, and are adopted primarily for convenience of discussion, but they have utility. It should be noted that I am not dividing the subject bilaterally, as has often been done previously, into oppositions such as 'cognitive vs. perceptual' or 'science vs. art'. The individual registers are instead conceived as useful vantages for viewing the same undivided subject, each viewpoint valid in itself but incapable by itself of providing a complete picture. As Durrell's (1968) Ludwig Pursewarden notes: "two paces west and the whole picture is changed."

"Rhetoric, understood in this manner is not 'the dress of thought' in the sense of 'the fancy dress*' but rather the* 'embodiment *of thought', or 'the* word *made* flesh*'."*

The register I identify as the cognitive encompasses the physical and perceptual aspects of the experience of the map: what one sees, how one sees it, the totality of the experience of how the object or artifact appears on the paper. The semiotic register is essentially the manner in which we make sense of what we perceive. How the signs acquire meaning both individually and as parts of a wider and more complex whole, and issues of control and direction of interpretation of the understandings engendered are engaged here. *Why who is saying what to whom, and how*, and *how is what being said by whom to who*? The artistic register works as the material vehicle for the exchange; it is the means of leaping from the image to the territory. It provides the mechanism for the organized blots and scratchings to blossom as items of significance.

These registers are analogous to those aspects of meaningfully charged language identified by Pound (1960) as phanopoeia, melopoeia, and logopoeia, that is, how the poem appears upon the page (*phanopoeia*), how it is presented to the ear (*melopoeia*), and how it is revealed to the mind (*logopoeia*). In his *ABC of Reading*, Pound (1960) states:

> Language is a means of communication. To charge language with meaning to the utmost degree, we have, as stated, the three chief means:
>
> I throwing the object (fixed or moving) on to the visual imagination.
> II inducing emotional correlations by the sound and rhythm of the speech.
> III inducing both of the effects by stimulating the associations (intellectual or emotional) that have remained in the receiver's consciousness in relation to the actual words or word groups employed.
> (p 63)

". . . "two paces west and the whole picture is changed.""

I would like to propose the equation of phanopoeia with the cognitive, logopoeia with the semiotic, and melopoeia with the artistic registers. The

'charging with meaning to the utmost degree' is the task of cartographic practice in a graphic environment in the same manner as Pound identifies the task of literature in language. I am not making hard and fast correlations here, but am instead trying to draw an analogy that may be useful in understanding the interrelationship of the registers. An alternative analogy would be to link the cognitive, semiotic, and artistic registers with the divisions of semiotic identified by Charles W. Morris (1982): syntactics, semantics, and pragmatics (respectively). The first concerns the relations of signs amongst themselves, the second deals with how signs carry meaning, while the third studies the origins, uses and effects of signs. Again, at this stage these analogous identifications are only offered as figures of metonymy or metaphor and may or may not be useful to the individual reader.

The operative levels, categorized in the identified registers, underpin the rhetorical nature of the map because it is through the registers that the rhetorical position of the map is put forward. The rhetorical position remains the central impetus for the map's existence, and so governs the operative implementations. The conception of the map as a rhetorical text ties the map together and makes of it a persuasive argument utilizing all possible means of convincing the user audience of its core thesis or theses.

Employment of a rhetorical model for cartography also allows access to the vocabulary of classical rhetoric for framing our discussion. Using this vocabulary we can examine and discuss cartography itself as opposed to examining individual maps. Three terms in particular are essential to the rhetorical model: *Logos*, *Pathos*, and *Ethos*. These are the primary appeals that a speaker (in this instance, a map) makes to an audience; the appeal to logic (logos), the appeal to the emotions (pathos), and the ethical or authoritative appeal (ethos). They each in turn govern, respectively, the usefulness, usability, and desirability of the map.

"Three terms in particular are essential to the rhetorical model: Logos, Pathos, *and* Ethos*."*

In dealing with such a complex subject it is perhaps good at the outset to consider just what sort of answer is to be sought by such an exploration. In undertaking this work I am keeping in mind what David Marr (1982) wrote concerning complex systems:

> [we must] be prepared to contemplate different kinds of explanation at different levels of description that are linked, at least in principle, into a cohesive whole, even if linking the levels in complete detail is impractical. (p 25)

The end sought here is the establishment of that cohesive convention of understanding; a persuasive argument of the rhetorical nature of cartography.

II. THE COGNITIVE REGISTER

This section will look at some aspects of the cognitive register: that is, with how one perceives and cognizes that which is placed before one on the paper, cathode ray tube, or whatever the case may be. I can only hope to touch upon a few aspects of this, so I will concentrate on the basics of empirical understanding: how one judges what is essential. I want to identify some basic 'rules of thumb', not as a recipe or prescription but instead as core principles establishing a 'toolkit' for 'good practice'.

The somewhat unfashionable tenets of Gestalt psychology are proposed here as a framework for understanding the working of perception and of cognition, and a brief discussion of the work of Marr (1982) in artificial vision will be used to support these tenets. Next, I will con-

sider the dichotomy of looking and of seeing, and the importance, in the cartographic context, of each to the composition of the map. This section will conclude with identification of the basic elements of a vocabulary of graphic symbols and a consideration of a grammar for that vocabulary and for text placement.

This cognitive side of the business is one that has received a great deal of attention in North American cartographic circles. That this should be so is not too surprising because, after all, it may, at first blush and without much reflection, seem pointedly self-evident that an 'improvement in mapping' would centre upon, well, 'improving' the map; that is, somehow improving the thing in one's hand. Early post-world war II formulations of communication theory, notably Shannon and Weaver's (1949) *Mathematical Theory of Communication,* would seem in fact point to precisely the carrier of the message (in this instance, the map) as being not only the crux but indeed the sum of the problem. The effect of Shannon and Weaver, and of various other communication theories on cartographic thinking will be dealt with in a later section, but suffice it to say that the clear value of the investigations, backed by a sometimes almost evangelical theoretical orthodoxy, has somewhat exaggerated the position of these concerns in cartographic thinking and practice. While it seems clear that while much that is of fundamental significance to understanding how to compose cartographic products of clarity and legibility has, and can yet be, learned, such study is not the whole of the biscuit. When Allen MacEachren (1995) writes that:

> research that makes maps used by air traffic controllers or pilots less prone to misinterpretation would probably be valued by anyone who travels by air, perhaps even a postmodernist. (p 11)

". . . there is an implicit assertion that avoiding misinterpretation (or Italian ski lifts) is largely a function of cognitive study."

there is an implicit assertion that avoiding misinterpretation (or Italian ski lifts) is largely a function of cognitive study. Although these aspects certainly deserve scrutiny, it is not clear that such results are deliverable by these means alone. There has been, and continues to be, a broad field of cognitive, perceptual cartographic concerns open for investigation. Details, and in many instances fundamental details, still await investigation and it is to be expected that important discoveries will yet be made.

The cartographic literature abounds with perceptual studies. There seems to be no shortage of diligent investigators busily pining down quantitative evaluations of what it is that is actually going on when one gazes, or even glances, at a map. Unfortunately, the bulk of this great body of documentation is rather stiff slogging, and in fact relatively little will ever be used in a production environment. How then do we proceed in our search for an understanding utilizable in that selfsame production situation? I would submit that we should look for tools or conventions directly applicable to the practical, production decisions encountered in day-to-day practice. A vocabulary of map symbols and text usage, and a grammar for implementation would allow us not only to guide and inform composition decision-making but it would as well provide a convention in the light of which to evaluate any new determination from research.

A. Gestalt

The main elements for understanding effective construction of maps that communicate exist today in broad empirical form. It is clear that effective implementations of the understandings put forward by Gestalt psychol-

ogy are central to the undertaking. Much recent cognitive map study seems to support or to build upon and extend the constructs posited by the Gestaltists, even where their laws are not explicitly referred to by the investigators. Although psychology and linguistics have each moved beyond, or perhaps diverged from Gestalt theory, the utility of the basic gestalt principles to cartographic design remains evident. As a basis for a conventional understanding these 'rules' provide an 'everyday' or 'workable' grounding in an easily grasped and applicable form. We should look to these 'laws' as a linking viewpoint in evaluating individual 'discoveries' or 'prescriptions'.

It is notable that the German term *Gestaltpsychologie* is often translated as 'psychology of form', because of the direct concern of the Gestaltists with particular, concrete phenomena. These principles or 'Laws of Organization in Perceptual Forms', include the factors of Proximity, Similarity, Figural Stability, Good Continuation, Closure, Common Fate, and Experience or Habit, as well as the factor of Objective Set that is of significance in dynamic situations. The dominant gestalt qualities of simplicity, symmetry, balance, and "closed-ness" (the state of being closed) form a field, which is at the same time both the product and the stage of the interactions. The theory has it that

> the visual system converges on the most regular and systematic perception consistent with the sensory information. (Rock and Palmer, 1990, p 88)

". . . a Gestalt is not an array of self-contained elements, but a configuration of forces interacting in a field. (Arnheim, 1986, p 267)"

Or perhaps more clearly, that:

> a Gestalt is not an array of self-contained elements, but a configuration of forces interacting in a field. (Arnheim, 1986, p 267)

In the same way that a sequence of notes can posses attributes of harmony and rhythm not to be identified in any one of the notes, we see that a whole has properties that do not reside in the individual parts. Integral with this unified effect is the fundamental duality of the relation of figure and ground. The qualities of the ground affect the qualities of the figure quite directly. This is perhaps most evident in relation to color. There, for example, the color of a background brings about a complementary shift in the color of the figure and can even play a part in the identification of the constituent elements' place in the figure - ground dichotomy. This may all seem rather obvious, but recall that at this point we are establishing first principals.

B. Vision

It is not unusual for writings about cartographic perception to begin with a discussion of the eye. The construction and substructure of the human eye has been examined in various levels of detail in an attempt to describe the function of vision as a function of the operation of the eye. This might seem to be a good starting point for developing an understanding: it is with and through the eye that vision is affected. The limits of the eye's response places solid limits upon vision: for example, only some wavelengths of electromagnetic radiation are visible. The variations in wavelengths that are discernable as different, the size of features identifiable, and so forth, all are in the end definitively restricted to what can be registered using that organ. The eye is the tool of vision, but one must be wary of analyses of processes that extrapolate from an examination of the tool. It

is, for instance, conceivable to conclude the existence of a screw from a slot screwdriver, but it is equally consistent with much of the evidence to hypothesize a paint can or block of ice. Wittgenstein's (perhaps apocryphal) question of 'what would the world look like if it looked round?' certainly comes to mind. Marr (1982) warns us about the pitfalls of trying to come to an understanding of flight from a study of the feather; it is "aerodynamics [that] provides the context in which to understand feathers" (p 336). There are many properties of feathers which contribute significantly to flight, but:

> almost never can a complex system of any kind be understood as a simple extrapolation from the properties of its elementary components […]"
> (Marr, 1982, p 10)

Flight is possible without feathers (bees and bats manage it), and possession of feathers is not a ticket to flight (kiwis, dodos, etc., etc.). One must begin an understanding of such a system (of vision or of flight) by consideration of why the task is undertaken and only after that can one sort out problems of implementation. This approach fits well with the experience of anyone who has set out to assemble a computer program: one must begin with a thorough understanding of the task requirements, including the whole range of demands likely to be placed upon the system. Neglecting this runs the risk of being trapped by shortcomings of the implementation mechanisms into allowing them to determine the parameters of functionality. We see as we do because sight developed to help us survive, and not because we had to make the best of the eyes we were given. It can be seen then that investigating the structure and mechanics of the eye itself, as fascinating as it might be, is not a particularly useful exercise for our purposes. We might take a look, however, at the mechanics of eye's function; that is at vision.

Marr (1982) posits that vision is an informational processing exercise, the process of making usable sense of the profusion of flecks and blobs impinging upon our eyes. We are "building a description of the shapes and positions of things from images" (p 123), which we do in a modularized process that allows decisions to be made. For instance, in comparing features we reach a stage in the processing where 'enough' has been 'seen' after which further detail resolution or evaluation is unnecessary.

The modularity of processing suggested by Marr has interesting implications for the interpretation of map symbols. For example, when we are visually scanning a National Park Service map looking for a camping site, this modular processing may allow us to sort out the set of winter sports symbols from the set of camping symbols before specific recognition of any symbol takes place. To locate a campsite symbol, we do not have to understand that a particular symbol means 'ski-bobbing' to rule it out as a candidate for closer examination. (MacEachren, 1995, p 31-2)

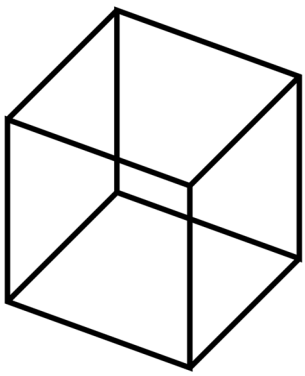
Although the mechanics of implementation in Marr's theory are rather more complex than the straightforward situation implied by the laws of Good Figure, it would seem that the groupings Marr finds formed in early vision are essentially Gestalt groups. That we are organizing our perceptions along the lines of these groups should play a significant role in our construction of the map graphic.

In my discussion of vision and perception as related to cartographic concerns I rely a good deal upon the theory of vision as an information processing activity as laid out by Marr, not so much because of a great faith in the ultimate truth of his work but rather because of its great utility.

Marr and Gestalt

According to Marr's model, we begin by processing the retinal image, the undifferentiated pattern, into a primal sketch: we identify edges, blobs, and as well identify apparent major and detail structures. This primal sketch is refined into what he calls the 2½D sketch by extrapolation of, among other things, 'hints' at a three dimensional organization. The centering of this cognitive picture remains on the viewer (one is still in the midst of a pattern to be understood) and is entirely precognitive, except insofar as already processed imagery, from moments or longer ago, can, for instance, provide direction for attention. Only then can the 3D model representation, an object centered depiction of the organization of the space in view, be achieved. It is in the 3D representation that we can actively function. Once the processing is at this stage, we have left the centre of the kaleidoscope image.

It seems apparent that what we are distinguishing early on in vision are the very differences which produce gestalt groupings and figures. If there is no contrast, no figures emerge from the ground; if the objects are indistinguishable among themselves, no groups coalesce from the mass. Certainly, we can 'learn' to see things certain ways (top - down processing of information). We can even 'flip' optical illusionary spaces at will. Apparently, though, we initially 'bootstrap' the visual scene into order by organizing what we actually find before us. This is significant when we are aiming for clear, concise, and immediate understanding of our graphic.



A theory that accounts reasonably for the observed phenomena without undue internal strain or logical fallacy, while adhering to the principal of simplicity (Occam's Razor), can, I think, reasonably be taken as a working truth. The Gestalt association can also be made with the writings of Jacques Bertin (1983), the French author of *Semiology of Graphics*, in regard to the distinction between image and figuration, and as well to his work with graphic variables.

C. Image and Figuration

In viewing and using maps one encounters a dichotomy in the opposition of looking and reading. When we read a page of text filled with unfamiliar words, or in an awkward or tortured syntax (or an unfamiliar language altogether), we must gaze at and 'read' each individual mark. Each letter may be significant and must be attended to, along with its association with its neighbors. Usually, however, we do not read a language with which we are familiar in this way. In such cases we are looking at the words as identifiable patterns; our eye skipping along, hitting here and there, recognizing words from their shape. We anticipate what will be found next from context and experience, and can be fooled without too much difficulty by tricks like

'Paris in the
the Spring'.

The distinction between reading and looking is a significant one. Reading, for instance, requires a detailed visual inspection, an engagement on the most basic level of the individual markings as well as a wider appreciation of the interrelationships between the individual mark and its neighbors in the vicinity. It is, in fact, a semantic activity. Bertin (1983) writes that a graphic constructed to carry its message this way relies on its figuration. This refers to the interrelationship between individual elements, each functioning as a sign, or as a part of a larger sign, and can practically only reach a ceiling density before merging into an undifferentiable mass. Bertin (1983) dictates a density of about ten signs per square centimeter as maximum, although he states that this value can vary considerably due to a number of factors including "the number of different images, the utilization of differences in implantation, the retinal variables employed, and the reading habits of the individual" (p 176). Much information can be encoded in this manner, and much can be gleaned from the study of such a graphic, but it can mean a lot of work on the part of the map reader. Very often, this reader would simply not bother and would instead seek the information in some other place; a supporting text for instance. The danger of misreading increases too, along with the demand for complex interpretation.

In contrast to figuration is the structuring of information as an image. Bertin (1983) uses "the term IMAGE to describe the meaningful form immediately perceptible in the minimum instant of vision" (p 151). He writes that

> an image remains legible while accommodating great graphic densities and thus substantial photographic reductions. Consequently, reading on the intermediate and overall levels is generally found to be easier. (p 176)

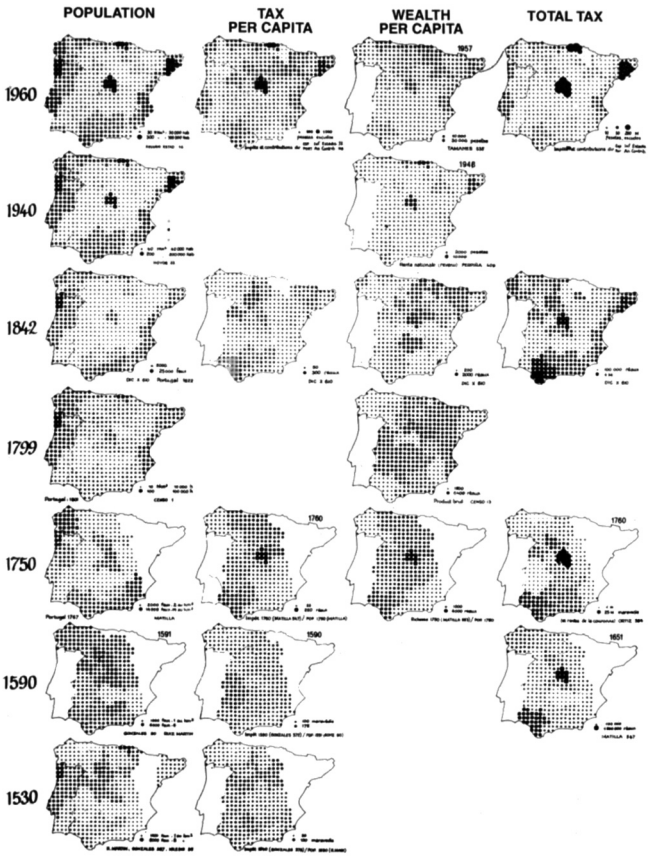


Figure 1. The general solution for any geographic problem involving more than two components is a collection of images, each one comprehensive. From Economic Censuses in Spain, Jacques Bertin, Semiology of Graphics, (University of Wisconsin Press: Madison, 1983), p 398.

This ease is ascribable to the manner of decipherment, to a looking over a reading, in the sense discussed above. Bertin himself makes excellent use of the image in his graphic multiples. As Wood (1985) wrote "No one has ever dared to shrink graphics as small as Bertin does" (p 120) (*figure* 1), and this is a function of Bertin's processing of information to create images which, although they sacrifice 'elemental precision' allow meaningful evaluations and comparisons. With an image the user retrieves the information and recognizes the relationships at a glance. This looking is far more efficacious than a laborious reading in achieving an end.

> With an IMAGE, we can choose to isolate either […] elementary images, or […] intermediate images, or reduce the information to a single overall image. Information constructed as an image accommodates all levels of reading. (Bertin, 1983, p 151)

In the overall image the character of the data can be presented while still allowing access to the detail that supports and further defines the information presented, but never allowing the detail to clutter or obscure the unified pattern. The source of the information is of course at the elementary level, but it is the patterns and relationships that emerge when we can see the broader configurations at intermediate or overall levels that may be of the greatest significance. If we simply require an inventory, then often (but not always) a list or table will serve better than a map. It is that

ability to climb between the different levels of reading that constitutes one of the unique powers of, and justifications for, a map.

Make no mistake, I am not advocating subsuming precision to the dictates of a pretty picture. I am highlighting the imperative importance of the independence of the various levels of information that may be presented. For many people the concentration of detail, even of extraneous detail, is the hallmark of 'accuracy'. Charles W. Chapman (1958), in *Piloting, Seamanship and Small Boat Handling* advises;

> In using a chart in which soundings are few, *indicating the lack of a thorough survey,* the area should be navigated with caution […] (p 328b) *(my italics)*

reflecting the practice until recently of crowding a navigational chart surface with numerals, primarily to give the user an illusion of the great pains with which the survey was made. One effect of this practice was to render visualization of the underwater topography a tedious and sometimes chancy operation: how easy it is to miss that one sounding shallower than your draft in the field of otherwise safe depths. Bertin (1983) noted that situations like this could easily arise, and felt that it could and should be avoided:

> Numerous studies show that the average person tends to read on the elementary level and encounter difficulties in adopting the intermediate level and, even more, the overall level. Graphic designers contribute to this habit by continuing to provide the public with figurations (haphazard curves, encyclopedic cartography, visual 'puzzles'). These encourage the reader to remain on the elementary level. However, as constructions in a single image multiply, and as designers realize to what extent figurations are inefficient or anecdotal, the reader will learn to utilize better the perceptual means with which we are endowed. (p 153)

It is worth noting that the trend in navigational charting is towards displaying a much sparser field of soundings, concentrating on those deemed significant and supplementing them by submarine contours. This practice constructs the map as an image while preserving the accuracy of the data. The illusion of accuracy fostered by the field of spot depths is replaced by the illusion of accuracy implied by continuous depth contours. The latter method, as an image of the situation, is easier to visualize. The accessibility to use, afforded by construction as an image, is coupled with the affordance of a clearer field left for plotting courses and bearings, no small advantage in such a product.

There remain nonetheless many situations where construction of a figuration is desirable or even required. Reasons for this could range from the need to incorporate multiple thematic variables, to the plain and simple need to present the very detailed information that would be generalized out in the construction of an image. The image's advantages of interplay between registers or levels of information should not be neglected even in these cases; in some instances both multi-variate figurations and single variate images (multiple maps) can be constructed, while in other situations careful selection of symbols and presentation can preserve both the higher and lower registers of information on the same map. In any case figuration is not always necessarily a confused mess of details. It is possible to

> […] superimpose several images in a figuration, and it would remain efficient, provided that the images were *not very numerous, that they were very simple,* and were differentiated in the most efficient graphic manner. (p 159) (*author's italics*)

D. Symbol Variables

The choice of map symbols must take cognizance of the kind of information that is to be presented. Some types of symbols are well matched to some types of data but awkward or even wholly unsuitable for others. A vocabulary of graphic symbols would establish a paradigm of available symbol types while a grammar would guide and dictate their use. Perhaps the earliest work of this nature was done by Bertin (1983) in the organization of what he referred to as the 'retinal variables'. It is probably his most widely recognized contribution to cartography and graphics in general, at least in North America. Bertin identifies seven of these variables: location, size, value, texture, color, orientation, and shape.

Bertin's organization of symbol types has been very influential, but it has also been widely noted that "it simply does not always work" (MacEachren, 1995, p 271). The typology is in many ways incomplete, and a number of theorists have suggested additions and extensions to it. Bertin's discussion of color, for instance, is confined to the dimension of hue and he specifically restricts it to "the repertoire of colored sensations which can be produced at a single value," (1983, p 61) while ignoring variation in saturation entirely. Obviously, color value and saturation variables must be added to the list. MacEachren (1995) has identified Caivano's (1990) three-dimensional system of texture (directionality, size, and density), Morrison's (1984) element of pattern arrangement and also proposed an additional tripartite element of clarity to address other shortcomings of Bertin's original typology. This clarity element would be composed of the three dimensions of crispness, resolution, and transparency. MacEachren's 'Extended Variable Syntactics' (1995, p 279) is illustrated here (*figure 2 and 3*) and this syntactical paradigm would seem to be a useful working vocabulary of graphic symbols, such as we are looking to identify.

Text

The handling of text, which plays a significant role in the gestalt of the map graphic, is pivotal to the success of a map. This category of element perhaps most recognizably bridges the three registers of understanding I identified at the outset of this paper. Any discussion of map names and text cannot easily be restricted to one register or another, but must of necessity touch in some manner on each simultaneously. Imhof (1975) observed that:

> A map sheet normally contains several hundred to several thousand names. Map lettering therefore, has great linguistic, practical, technical, and esthetic importance and we can examine the subject of map lettering from vastly different points of view. Important and often difficult grammatical-linguistic and linguistic-geographic problems arise, as do questions about principals of name adoption, the number and selection of names. Furthermore, problems, such as the those of graphic structure, type style, type size, type appearance, type color, association of type with object (i.e., the establishment of a type style for each class of

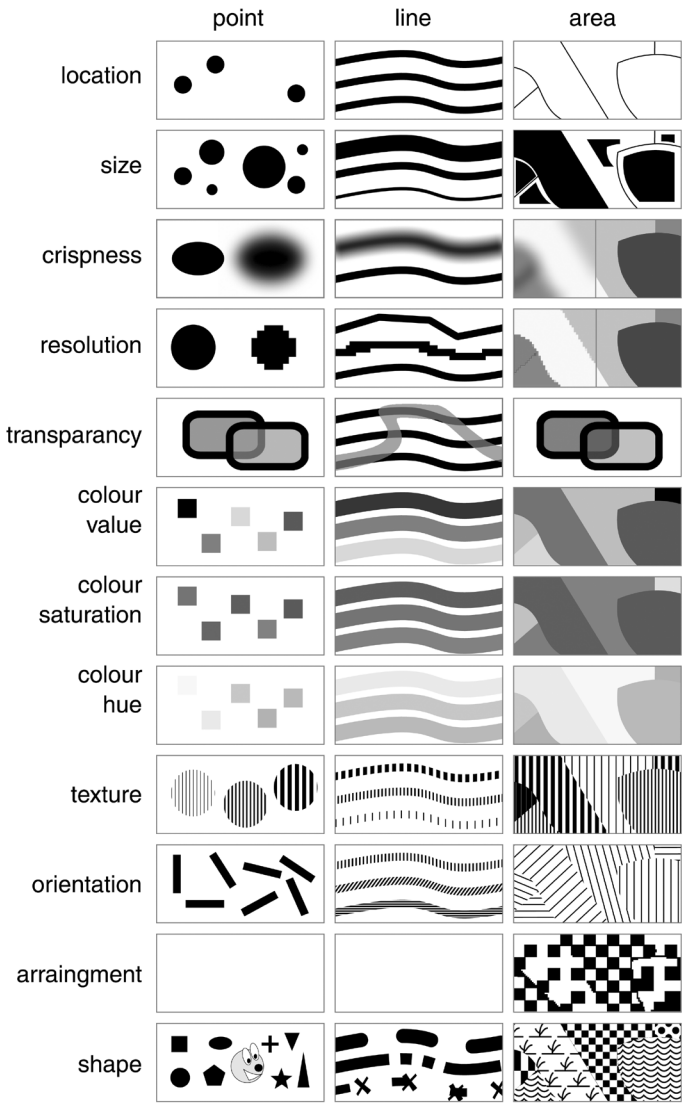


Figure 2. MacEachren's expanded graphic vocabulary. Adapted from Alan M. MacEachren, How Maps Work: Representation, Visualization, and Design, *(Guildford Press: New York, 1995), p 279. (see page 78 for color plate)*

> objects), type arraignment or type position, and, finally, the actual placing of type also arise. (p 128)

Issues of control and hegemony over naming are dealt with latter in this paper, but my concern at this juncture is with the latter part of this list: the placement and appearance of the text on the map.

> Good name position aids map reading considerably and enhances the esthetics of the map. The expression 'clothes make the man' applied to cartography would be 'good form and placing of type make the good map.' Poor, sloppy, amateurish type placement is irresponsible: it spoils even the best image and impedes reading. (Imhof, 1975, p 129)

That it is not a simple matter to avoid the poor, sloppy, and amateurish is quite apparent.

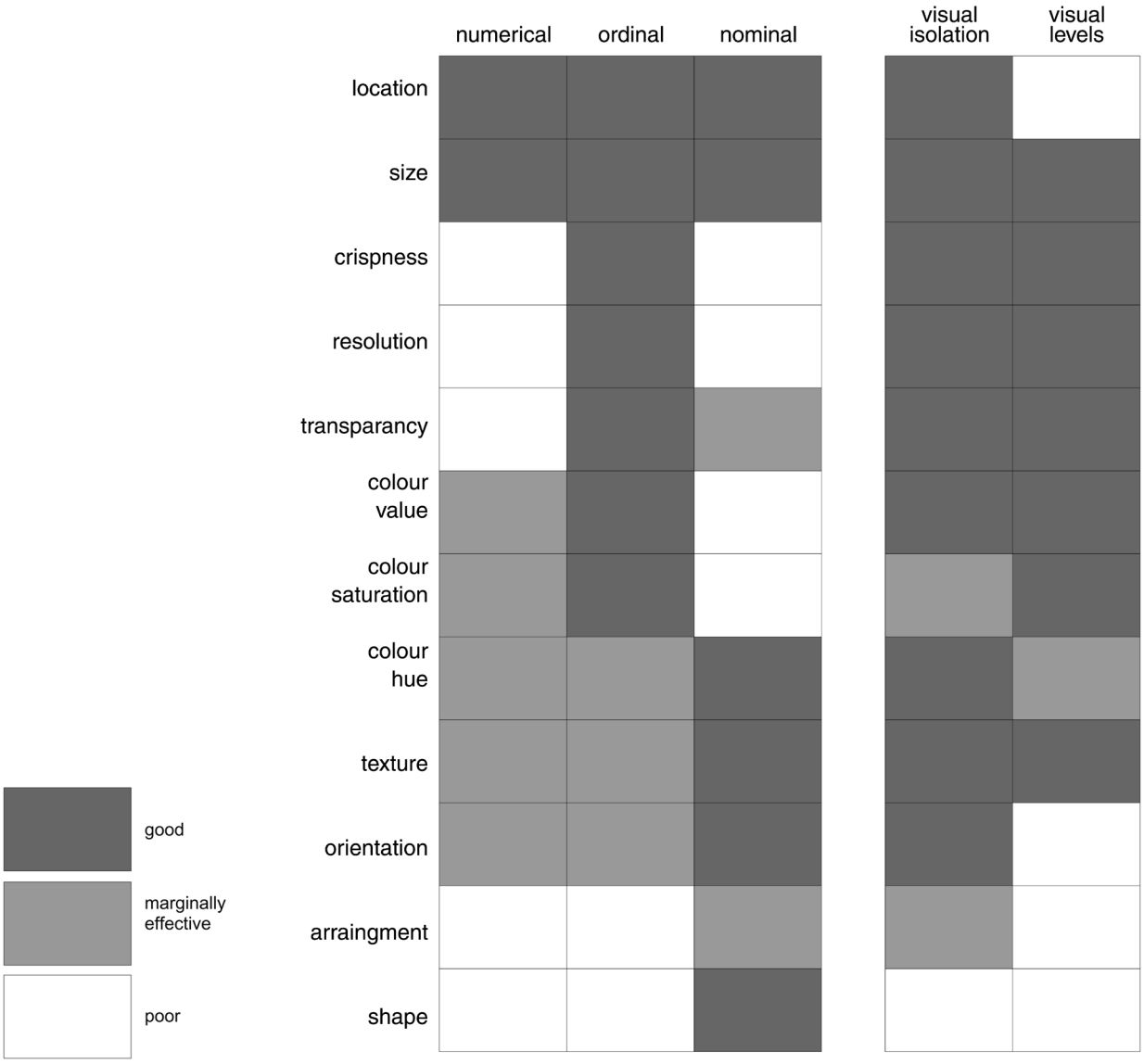


Figure 3. MacEachren's visual variable syntactics. The two right hand columns represent Bertin's "associativity" and "selectivity". Many of these value assessments carry qualifications; refer to the original work for a more detailed discussion. Adapted from Alan M. MacEachren, How Maps Work: Representation, Visualization, and Design, *(Guildford Press: New York, 1995), p 279.*

> Map lettering stands not on a uniform white ground, like the print of books, but in graphic competition and opposition with [other elements of] map design. Lettering and design are equally important and necessary; therefore a compromise must be found. (Imhof, 1975, p 129)

My extensive quotation of Imhof in these passages may well be noted. In any discussion of map text (as indeed in discussion of any number of topics concerned with mapping) it is impossible to ignore the precepts put forward by this scholar and map maker. In regard to map text, Imhof's (1962) work is, in effect, the codification of the best experience of the long cartographic tradition. That I (and others) should lean on his guidance so heavily should not be wondered at; still, his precepts are not gospel. Maybe he himself recognized this when he wrote that "every case must be considered individually and then the principle to be used chosen" (1975, p 130).

Imhof's principles

1. The names should, in spite of their incorporation into the dense graphics of the map, be easily read, easily discriminated, and easily and quickly located. Legibility depends not only on type form, type size, and type color but also on the position or arraignment of other names. It also depends on other map contents…
2. The name and the object to which it belongs should be easily recognized, Clear graphic association often determines style, size size-gradation, and quality of type, as well as map content. Narrow-running types are generally used on small-scale maps, where contents are more crowded than on large-scale maps.
3. Names should disturb other map contents as little as possible. Avoid covering, overlapping, and concealment.
4. Names should assist directly in revealing spatial situation, territorial extent, connections, importance, and differentiation of objects.
5. Type arrangement should reflect the classification and hierarchy of objects on the map: variation of style and size help to do this.
6. Names should not be evenly dispersed over the map, nor should names be densely clustered. Here name selection and name arrangement are important. (p 129)

Bumstead's rules

1. The visual appearance of the space between letters of all words of the same style and size must be the same.
2. The space between letters must be seen to be less than the space between words.
3. The space between words must be seen to be less than the space between lines of text in the information unit in which they appear.
4. The space between lines of a single unit must be seen to be less than the space between lines separating units.
5. The space between lines separating different units of information must be less than the space that surrounds that textural information. (p 264)

What Imhof provides is a 'basic set' of principles for application. Beginning with "some general principles and requirements", he supplemented them with extensive discussion and example. Between them "the […] principles and […] directions generate clarity and legibility" (Imhof, 1975, p 129).

Another 'basic set' of guidelines for consistent and highly readable text is the system developed by Newman Bumstead (unpublished, referenced in Belbin 1996, p 262) of the National Geographic Society. Comprised of simple rules of thumb, easy to remember primarily because of their apparently self-evident grounding in common sense, they establish a complement to the rules of Imhof. Where Imhof deals primarily with the names on the map, Bumstead structures the other text, although extrapolations of either may be applicable in any given situation (*remember*: "every case must be considered individually and then the principle to be used chosen" Imhof, 1975, p 129).

In considering the building blocks of the text, that is, the type itself, Robert Bringhurst's (1999) work *The Elements of Typographic Style* is an invaluable resource. His approach to the use of type is very similar in spirit to the conventional understanding of cartography I am attempting to formulate here. For Bringhurst (1999), a concern for the voice of the type; for instance in the relationship of "the outer logic of the typography and the inner logic of the text" (p 20), is central. He, like I, presents rules only as points of departure.

F. Summary of The Cognitive Register

To recapitulate: in this section I have identified some elements of map composition to constitute the core of the conventional understanding I am attempting to discover. Specifically, I have concentrated on the dichotomy of image and figuration, on a vocabulary of symbols, and on grammars for the use of those symbols and for text placement. As an overall theoretical structure for evaluation of these elements I have, as well, identified the tenets of Gestalt psychology. I think that the elements I have discussed above can be seen as central, and that other studies can be seen as supporting, elaborating and furthering the understandings outlined here. In other words, with these tools the measure of rest may be confidently taken.

III. SEMIOTIC REGISTER

In this section I will outline some theoretical approaches to cartographic communication. I begin with a discussion of the very influential mathematical / mechanistic model of communication, and then proceed to the rather more useful semiotic or sign process model. This model introduces the importance of interrelated codes to the operation, and I specifically draw attention to the intrasignificant and extrasignificant codes identified by Wood and Fels (1986). A discussion of the political implications in cartographic coding follows. There are questions raised such as, for instance, how and why codes are selected, and how other codes can be applied to change or subvert interpretation. This section ends with a discussion of intertextuality and how this can influence a reader's choice of code, and hence the reader's reading.

A. Mechanical Communication Theory

The bulk of cartographic investigation in North America, at least since the Second World War, has been in the cognitive, or, as the practitioners of the investigations would have it, scientific, vein. As a function of that search for a 'scientific' foundation, the concept of *map as a communication system* was seized upon by many cartographic thinkers with loud whoops and frequent hosannas. In the first part of Shannon and Weaver's (1949) *The Mathematical Theory of Communication*, Weaver divides the problem of communication into three levels: A) the technical problem, (can he hear me?), B) the semantic problem (does he understand me?), and C) the effectiveness problem (did he do what he was told?). Weaver then proceeds:

> So stated one would be inclined to think that Level A is a relatively superficial one, involving only the engineering details of good design of a communication system; while B and C seem to contain most if not all of the philosophical content of the general problem of communication. […] levels B and C, above, can make use only of those signal accuracies which turn out to be possible when analysed at Level A. […] this level overlaps the other levels more than one could possible [*sic*] naively suspect. […] Thus the theory of Level A is, at least to a significant degree, also a theory of levels B and C. (p 6)

While there is a recognition that all the categories overlap "in a rather vague way", the model remains one focused on the carrier. When Shannon states that "the semantic aspects of communication are irrelevant to the engineering aspects," (Shannon and Weaver, 1949, p 8) Weaver chimes in that the reverse is not so. The information aspect of the message (and Weaver points out that in this usage "information must not be confused with meaning", p 27) is relegated to a selection process, one of picking from among the range of messages available for communication. That message is then delivered to the "proper and discrete girl accepting your telegram" (p 27) and forwarded to the receiver (*figure 4*). It travels through a conduit (a wire, the ether, or, in our case, as decanted into map form) where it may or may not be subjected to disturbance or disruption from noise, but after that element is subtracted or compensated for the message emerges just as it entered (no doubt to be handed over by an identical "proper and discrete girl"). Nowhere in the model is there any hint that the form of the communication itself might be a part of the message, although there is a mention of a possibility of adding a "semantic noise box" (p 26) to the model between the information source and the transmitter (with a corresponding "semantic receiver" on the other end; the implication being that these 'boxes' are of similar if not identical programming). Shannon and Weaver (1949) do not, however, show these boxes in their diagram.

The adaptation of this very simple system to the processes of cartography by Kolacny (1977) of the Prague Research Institute for Geodesy and Cartography,(*figure 5*) paved the way for ever more elaborate formulations. Like the endless multiplication of epicycles in the Ptolemaic cosmology, it always seemed that just one more step or stage in the process would account definitively for everything.

The discovery of these communication theories seemed to affect the cartographic community like the bolt that hit Saul on the road to Damascus. Suddenly cartographers were drawing flow charts and diagrams detailing the 'Communication of Cartographic Information' and the like. In sup-

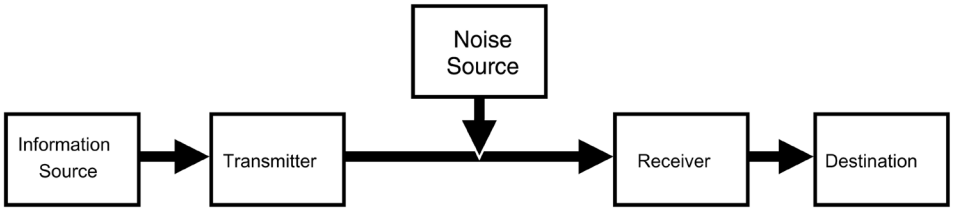


Figure 4. The Mathematical Theory of Communication. Adapted from Claude Shannon and William Weaver, The Mathematical Theory of Communication, *(University of Illinois Press: Urbana, 1949).*

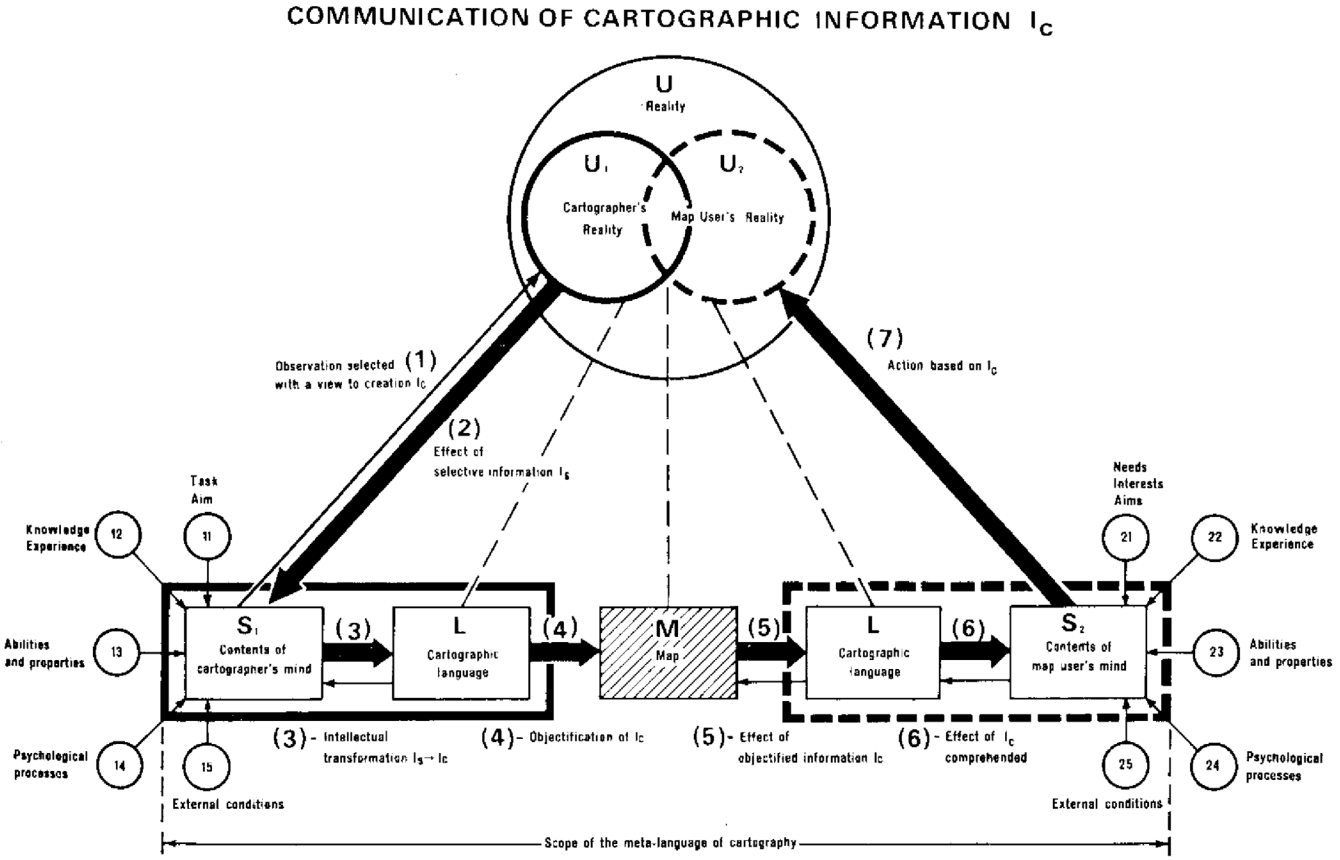


Figure 5. Kolacny's Communication of Cartographic Information. From A. Kolacny, "Cartographic Information - a Fundamental Concept and Term in Modern Cartography." Cartographica. *"The Nature of Cartographic Communication: monograph no. 19." 1977 Leonard Guelke (ed.) p 48.*

port of this were calls for a redefinition of cartographic practice, nothing short of a placement of map making activities full square in the scientific domain with all the rights and high privileges attendant thereon. Joel Morrison (1977), of the United States Geological Survey, wrote that

> A new definition [of cartography] must be formulated which will delete the equating of art and technology with science. (p 58) […] Cartography is the detailed scientific study of a communication channel. (p 69)

At one point, the British Cartographic Association even expressed a desire to espouse two different definitions of cartography; one describing it for the general public as an 'art and science' and another definition

for the 'serious practitioner' mentioning only scientific communication. It certainly must have appeared to some people that the Enlightenment had dawned upon cartography.

The main problem I find with this approach to communication is that it would seem to mistake the signaling for the communicating. This tends to focus attention on the mechanical portion of a much wider and more complex operation. It is quite simple and seductive to imagine that information or messages are stacked somewhere waiting to be selected, packaged, and sped off to the eagerly awaiting recipient. For that simplicity alone it is not surprising that such an attitude is widespread (albeit in perhaps not so graphic a form). There is, however, more to communication than that although this may not be obvious from a mechanistic standpoint. It does not really make things clearer that 'communication' is, as Richard Buchanan (1989) has written, "an ambiguous term often used casually and without regard to its many useful and sometimes conflicting meanings. (p 91, footnote 1)"

Even at the height of this positivist madness, however, there was a recognition on the part of most writers that communication with maps was inherently very different from the electronic communication modeled by Shannon and Weaver in the 1940s. In that older model, a signal transmitted through a medium is degraded by interference or static: in other words what comes out can only be a part of what goes in, and at best the output can equal the input. With a map however, it is obvious that output can be, and often is, greater than the input. In fact, the discovery of spatial relationships is one of the primary reasons for mapping data in the first place. In some sort of recognition of this, many theoreticians included in their diagrams graphic boxes labeled 'Reality' or overlapping boxes with labels like: 'map maker's view of reality' and 'map user's cognitive realm'. Some, such as Morrison's (1977) "A Venn Diagram Illustrating the Map in Relation to Reality and the Two Cognitive Realms Involved in Cartographic Communication" even made sure that the 'view of reality' boxes had some bit lying outside of the overall 'actual reality' box (*figure 6*). It is notable, too, that Morrison's diagram credits the cartographer with the better grasp of reality, although the evidence for this assumption is not offered.

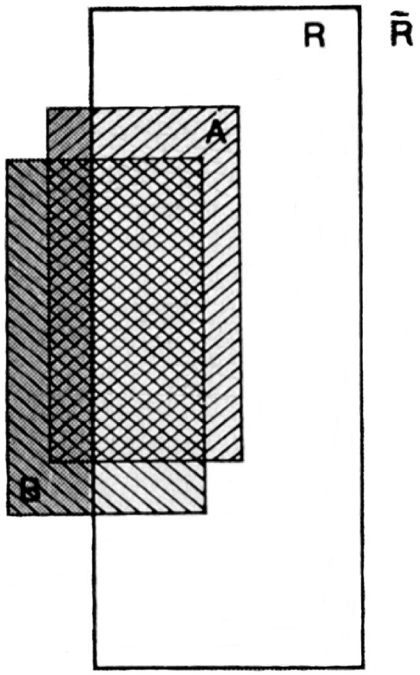


Figure 6. "A Venn Diagram Illustrating Reality, R, Misconceptions of Reality, R, and Two Cognitive Realms A and B" From "A Venn Diagram Illustrating the Map in Relation to Reality and the Two Cognitive Realms Involved in Cartographic Communication", from Joel Morrison, "The Science of Cartography and its Essential Processes" Cartographica. *"The Nature of Cartographic Communication: monograph no. 19." 1977 Leonard Guelke (ed.), p 62.*

B. Another approach

These diagrams for the most part predated or ignored the postmodern critique, which among other things brought to the fore questions of the ownership of, and hegemony over, reality. In any case, the Procrustean movement to conform cartographic practice to the dictates of scientific positivism, even at the expense of lopping off inconvenient limbs, is not yet completely over. Since the time that these notions exploded upon the mapmaking world, however, a number of other approaches have found application in cartographic theory. Significant among these have been the tenets of semiology or semiotics, the study of signs. The late J.B. Harley of the University of Wisconsin played a significant role in bringing that, and the postmodern critique in general, to the study of cartography. His lead has been taken up by writers such as Wood (1992), and others. The recent work of MacEachren (1995) comes to mind too in this regard, where he has worked to reconcile these important ideas with more 'traditional' cartographic thinking.

In discussing semiotics, the study of signs, one has a choice of conceptual models and of associated vocabulary, much of it quite technical and specific. Alternatively, we could take the advise of Wood, quoted in the discussion, that in this case vocabulary is of secondary importance to concept as long as we can keep clear about what we mean. Rather than enumerating at length the various typologies of signs, or the Peirceian model of semiotics and Sassurian model of semiology, Barthes' theories … and so on, I will define here a simplified model. It is derived from the work of the semiotition and cartographer Charles Sanders Peirce.

representation = that which stands for the object

object = that which is stood for: it could be an actual object or it could be another sign

code = that which allows an interpreter to understand the relationship between sign and object *(figure 7)*

1. Semiotics

The practice of communication is an act of semiosis or sign making, and is the beginning of a potentially open ended process of derivation of meaning. It is going on all the time, all about us; in fact we are immersed in this process of semiosis. When I write the word 'cup', you *know* right away what I refer to; or at least you can picture many of the salient features of that to which I refer. You can attach the word cup to many individual instances of 'cups', many quite different in any variety of ways from other cups but all sharing the essential value of 'cup-ness'. You would most likely not think I meant a book, but would not discount a reference to a hand gesture (cupped hand). The reason for this is that the word 'cup' is a sign identified or linked to the attribute of 'cup-ness' (an attribute shared by teacups and certain hand gestures but not usually associated with books) in the English language, which is a conventionalized code.

This kind of analysis may, at first blush, seem a bit of a silly game; taking the obvious and making it obscure. The point is that only once we recognize how this sign making and sign using works, and see that it is going on all the time, can we begin to take command of the process. Wood (1992), formerly of the School of Design at North Carolina State University, made this situation and its ramifications quite clear:

> This is not a game of words. Nor is the vocabulary important. What *is* important is the notion that signs, or sign-functions, or symbols – what they are called *does not matter* – are realized *only* when coding rules bring into correlation two elements or items (or functives) from two domains or systems (the one signifying, of expression; the other signified, of content) and that *whenever* there is such a correlation, there is a sign. You may call this resulting sign an icon. You may call it a pictogram. You may call it a word. You may call it an index. You may call it a symbol. You may call it a piece of sculpture. You may call it a sentence. You may call it a map. You may call it New York City. In every case, whatever else it is, it is, in *its sign function,* also a sign, that is, a creature of a code.

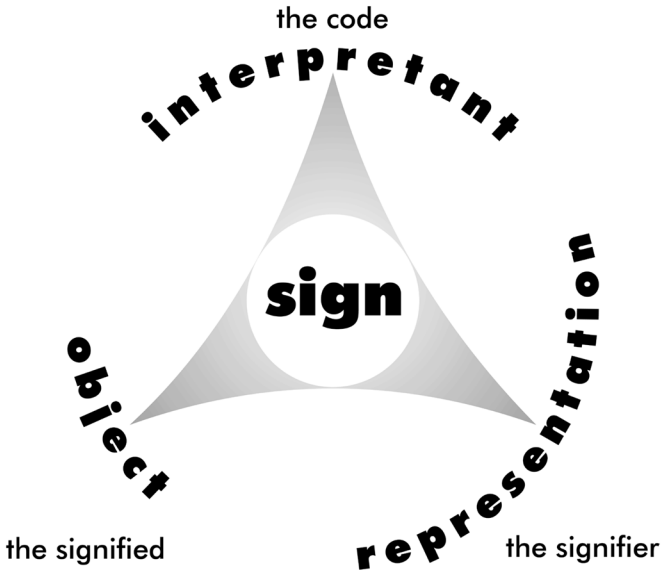


Figure 7. A tripartite model of sign function.

> *No signs without codes.* This must be insisted upon: that is, there are no self-explanatory signs; no signs that so resemble their referents as to self-evidently refer to them. They are inevitably arbitrary, inevitably reveal... *a value.* (p 110)

It is only by looking at a map through the conventions of a large number of complicated code sets that we can recognize any resemblance between the map and what it supposedly represents. Without those conventions, in fact, we are unlikely to recognize the article as a map at all. This initial stage is, however, just a beginning in what I have already mentioned is a continuing process.

2. The power of signs

Each sign potentially, and often, becomes the basis for a further step in the signifying process. Let us take our 'cup' again: let us imagine that we find a stylized, yet quite recognizable picture of a cup on a sign board in an airport. We identify it as a sign for a 'cup', and we know all about 'cups' from our linguistic studies (as infants, perhaps). We use this sign, which we directly identify with a cup (it *denotes* a cup), as the grist for a further act of semiosis. It reminds us of an association we make between a cup and a restaurant or cafe (in other words it *connotes* a restaurant); a place where cups are used in abundance and where food is served as well. It is the code or convention of such places that prompts us to expect it. Again, we know that very near a place selling food and drink we will find a rest room. It is our facile understanding of the variety of intersecting codes (in this case the health laws) that tells us this. Seeing the marking that we interpret as a cup then gives us the confidence to tell our fidgeting child (using a linguistic code, supplemented by tugging on their arm, which is another coded message) that if they hold on a few moments longer … I think you must get the idea. The point is that the power of signs rests in this ability to take part in these potentially open ended operations of connotation, and furthermore, that it is happening all the time.

Maps, after all, are signs; they are both large complicated signs and a synthesis of constituent signs. Sometimes such complex configurations are referred to as super-signs, and this is a convenient way of speaking about them. Just as a book will have, between its covers, chapters, and within those chapters, paragraphs, and within the paragraphs, sentences, made in turn of words composed of letters, so too the map is constituted as a sign vehicle. A bit like a Russian doll, isn't it?

In any event it may be misleading to speak of the power of the signs; the signs are the tools, the handles on the process. It is the codes that are doing the work. There is no possible way to leap from the sign to the object without the operation of the code. When the sign breaks down there is a localized problem, but when codes break down, general confusion results. Sometimes this is disastrous, as in the breakdown of the signal code system in the Toronto subway where no one could effectively interpret the signals even on the occasions when they were working correctly. This lead, ultimately, to a major collision and much loss of life. At other times such a breakdown can be delightful or consternating, as in the case of Dada art. The power, then, resides in the understanding that the marks stand for something else in some way, and not in the marks themselves. The vampire is not driven off by the crossed sticks as sticks, but by the power that they hold in that configuration as a sign.

3. Cultural codes

Codes come in various flavors, with varying applicabilities. All are arbitrary; there is no self-explanatory sign and no sign is so like its signified as to be coincident in any and all cases. Any code, in order to be used, must first be learned; but understanding of the learned codes may not be identical across the user community. There are, however, some code sets that enjoy a wide circulation and are shared by many people. These code sets should be adopted by the cartographer whenever possible. When the readership can be counted upon to understand the code, these signs are as close as one will ever come to being self-explanatory. These code sets are cultural artifacts, and in fact they make up and define their culture. They are not immutable, but dynamic; the active selection and usage of symbols within the culture keeps the associations evolving in a living way. When any particular symbol becomes mired in its connotations and ceases to evolve, it becomes a cliché. When this happens to the entire code set, the culture stagnates. The point is, that for any particular cultural milieu these code sets are powerful framers of understanding and interpretation. The understanding of color associations, for instance, or shapes usable for iconic point symbols, as another example, are embedded in a culture.

"Codes come in various flavors, with varying applicabilities."

> Our 'dictionary' of core visual symbols is formed through our personal experiences, which 'fill up', personalize, and expand our understanding of particular symbols. (Moore, 1998, p 1)

These aspects should not be ignored when choosing map symbols because any colloquial reading will tend to overpower any contrary one and usurp the meaning intended. By the same token, the dynamic nature and the cultural identity of the codes may lead to confusions in interpretation. The association of a particular symbol may shift over time, or may be quite different (or even empty) in a slightly different cultural milieu. The old British practice of showing the Empire on world maps in red, strongly evocative to an Imperial or Commonwealth subject (of a certain age), would be quite lost on an average American map user, for instance. The American could, given enough context, of course figure it out; but the force of the association would likely be quite different.

"These code sets are cultural artifacts, and in fact they make up and define their culture."

4. Cartographic Codes

Denis Wood and John Fels (1986) and Wood (1992) begin their search for the types of coding at work in maps with a deconstruction of a specific example: the North Carolina State Highway map. In the course of this operation they identify ten cartographic codes, which they claim operate on and through any map, although many other codes may play various parts. Each code has a complex relationship to the others, but each is either exploited by the map or allows the map to be exploited (*figure 8*).

> Those that the map exploits are termed *codes of intrasignification.* These operate, so to speak, within the map: at the level of language. Those by virtue of which the map is exploited we term *codes of extrasignification.* These operate, so to speak, outside the map, at the level of myth. (Wood and Fels, 1986, p 68)

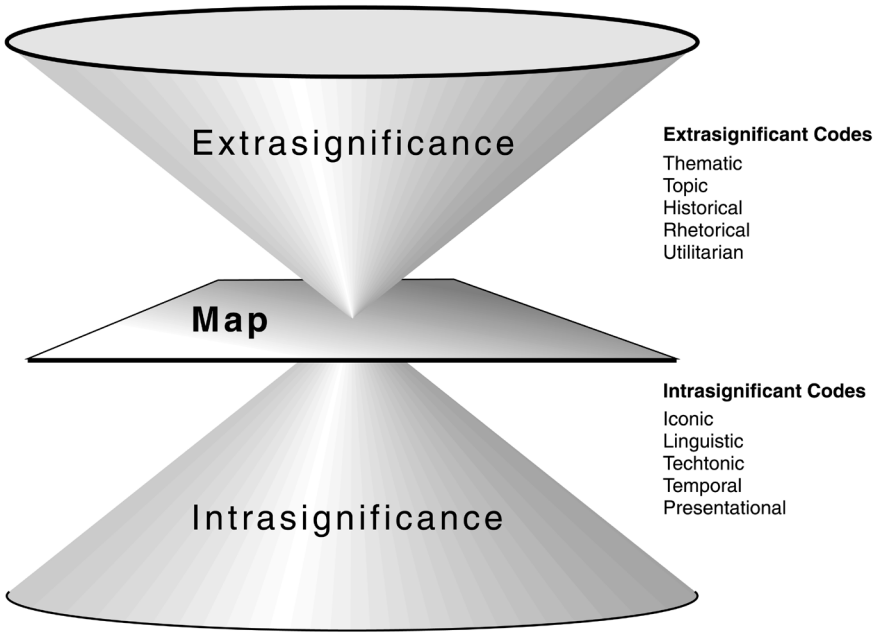


Figure 8. Intersection of Intra- and Extrasignificant codes in the map. Adapted from Denis Wood and John Fels, "Designs on Signs: Myth and Meaning in Maps", Cartographica*, vol. 23, no. 3, 1986, p 68.*

The codes identified as intrasignificant, or operating within the map are:

iconic:	the code of inventory, of things and of 'events'
linguistic:	the code of naming, identifying, ownership, classification
tectonic:	which is divisible into:
scalar:	the code of scale, the size relationship
topological:	the code of the topology, the spatial relationship (adjacency, connectivity, and so forth)
temporal:	which is divisible into:
durative:	the code of 'how long', or the time 'thickness' (from when to when)
tense:	the code of 'when is now?'
presentational:	the code of presentation

This last, the presentational code, is of special significance. It is through this code that the map is brought into being, and so it forms the bridge between the realms of intra- and extrasignification. It is this code, operating "at the end and the beginning of the map, [that] closes the loop of its design. […] It injects the map into its culture." (Wood, 1992, p 142)

> The map image is accompanied by a crowd of signs: titles, dates, legends, keys, scale statements, graphs, diagrams, tables, pictures, photographs, more map images, emblems, texts, references, footnotes, potentially any device of visual expression. The map gathers up this potpourri of signs an makes it a coherent and purposeful … *proposition*. [… it] takes *as content* the relationship among messages resident in the map and offers *as expression* a structured, ordered, articulated and effective and affective display: a legitimate discourse (Wood, 1992, p 131) (*author's italics*)

This is strangely familiar, this presentational code. This is nothing other than visual art by another name. It is visual art which: "takes *as content* the relationship among messages resident in [whatever] and offers *as expression* a structured, ordered, articulated and effective and affective display: a legitimate discourse" (Wood, 1992, p 131) (*author's italics*). The authors may have thought they intended something quite different from this, but to paraphrase the Red Queen: they couldn't deny the correspondence if they tried with both hands (Carroll, 1976, p 251).

The codes Wood and Fels (1986) identify as extrasignificant, or operating to exploit the map are:

thematic:	the domain of discourse, 'what shall be argued, what shall be shown?' it operates on the iconic codes, determining a subject
topic:	the domain of the place (topos), 'what is this place?' it operates on the tectonic and linguistic codes, turning space into place
historical:	the domain of the time, 'what is the diachronic (historic) and synchronic (contemporary) context?' it operates on the temporal codes
rhetorical:	the domain of the voice, the orientation of the map in its culture it operates on the presentational codes
utilitarian:	the domain of how the map is, finally, used. it operates on any "purpose myth might serve" (Wood, 1992, p 115)

"What goes around, comes around; and by swings and roundabouts the process pulls itself up by its own bootstraps."

I would identify the rhetorical code, as named here, with the desirability of the map or how the map is made desirable or appropriate for that use. Later I will discuss these aspects as the *ethos* of the map, and the affordance of the *ethos* by the *pathos*.

The domains of these intra- and extrasignificant code sets are intersected or focused in the map. At that place of intersection, the signs that operate within the map (governed by the intrasignificant codes) are operated upon by the codes of extrasignification; the 'external' codes, which specified what those constituent signs were, and determined how the intrasignificant elements were chosen in the first place. What goes around, comes around; and by swings and roundabouts the process pulls itself up by its own bootstraps. The complexity of this cycle of coding is part of the reason why the process itself is often so hard to see: it all seems so natural.

> It is, of course, an illusion: there is nothing natural about a map. It is a cultural artifact, a cumulation of choices made among choices every one of which reveals a value: not the world, but a slice of a piece of the world; not nature but a slant on it; not innocent, but loaded with intentions and purposes; not directly, but through a glass; not straight, but mediated by words and other signs; not, in a word, as it is, but in... code. (Wood, 1992, p 108)

5. The 'good man' speaking

That maps carry a range of connotation (the text 'between the lines') and implication in addition to the strict denotative (the words on the page) elements of their make up is not a new concept by any stretch. It has been only relatively recently, though, that this has been acknowledged by some writers to be taking place in all maps, and not only in the products

identified as 'biased': specifically in journalistic and propaganda maps. Wood (1992) points out that the inauguration in Great Britain of a "media watch" to identify and publicly admonish 'poor' mapping in the media is a symptom of this narrowness of acknowledgement. While on one hand it is laudable to undertake education of the public to an awareness of the editorial nature of maps, he maintains that it is precisely the specification of only certain types or examples of maps as being suspect that gives the impression of overall objectivity for maps in general as products of concerned, objective map makers. The underlying objectivity of so called base or reference mapping, normally produced by government cartographic houses, is so strongly connoted as to seem axiomatic, and is so accepted by many people. One reason for this acceptance is the rhetorical, ethical appeal of the map itself (operating through the extrasignificant rhetorical code). It presents itself as Marcus Cato and Quintilian (Corbett, 1990, p 601-2) suggested an ideal orator should; that is, as 'a good man skilled in speaking'. Wright (1977) wrote that

> the trim, precise, and clean-cut appearance that a well drawn map presents lends it an air of scientific authenticity that may or may not be deserved…A map may be like a person who talks clearly and convincingly about on a subject of which his knowledge is imperfect. (p 8)

To a large extent the depersonalization of the map and its surround, the 'clean cut appearance' just mentioned, is responsible for this, but that implication is supported by other mechanisms as well. There is an implicit denial of the actuality of the forces at work in the authorship of any map, a denial that supports the mythology of veracity and objective disinterest. We have faith in the good intentions, the disinterested objectivity, and the baldly innocent disingenuous honesty of the mapping agency. Why on earth would these people lie? When Wright (1977) notes that "The essential accuracy of certain types of map […] can be taken on faith" (p 12), it is not clear if he can differentiate between accuracy and truthfulness. Even the supposedly fundamentally objective topographic maps put out by national governments are framed by these considerations: it has been noted that United States Geological Survey (USGS) maps, for instance, routinely show abandoned mines and omit toxic waste dumps. But do we even suspect the existence of that for which there is no visible (mapped) evidence, or guess that it may be as (or more) important than what is shown?

Information and features are included or not on the basis of hierarchies of information which can have or can be formed by very widely and variously based criteria. Omission, inclusion, symbolization, generalization, and centrality are all factors in this process, a process that is not by any means always conscious or overtly intentional. In many cases the societal values and political forces dictating the decisions made have become internalized by the map makers and patrons, by mechanisms made familiar and discussed at great length by Noam Chomsky (1989) in several writings in connection with journalism, etc. It would simply not occur to either party to question the correctness of the implemented hierarchy. The king's house is more important than the baron's, which is more important than the farmer's; what could be more natural?

> A challenge to the underlying patriotic assumption is virtually unthinkable within the mainstream and, if permitted expression, would be dismissed as a variety of ideological fanaticism, an absurdity, even if backed by overwhelming evidence [...] (Chomsky, 1989, p 9)

> What is at issue is not the honesty of the opinions expressed or the integrity of those who seek the facts but rather the choice of topics and highlighting of issues, the range of opinion permitted expression, the unquestioned premises that guide reporting and commentary, and the general framework imposed for the presentation of a certain view of the world. (Chomsky, 1989, p 11-12)

Arguably, objectivity can be seen to be a subjectively infiltrated quality; but even in recognizing that fact there are pratfalls. Some people have found problems arising even where there seems to be an attempt on the part of the map-makers to acknowledge the prevalence of the tendency to confuse map and territory, and reality with representation. MacEachern (1995) points to Wood's and Fels' discounting of the caution from *Goode's World Atlas,* that the reader should be careful not to take the maps too literally, as not only a warning to be on guard, but a declaration as well of a complementary connotation of the ethics and integrity of the map makers at Goode's. This leads to a conclusion MacEachren (1995) finds "possibly absurd" (p 341): it is that

> a blatantly biased propaganda map is more ethical than a conscientious attempt to map things fairly and to warn the reader about abstractness, because things cannot be mapped fairly and the propaganda map does not falsely imply that they can, by pointing to the potential lack of fairness. (p 341)

*". . . should a statement of "*caveat emptor*" from a used car salesman make you trust him?"*

The point that Wood and Fels (1986) are making though, is valid:

> it is not that the map is right or wrong (it is not a question of accuracy), but that it is taking a stand while pretending to be neutral on an issue over which people are divided. (p 64)

In other words, should a statement of "*caveat emptor*" from a used car salesman make you trust him?

6. Open and closed texts

This issue of pretense highlights another interesting aspect of the map; that is, the openness of interpretation. Construction of the map is, in the intersection of the various interrelated codes, the construction of a text, an instrument animated by the activity of a Reader. This Reader is, in the cartographic code model discussed above, the bringer of the codes of utility to the map; s/he is the arbiter of the use made, or interpretation applied to, the map text. The Italian semiotician Umberto Eco (1979) identified one significant differentiation between types of texts as the distinction between an open and a closed text. Eco (1979) defines the open text as one that is able to transcend its context, and accommodate a variety of meanings or interpretations. Closed texts are highly circumscribed, in that they presuppose a narrowly defined reader; one who is only willing or able to bring a specific set of understandings to the work. In other words, the closed text defines its boundaries in absolute terms, beyond which it will neither step nor allow the reader to go. A feature of the pretense of neutrality of the map is a corresponding pretense of closure; a pretense of incorruptibility. Closed texts cannot be opened by perpetrating violence upon the closed structure of the text, but can occasionally be opened by subversion. Generally speaking, there must be some motivation for this: very often it is an ideological difference with some or all of the assumptions underpinning

the frame. As Eco (1979) says "an ideological bias can lead a critical reader to make a given text say more than it apparently says […] even the most closed texts are surgically 'opened' "
(p 22). In fact, it is a reader not in sympathy with the original bent of the text that is more likely to "go further with an ideological analysis so as to 'unmask' the hidden catechization performed at more profound levels" (Eco, 1979, p 22). He points out how "ideological biases can act as code-switchers […]" (p 22) as in the case of medieval interpretations of Virgil. We can recall how in the *Divine Comedy*, Dante has Virgil openly declare that he knew all along that Christ was on the way, and had been heralding that arrival in coded verse messages. Medieval scholars applied the theological constructs of Christian mythology to everything they encountered, including the writings of the ancients; these tenants were the unquestioned and unquestionable code-framework through which these scholars made sense of the universe. What Virgil himself might have thought about it all mattered not a bit.

We can see that it is the Reader or end user who chooses and applies the code(s) to the text, be that text a map, a poem, or something else. In much the same way that we identify different phenomena and features by switching the wavelength sensitivity of photographic film, we can, by switching codes, identify very different readings of a given text. The text remains unchanged, as does the landscape in our photo analogy, but by receiving the exposure with different sensitivities we can discover other messages. These other messages (or images) may have been implicit, or been wholly or in part unsuspected by the authors.

"In much the same way that we identify different phenomena and features by switching the wavelength sensitivity of photographic film, we can, by switching codes, identify very different readings of a given text."

Is a map then really an open or a closed work? It would seem that it is both at the same time. Both readings are important, and both the ostensive 'public' reason and a 'subversive' rationale can be valid and can inform (or ignore) each other. It seems obvious that Eco's (1979) discussion of the status of art works is, in this regard, broadly applicable to cartographic works as well. He states that:

> the form of a work of art gains its aesthetic validity precisely in proportion to the number of different perspectives from which it can be viewed and understood. These give it a wealth of different resonances and echoes without impairing its original essence; a road traffic sign, on the other hand, can only be viewed in one sense, and if it is transfigured into some fantastic meaning by some imaginative driver, it merely ceases to be *that* particular traffic sign with that particular meaning. A work of art, therefore is a complete and *closed* form in its uniqueness as a balanced organic whole, while at the same time constituting an *open* project on account of its susceptibility to countless different interpretations which do not impinge on its unalterable specificity. Hence every reception of a work of art is both an *interpretation* and a *performance* of it, because in every reception the work takes on a fresh perspective for itself. (Eco, 1979, p 49)

7. Intertextuality

An important element in our ability to recognize or make use of any particular code system, and by extension to interpret or understand the map or any other text, is our ability to draw parallels to or inferences from other texts in our experience. This intertextuality is inescapable; "no text is read independently of the reader's experience of other texts." (Eco, 1979, p 21) When one listens to the William Tell Overture and thinks of the Lone Ranger one is applying an intertextual frame of reference. In a

similar manner, it is the intertextual references in Bulgakov's (1967) novel, *The Master and Margarita,* which allow us in the first chapter to recognize the 'stranger' as Mephistopheles simply from his described appearance. On top of the other clues, his cane with the poodle's head handle is a dead give away if, that is, we know *Faust* (Goethe, 1808). In fact, later in the story the character of the Master expresses astonishment that an educated man like Berlioz (not the composer), who came to grief as a result of his encounter in that opening scene, failed to make the intertextual connection. Often this intertextual frame is from far back in the memory; half remembered, or half misremembered. Familiarity with popular ideological mythology is invaluable in utilizing these powerful associations. This is closely related to the cultural associativity of signs, discussed earlier, and has similar advantages and hazards in use.

". . . two things must be recognized: first, that understanding happens in an understandable way, and second, that this understood way can be used in composing the map text."

C. Summary of the Semiotic Register

Each reader is a complex amalgam of beliefs, memories, and intellectual habits. The fact that all understanding is predicated on the potpourri of experience and emotional baggage carried about by the individual, some elements shared widely across a culture and other bits quite personal, may be good or bad, but that point is, really, immaterial. The point is that two things must be recognized: first, that understanding happens in an understandable way, and second, that this understood way can be used in composing the map text.

We have seen in this section that maps are super-signs, both single large collective signs and organizations of constituent signs. We know that the power of the sign is not in the marking itself, but in the mark's operation as sign in a code. Each map is only interpretable by means of numerous code systems, but there are, in each map, at least ten code sets to be found in operation. Some five of these are intrasignificant, operating within the map itself, and five are extrasignificant, operating to exploit the map. These codes can be, and often are, culturally and politically determined; both in their maker's intentions and in any alternative interpretation. In any event, it is the reader or user who in the final instance determines the utility or use of the map, and each of these potential readers brings a regular dog's breakfast of experience, mythology and superstition to the map they use. The cartographer must, like James Joyce, take responsibility for all possible interpretations of his or her work.

". . . the dichotomy of art and science is a false one, and can clearly be seen as such from the perspective of a rhetorical approach to cartography."

IV. THE ARTISITC REGISTER

Most cartographic theorists assume there to be a clear cleavage between art and science. While there are dissenting voices, this distinction seems to be a rigid line of demarcation between partisan camps. In this section I will review some of the opinions that have been put forward by different participants in this debate, and bring in, as well, some pertinent testimony from literary and art circles. I am compelled at the outset to state that I am not entirely neutral in my opinions on this question; but by the same token I am not wholly given to either camp. The proponents of the exclusion of esthetics and art from cartography I find a bit more than slightly absurd, while, on the other hand, I think many of the arguments of the supporters of the 'other side' are neither properly based nor fully engaged with the question. My own view is that the dichotomy of art and science is a false one, and can clearly be seen as such from the perspective of a rhetorical approach to cartography.

Cartographers often react to insinuations that they may be engaged in an art practice with conspicuous revulsion. Some, such as Morrison (1977), are quite strident in rejection of any association with art. Morrison seems to equate art with a penchant for invention of data, and denounces it all with great bombast. Other writers are only seemingly less doctrinaire. It has been noted, for example, that Robinson, *et al.'s* (1969) careful concession in *Elements of Cartography* that cartography is artistic, but only in the sense of "careful literary composition", contains the clear implication "that the other art (whatever that may be), is frivolous and careless" (Morris, 1982, p 80). There is no shortage of quotations of this sort available in the literature, but let us consider another, bolder statement from *Elements of Cartography*. The authors state that

> maps today are strongly functional in the way that they *are designed, like a bridge or a house, for a purpose*. Their primary purpose is to convey information, or to 'get across' a geographical concept or relationship; it is not to serve as an adornment for a wall. (Robinson et al., 1969, p 7) (*my italics*)

Well, it could be argued that sometimes a map *is* 'just' an adornment for a wall (and it adorns that wall, like any trophy, for a very specific *reason* which is in fact to *get something across*), but it is clear that the authors' primary implication is that were the cartographer an artist (by their definition), the map would somehow be something less than it should or might be. That even the authors realize this assertion to be rather untenable can be seen by their next statement:

> On the other hand, one of the cartographer's concerns may be to keep from producing an ugly map; in this respect he is definitely an artist, albeit in a somewhat negative sense. (Robinson, *et al.*, 1969, p 7)

What is this ugliness that the cartographer as inverted artist is attempting to avoid? What can this ugliness be, if not a crippling of the very fabric of the map as a means of communication, as a sign, and in fact, of all rationales for producing a map? The authors of *Elements of Cartography* are identifying a real concern, even if their thinking about it is a bit fluffy. Obviously the cartographer, in order to successfully "convey information, or to 'get across' a geographical concept or relationship" (Robinson, *et al.*, 1969, p 7) must engage in an art practice. "It concerns", as Pound (1960) says, "the relation of expression to meaning" (p 34).

One could draw an analogy to the geometrical operation of the projection of the globe. The surface of the globe must be translated in some manner, made accessible through the language of geometry (a convention), in order to appear upon a sheet of paper. So too must all the information, features, and so forth be translated through the constructs of a conventionalized code, something that is often referred to as a language, to even appear (let alone appear coherently) on the graphic. The geometry takes care that the relative position is correct (as it does in a painting like Masaccio's *Trinity* (1425-1428) fresco in Florence, (*figures 9a and b*), but the question at hand is what the representation will be, how will (can) it be expressed? It should be obvious to everyone that:

> the 'statesman cannot govern, the scientist cannot participate [sic] his discoveries, men cannot agree on wise action without language', and all their deeds and conditions are affected by the defects or virtues of idiom. (Pound, 1960, p 34)

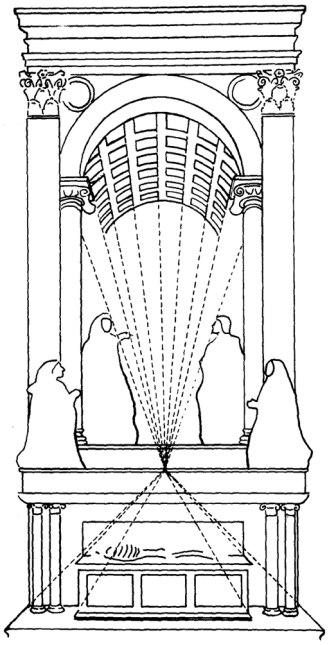


Figure 9a. Perspective diagram of Masaccio's Trinity *fresco in S. Maria Novella, Florance, from James Smith Pierce, From Abacus to Zeus: a handbook of art history, (Prentice-Hall, Englewood Cliffs, New Jersey: 1977) p 40.*

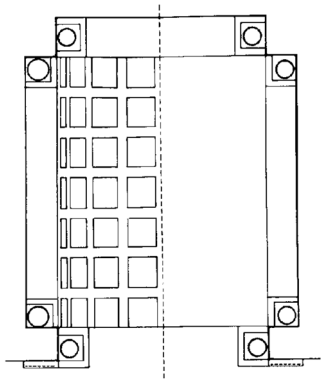


Figure 9b. Diagram deduced from Masaccio's Trinity *showing the ground plan of the chamber and the surface of the barrel vault. From James Smith Pierce, From Abacus to Zeus: a handbook of art history, (Prentice-Hall, Englewood Cliffs, New Jersey: 1977) p 41.*

Yet, when it comes to the cartographer acknowledging, or, it would seem, even recognizing the language s/he employs so well or ill in daily endeavor, revulsion intervenes. To believe that one can even begin to compose, construct, assemble, put together, or otherwise 'come up with' a map without recourse to the language of art is patently absurd, and only little wit can excuse such a hallucination. On the other hand, to realize that one's grasp of that language may be less than it might be, or even quite rudimentary, is perfectly rational.

"To believe that one can even begin to compose, construct, assemble, put together, or otherwise 'come up with' a map without recourse to the language of art is patently absurd . . ."

In some ways this examination of the means of utterance is not unlike the examination of the operation of the sign and of the code systems I discussed in the last section. The fact that we make use of it so intimately, and have assimilated it so completely into our mechanisms of viewing and operating in the world makes it seem almost absurd to look at it as a separate thing.

Since, as Lawrence Durrell (1976) noted: "what one becomes one forgets", a way must be found to begin to examine these workings. Pound (1960) advised the reader:

> For the sake of keeping a proportionate evaluation, it would be well to start by thinking of the different KINDS of expression, the different WAYS of getting meaning into words, rather than of particular things said or particular comments made. The term 'meaning' cannot be restricted to strictly intellectual or 'coldly intellectual' significance. The how much you mean it, the how you feel about meaning it, can all be 'put into language' (p 47-8)

My intention here is to show that we do make use of the language or expression of visual art in making any map, and perhaps to make clear that it is advantageous to acquire such a literacy.

The 'how you feel about meaning it' and 'how much you mean it', as Pound notes, is central, but perhaps that word "feel" is problematic for some. Feeling is "… not only a sensation of pleasure but a real judgment concerning the excellence of the object" (Reid, 1774). As soon as you prefer one means, option, or version to another, as soon as you make a judgment (for whatever 'reason' that judgment is made), you are 'feeling' something.

The very mention of feeling or art will make many cartographers jump. It is as if each can feel the bite of Swift's (1733) oft-quoted verses:

> So Geographers in *Afric*-maps
> With Savage-Pictures fill their Gaps;
> And o'er uninhabitable Downs
> Place Elephants for want of Towns. (p 571)

For instance, much embarrassment has been expended on the elaborate and ornate decoration of historical maps, which in practice means almost any from before the late 19th century, Often this manner of presentation has been equated with the art part of the 'art and science' of cartography. Jean Morris (1982) noted that

> Most believe […] that the science of a map is to be found in its empirical data and the art in extra embellishments. The layman's view of cartographic art includes rose compasses, elaborate calligraphy, and illustrations of the exotic beasts and sailing ships that filled the empty spaces of the maps of long ago. Artwork then was required to take over where science failed. (p 41)

More lately the postmodern critique, pioneered in cartography by the work of Harley, has allowed us to place the styling of antique maps in an understandable context, as part of the rhetoric of the map as a whole. As well, the reinvestigation of decoration as an integral aspect of object making should lead to further re-evaluation of these maligned works. David Brett (1992) of University of Ulster in Northern Ireland has been particularly instrumental in this re-thinking of the place decoration. Brett writes of how

> Modernization – in which industrial production and a science-based technology are allied to the growth of mass education and bureaucracy – requires the destruction of age-old habits of thought and behavior. Thereafter 'traditional' culture becomes a very problematic area whose continued existence has to be defended, asserted, and in certain cases even invented. The study of decoration reveals this process very clearly, and demonstrates some of the political and social tensions that ensue. The history of the decorative arts in the past one hundred and fifty years can be analyzed in terms of contrasting ideological positions whose roots are in the struggle for mastery within sections of the dominant class. These roots are also deeply embedded in the intellectual foundations of modernism and in particular the disruption of culture and qualitative thought by scientific positivism, which, by undermining the basis of metaphor, renders traditional symbolism invalid, and any decoration based upon it meaningless.

> Thus, the study of decoration becomes part of the study of the many ways in which modern society searches for its meanings. (p 3)

However, it is not specifically to embellishment that I refer when I speak of the map as functioning as art.

A. Art as a language

Maps, it seems to me, have held on to the imagination and awe of the large majority of the population while fine art products in general have, since the middle of the nineteenth century, slowly lost that hold. This is a proposition which I think would bear further investigation. The attraction that maps hold for large numbers of individual viewers is well known and long noted. Witness Blundeville's (1589) observation, already quoted: "I daylie see many that delight to looke on Mappes…" (To the reader). The engagement each individual makes with a map is varied and complex, and often entered into for no other reason than the pleasure that engagement affords. Very seldom is tabular data perused in the manner that a graphic representation of the spatial relationships between features will be. That this happens too, for reasons beyond the mere efficiency of presentation, is evident because one will look at a map even when the subject or theme is of little or no interest. The motivations for this are, I believe, rooted in the same attraction that art holds.

That we learn and understand a visual language, that is, that our understanding of the world around us is mediated by visual codes with shared vocabularies and grammars, is commonly understood and accepted (except, it must be noted, in some cartographic literature). (*see sidebar*) Visual art feeds on and is fed by this visual language. The production of works by means of visual language is an art activity; cartography is an activity producing works by means of visual language; ergo…

It is to this understanding of the production of cartographic works that I look when seeking the 'artistic element' in cartography. It is not something 'added in', or present in a greater or lesser amount or degree, but is instead intimately bound up in the activity. This is not to imply that it is always well or even adequately handled.

There has long endured a camp in cartography which held out for the quality they recognized in maps as esthetic, or identifiable as art. Often the proponents of these views are branded as 'Romanticists', and thought of as stubbornly prejudiced against the sound and reasonable 'Scientists'; and it is true that "…the despoilers of science end up sounding a bit silly and slightly hysterical. That, regrettably, is what is thought of them already by those in power" (Morris, 1982, p 48). It can be a tight corner to fight from, though.

> It is very difficult to make people understand the *impersonal* indignation that a decay of writing can cause men who understand what it implies, and the end whereto it leads. It is almost impossible to express any degree of such indignation without being called "embittered" or something of that sort. (Pound, 1960, p 34)

Pound's (1960) words are directly applicable to this situation. It can be very difficult to make a stand for the importance of something like art in cartography when so many otherwise accomplished, or at least admired, theorists and practitioners so roundly denounce it.

An example of the development and growth of this visual language can be seen in comparing some visual aspects of two of the famous 'Adventures of Tintin' stories: *The Crab with the Golden Claws* (Hergé, 1941) (a fairly early tale) and *The Picaros* (Hergé, 1976) (the last complete story). There are many visual (and other) differences, but let us look at the technique employed in composing the individual frames. In *The Crab* the frames are spacious, with full figures placed across a rather flat stage with a shallow plane of action. With *The Picaros*, however, the frames are crowded, with many dominated by a large head, perhaps with a gesturing hand, the speech balloon, and an action field of depth. What happened to the visual language between these two examples? *Television* is what happened: by the 1970s the framing conventions of the small noisy box have taught Hergé's readers to *understand* what they are seeing. This kind of framing has become a part of the visual grammar and vocabulary; the ability to read such a construct is now an entrenched part of the common visual literacy. Similarly, contemporary video camera technique: hand held shots, jump cuts, etcetera, which would have been deeply disturbing to an audience in 1960 are commonplace today because, again, the visual language has evolved. Now, if Pop Art showed us nothing else, it was the primacy of the common visual literature (and Andy Warhol, one incidentally recalls, was a great admirer of Hergé). A comparison of Bertin's map multiples with Warhol's multiple image works such as *Sixteen Jackies* (Warhol, 1965) is also instructive.

B. The millstone of prejudice

Could it all stem from something as simple as a misunderstanding? There is certainly no shortage of misunderstanding in which to root the problem. I am convinced that one reason authorities such as Bertin discount the importance of the artistic register in cartography is simply that the qualities I identify with art are not recognizable to them as such. These aspects, for them, would simply be self-evident marks of good practice, as familiar as the air, and the understandings so entrenched in their procedures and psyches as to be of second nature. Because they have identified art as being a practice they reject, they cannot recognize the artistic nature of the practice they pursue. It may seem petty to object to what someone calls their practice, if, as I have said, it is only a matter of a rose by any other name. It is, however, against the prejudice, grounded on so slim a nicety of vocabulary that I chafe. It is far easier to learn a categorical condemnation than a skill. Johann Wolfgang von Goethe (1773) wrote about just these sort of prejudices in his 1773 work *On German Architecture*. Upon his first visit to the Strasbourg cathedral he confesses that he had his:

> head full of general ideas about good taste. From hearsay I honored the harmony of masses, the purity of shapes, and I was a decided enemy of the confused arbitrariness of Gothic ornamentation. Under the heading of Gothic, as though in the entry in a dictionary, I heaped all the synonymous misunderstandings that had ever crossed my mind as to the indistinct, the disorderly, the unnatural, the overloaded, the patchwork […] (p 297)

The indistinct, the disorderly, the unnatural, the overloaded, the patchwork, the unscientific, the boutique, the artsy, the fartsy. Art in this context could almost be seen as cartography's dirty little secret.

C. Some defenders

Not everyone associated with maps always breaks out in a rash at insinuations of art. Thrower (1966) and even Robinson (1967), each in separate *Yearbook of Cartography* articles from the mid nineteen-sixties discussing, respectfully, "Relation and Discordancy in Cartography" and "Psychological aspects of color in Cartography", found that there is a place and need for at least "the cartographic equivalent of the ability of the truly great communicative artists in other fields, be it speaker, writer, painter, or what you will" (Robinson, 1967, p 57). One man unafraid of the stigma, or perhaps I should say, less afraid than most, was John Keates. Keates (1984) raised "the question of whether a map can be said to have any of the attributes of a work of art, and whether the attempt to create such works is a proper Cartographic objective" (p 38). Keates maintains that it can indeed be said, and goes on to point out "that there is more to a map than something vaguely called information […] which is in no way contrary to the need to make maps which are functionally informative" (p 39). His objective in the article is to investigate whether maps can, or should, arouse an aesthetic response. Decidedly, Keates is acknowledging something fundamentally important here, and doing it quite eloquently, yet he backs away at crucial points. I have difficulty agreeing with him, for instance, when he states that "as the actual arraignment and interplay of contours, lines and shapes on a map is ordered by the phenomena, maps would appear to have little to offer from a formalist point of view" (p 40). Formal concerns can and do play as significant a role in the generaliza-

tion and representational processes in cartography as in other art making. Portraiture certainly comes to mind here as an analogues situation, for instance the recent portrait heads by the British sculptor William Tucker. It is also problematic when Keates writes that "a map can be 'well designed' in a functional sense without creating anything of the aesthetic property we can sense in other things" (p 41). He seems to be saying that art is, in the end, something that really need not be present in the map. How he can come to this conclusion is not immediately obvious.

Other writers on the relation of art and cartography, however, seem to approach the topic with rather more confused notions. Discussions of 'beauty' (objective and / or subjective), the golden section, and so forth, are generally less helpful as they are the less well informed. Most writers are careful to point up something along the line that ultimately the 'artistic element' or "beauty … is not put into a map but merely added to it" (Karssen, 1980, p 124). I do not, however, think it appropriate to sneak art in through the back door, so to speak. No apologies are required for a mature and accomplished body of knowledge and practice. Embarrassment and apology should come, rather, from the cartographer without a conversant understanding of art and his own activities. The work itself must in the end speak, and the cartographer can do no more than to prepare that voice. "When the writing is masterly one does NOT have to excuse it or to hunt up the reason" (Pound, 1960, p 51).

D. Defining a faith in art

"Williams Carlos Williams (1937) grappled with questions of this sort . . ."

Without doubt contemporary post- postmodern uncertainties surrounding definitive definitions of art and science practice do little to clarify things. It does, however, seem apparent that this uncertainty also makes the reinvestigation and the rehabilitation of cartography as a meeting ground of art, science, and technology a more viable proposition than has seemed likely in recent years. Perhaps by defining that relationship we will be better positioned to tackle the wider questions.

The American Early Modernist writer Williams Carlos Williams (1937) grappled with questions of this sort when he outlined a dialog between the poet and his brother.

> My brother, who is an architect, told me recently that his mind has been aflame over the problems of construction today more than ever before. Upon what shall we base our judgments? he said to me almost in despair. You are a writer, he said, I'd like to know how you work. What do you find to be of importance? We must both be looking for more or less the same things. Tell me how you go about it. (p 175)

There is a fundamental similarity of the problems and aims of construction faced by the physical and the linguistic builder. The similarity is shared by the constructor of a graphic, and specifically (for our discussion here) of the composer of a map. If we recall Robinson *et al.'s* (1969) recognition that maps "are designed, like a bridge or a house, for a purpose", p 7) then it will be plain that this should be a by no means novel concept to the cartographer.

> You build houses, for people. Poems are the same.
>
> Yes, I know, he said. But I'm sick of this 'back to humanity - back to the soil' business. You grow spinach in the soil, you don't grow writing there and certainly it doesn't sprout little new buildings ready-made.

> Neither does humanity. Architecture is an art and writing is an art also, mossy with tradition.
>
> Who said anything else? What I said was that I go back to people. They are the origin of every bit of life that can possibly inhabit any structure, house, poem or novel of conceivable human interest. It doesn't precisely come out of the tops of their heads like flowers but they represent, in themselves, the structure which art... Put it this way: If we don't cling to the warmth which breathes into a house or a poem alike from human need –
>
> The stink, you mean.
>
> – the whole matter has nothing to hold it together and becomes structurally weak so that it falls to pieces.
>
> Possibly, but I don't follow you.
>
> Maybe I don't follow myself, it's always a possibility. You began by telling me about a craftsmanlike integrity to ones materials. No lying. But that's no incentive to either build or write – no safe incentive, that is. […] I mean you build a house for people, don't you ? Then the needs of... I mean, the minute you let yourself be carried away by purely 'architectural' or 'literary' reasoning without consulting the thing from which it grew, you've cut the life-giving artery and nothing ensues but rot.
>
> (Williams, 1937, p 178)

". . . operating at a less than obvious level is not the same as to not be present . . ."

In many ways this is not dissimilar to the calls made by many in the cartographic community for the recognition "that there is more to a map than something vaguely called information" (Keates, 1989, p 39); calls that are often sneered down by those who fancy themselves to be 'serious' practitioners. However, that which constitutes this so styled 'serious' practice, exactly like that which Williams identifies as the "purely 'architectural' or 'literary'", is inadequate as a fundamental basis for the activity; "– no safe incentive, that is" (Williams, 1937, p 178). It is easy and hence quite usual to mistake a concern with matters broader than the so-called 'pure' with the frivolous and extraneous; just as it is not uncommon to characterize Pablo Picasso as a messy scribbler. But, like the codes discussed previously, operating at a less than obvious level is not the same as to not be present: what is engaged is visceral and speaks directly to us and to our needs.

> What we seem to be getting to is that all the arts have to come back to something.
> And that that thing is human need. When our manner of action becomes imbecilic we breed Dada, Gertrude Stein, surrealism. These things seem unrelated to any sort of sense UNTIL we look for the NEED of human beings. (Williams, 1937, p 178-9)

As Williams says, we must look for that need. The need may well be, and often is, for a National Topographic System 1:50,000 sheet: such a map speaks in a voice and tongue which responds to that need (or persuades us that it is responding). However, no matter how often or how well it does respond it remains only an option; a single choice among many; a

possible answer for today's need. The seduction of the 'pure' thinking, be it architectural, literary, or cartographic, is to calcify and to catechize and in the end, like Procrustes, to make the problem fit the answer.

> […] we find that these apparently irrelevant movements of art represent mind saving, even at moments of genius, soul saving, continents of security for the pestered and bedevilled spirit of man, bedevilled by the deadly, lying repetitiousness of doctrinaire formula worship which is the standard work of the day. In my young days it was 'English.' In your young days it was 'Greece,' 'Rome.' But the mind is merely enslaved by these ideals, these ideas, unless we can relate them, here, now, in our environment, to ourselves and our day. This requires invention. ...
>
> Wait a minute! Wait a minute! You forget you are a writer, I am an architect. You are working with words. I am working with building materials. We have to have rules which shall govern us. I grant you that we have to have universal rules – that will work today just as they worked to produce the marvels of antiquity – but they're rules just the same.
>
> As far as I'm concerned I don't think they're any different from human character in service to the inauguration [*sic*].
>
> You mean that art should be useful?
>
> Stuck your foot out that time, didn't you? But I didn't trip. Yes, useful. They try to deny it. There's an arrogance in art that likes to set itself up against the world.
>
> (Williams, 1937, p 179)

"The seduction of the 'pure' thinking . . . is to calcify and to catechize and in the end, like Procrustes, to make the problem fit the answer."

Utility and non-utility is targeted here as argument. The point is that of the reclamation of that which is not useless, but only identified as useless by others as a part of their circumscription of the bounds of valid debate. Be that as it may, and setting aside the 'utility of non-utility' point as a side issue (as Williams clearly does), we return to the main question in this passage; is art useful?

"The point is that of the reclamation of that which is not useless, but only identified as useless by others as a part of their circumscription of the bounds of valid debate."

> But I insist, yes, that the purpose of art IS to be useful.
>
> […] every minutest thing that is part of a work is good only when it is useful and […] any other explanation of the 'work' would be less useful than the work itself.
> (p 179-180)

Williams then examines the process of creation by considering the approach to the project at hand, making use of what I interpret to be the rhetorical design control elements, applying them, in this case, to an architectural project although they are just as applicable to a cartographic project.

> Anyhow houses do have to be lived in physically. That makes a big practical difference But wait a minute, maybe I am the one who should be learning, from you. A man comes to you and wants a house, What

happens? Some will belie their materials and do anything the client asks. But you're an architect, what would you do?

I wouldn't sell out, I'd rather lose the commission – and do lose them very often for that reason – rather than lie.

I know. But what would you 'do,' you, yourself, while the man is still in the act of making his proposal to you. You'd start on the house, in your mind, I mean, constructing it, as it must be FOR CERTAIN REASONS. Isn't that right?

Yes, of course.

(p 180-1)

This is a critical point. Later, we will see how this is in fact the invention of the *logos*, or logical appeal. It is those 'CERTAIN REASONS' which determine that the house, poem, or map shall be useful.

Nine cases out of ten you'd have the thing up there inside your head within the first ten minutes.

That's right.

Then so far it's just like a poem. After that, hungry for work, you'd look at the man, inwardly, and size him up as to just what he amounted to in your mind, architecturally speaking.

"It is a matter of persuasion: 'human character in service'."

Yes.

(p 181)

Williams has determined that he would provide something of a specific *use*, something *useful* (logos), and must now consider further. *How* will this client make use of it; how will he find it *useable* (what is the pathos)? Next, the client must choose to have *that particular* house built and not another; how does he determine that this *particular* house is better than all the others? In other words, how shall that house be shown to be *desirable* (ethos)?

After that you'd go to work on him to get what YOU wanted. Isn't that right?

That's right. I would – with my heart in my mouth.

(p 181)

Once the architect (poet, or cartographer) has these design control elements in hand, the argument can then be put forward. It is a matter of persuasion: 'human character in service'. Note that the persuasion is not effected here, at the end; the arguing is not a hoodwinking of the client to buy a pig in a poke, but has instead been framed and accomplished by the elements which are already in play. The logos or logical appeal is the conception of the edifice 'as it must be FOR CERTAIN REASONS'. The pathetic and ethical appeals (pathos and ethos) are dealt with in the 'siz-

ing up' of the client: how will s/he find the edifice (in Williams' example) so usable and desirable as to commission it?

> What else does a poet do? And how can I tell you anything about it? It isn't only the tensile strength of the materials. It isn't just 'honesty.' It isn't standard lengths and all that. It's everything in the world today. First it's human character that decides. Your character, the quality of your client. The only difference with poetry is that the poet builds for an everybody, any person, while you build for everyone in one person. All the modern necessities, the social needs, the falsification of thought, the constrictions of vile habit. The architect is a rebel just as I am. He should be a philosopher, a sociologist, he must have read Thorstein Veblen. He must know human habits, eccentricities. But above all he must know how to put it over.
> (Williams, 1937, p 181)

And what a cartographer does is, again, no different in its essential aspects. Williams points out that it is not circumstantial or happenstance differences of material or implementation which are central to any of these activities. There is instead a central correspondence identifiable under the obscuring layer of the circumstantial; it is a question of knowing 'how to put it over'. What, though, is *it*?

> … of course you know what 'it' means.
>
> I know what 'it' means well enough, when I find a thing, said the Duck: it's generally a frog, or a worm. The question is, what did the archbishop find?
>
> (Carroll, 1976, p 36)

In the case of our discussion here, 'it' is the persuasive argument as put forward in the map.

Nowhere in any of this is an equation of persuasion with deception, which is not to imply that deception is not present at one or more levels.

> Fine! But what 'art' means to most seems to be the art of deceit. If they flatter a client and give him what he wants they feel that they don't give up their franchise as an artist. On the contrary, they're doing something human, they're employing their hard-earned structural skill to bring into effect the bare demands he makes of them –
>
> The commercial artist, so-called.
>
> Some are pretty good, too.
>
> Why not? *provided* they can adapt the client's needs to *their* own necessities. This applies also to propaganda.
>
> I'd solve the problem architecturally till hell freezes over – or not at all.
> (Williams, 1937, p 182).

This is critical, and incidentally raises certain ethical questions about the undertaking of another's argument for them. The arguments advanced in the map are not, of course necessarily, or even very often, that of the cartographer personally but are instead those of the client. We have only

to remember Socrates and Gorgias' discussion of the validity of making the worse case appear the better to warn ourselves of the dangers of that. However, the point here is not the judgment of the relative validity of any particular arguments forwarded by maps, but rather that an argument is always forwarded.

> You know, you've made me think. Propaganda is like a house an architect has to build for people to live in. Maybe your client is a damn fool, maybe he isn't. You've *got to argue with him* – broadly speaking. That broadens the whole matter, doesn't it? Only we're so damned beset with hangovers and dragbacks. They've got to live in them, the houses, poems, we make – but they don't even know they're houses. Their needs govern it but in such a complex manner that it flies out of the mind and nobody knows what it is about. But we've got to come back to it, from both sides. The poet has to serve and the reader has to – be met and won – without compromise.
>
> But how?
> (Williams, 1937, p 182-3) (*my italics*)

". . . the point here is not the judgment of the relative validity of any particular arguments forwarded by maps, but rather that an argument is always forwarded."

Williams touches on several points in these passages, which are fundamental to what must make up our understanding of the functioning of art in our work in its broadest sense, and in cartography in particular.

What is the question I am harping on here? Is this an attempt to glorify cartography by claiming the status of art, or conversely, to attempt to escape from considerations of 'scientific accuracy' by implying that, as art, one needn't be concerned with the discipline or tyranny of precision? I would reply *neither*, and that such a choice is not relevant because the demands of high quality data and high quality presentation are two facets of the same prism, and the one is lost without the other.

E. Appropriate presentation

The artist Jenny Holtzer (1985) is noted for her works in which texts function simultaneously as form and message. There is a complex interplay between the presentation, the communication and the content of the message that is especially piquant in regard to this present study. In an interview Holtzer (1985) considered whether criticism of content should supersede criticism of formal issues; although she refers specifically to her own work, the parallel to our consideration of cartography is clear.

". . . Holtzer (1985) considered whether criticism of content should supersede criticism of formal issues . . ."

> Best of all would be a criticism that remarks on all aspects of the work. For the art to be successful, and for that matter, for the content to be compelling, the subject must be presented in a way that's compelling, the subject must be presented in a way that is appropriate. Appropriate means that formal considerations have been attended to, that they are as marvelous as the message. That's what the artist has to shoot for, and that's what the critics need to recognize and describe.
> (Holtzer, 1985, p 66)

This concept of the appropriate presentation is precisely what is required. We can draw connections between this to Wood's 'presentational codes' by recalling our discussion of how the intrasignificant presentational codes act as a bridge, and thus allows the map to enter a culture. What is under consideration here is precisely how it manages to do that.

F. Function

Many definitions of art include some qualification of the maker's 'intention', and it is a common assumption that an 'intention' to 'function' is a disqualification for, or incompatible with an 'intention' to make art. But what then is functionality, and at what level of content or competency of function is the line of disqualification: where is the foul line and how is it crossed? The problem here lies, I think with the question itself. Rudolf Arnheim (1986) pressed directly on the root of such questions when he wrote that

> In philosophical aesthetics, tedious pseudoproblems have been introduced by dichotomous thinking. […] None of these questions can be answered by an either/or decision.
> If instead one starts from the realization that the properties of the work of art reside in all its various embodiments, one arrives at an interesting and manageable problem. One can ask: In what ways do the various manifestations partake in the work, each in its own manner? (p 276)

There are certain parallels between my views on the manner in which maps function and the way I thought about my sculpture work in the 1970s and 80s. The concept of functionality is central to both practices but any function in and of itself is not a point of definitive determination of the work's status as art, whether that function is integral to the work as a whole or not. A common conception tends to expect non-functionality of art and to see functionality as an indication or attribute of the non-art. Little, however, could be further from the truth. It is not an issue of yea or nay, but instead a question of what that particular function is, and where it is aimed.

"Let us examine this vocalization by supposing that we were setting out to make a painting of 'American History'."

G. Embodiment

If we look at a painting and consider the manner in which the image is constructed or 'made up' we discover the same, or a parallel kind, of vocalization or expression through the language of representation as we find in a map. Let us examine this vocalization by supposing that we were setting out to make a painting of 'American History'. Not, say, a picture of some specific or particular event such as Washington crossing the Delaware, Lee at Appomattox, or John Mitchell committing perjury, but instead something more general: a painting of 'American History' itself. How might one evoke this thing without particularizing the imagery, and thus narrowing the scope? Color could be the key; one could make exclusive use of colors evocative of 'American History'. But how is one to decide what colors these might be? A visit to the local paint store will provide us with a little card of paint chips, samples of colors of interior paints with names like 'Newport Brown' and 'Appalachian Fern'; indeed, they are part of this particular paint company's 'Historic Color Series'! So, we have an extensive set of colors, collectively and each separately connected in some manner (for someone, at any rate), with 'American History', but how do we set about ordering them upon our painting? If we were composing a landscape of Mi Lai, or a portrait of Sacco and Vanzetti, we would have a framework in place already to determine which color would lie alongside of which other. However, these types of framework were rejected earlier on in the process. The key to the colors' evocation of 'American History' is in the name given to

each color, so it would make sense to order the colors based upon some aspect of these names; for instance, the length of the name. Again it follows that an order based upon the length of the names could be logically presented as a list or stack; we could have the longest name at the bottom and the shortest name at the top. Okay, we are making great progress here: we have the colors, and we have them ordered. Let us now give some thought to the colored marks themselves. If the length of each paint stroke was proportionate to the length of the name (and by extension to its place in the order) this conceptual structure would be consolidated. The name of the color could, perhaps, be painted over that color, helping to clarify the interrelationships, and the size of that text string could determine precise height and width of the paint mark. Marking the name of each color in characters of the color of the paint stroke just below serves to tie the work together as a whole. Of course the uppermost paint color would be used for the text of the bottom stroke, closing the circle (and isn't history cyclical?).

There are other decisions yet to be made; type-face and letter-spacing, for instance, but my purpose here is not to make the painting (in fact, Garry Neill Kennedy (1989) already has made this painting, in various versions on various occasions), but to illuminate the conceptual process of the making. It should be pointed out as well that this outline is my conception of how I would go about constructing this painting, and it is a procedure which may or may not have been in any way similar to that followed by the artist.

My point is that this conceptual process is present, more or less obviously, more or less overtly, in all compositional making regardless of differences in pictorial detail, overt intention or ideological grounding. Vermeer (1669), in his painting *Geographer* (*figure 10*), undertook the same conceptual process; he was asking superficially different questions, applying different valuations and criteria, and aiming for something quite specific (and not so self -conscious, -referential, and -aware), but nonetheless in all essential aspects it was the selfsame conceptual undertaking. Malcolm Lowey did this with automobiles and locomotives. We do this when we compose a map. We are foregrounding something quite specific in each case, and while normally it is not the conceptual process itself which is awarded centrality in our valuation mythologies, it is imperative that the presence and function of that process be acknowledged if we are to understand the activity in which we are engaged.

H. Divergence

I think that in former days the association between cartographic and artistic activity was not unclear, and in fact it was the distinction that was not defined. That the innovations in the optical rendering of space in Renaissance painting were not reflected by a corresponding advance in geodetic measurement, until relatively recent times, had a significant effect on the divergence of association since the time of Mercator and Ortelius. Developments in cartography tended to take some time to occur. Remember, although Giovanni Cassini began the topographic survey of France in 1669, it was his great-grandson Jean who directed preparation of the last of the 182 sheets in 1793. Pendulum clocks had been used in determining the longitude of fixed points of observation since 1657, but real locational accuracy on demand anywhere on the globe had to await John Harrison's completion of his Chronometer Number Four in 1759. It was this instrument, which eventually (some 13 years later) won the award from the Board of Longitude for 'discovering the Longitude'. Of course, there then

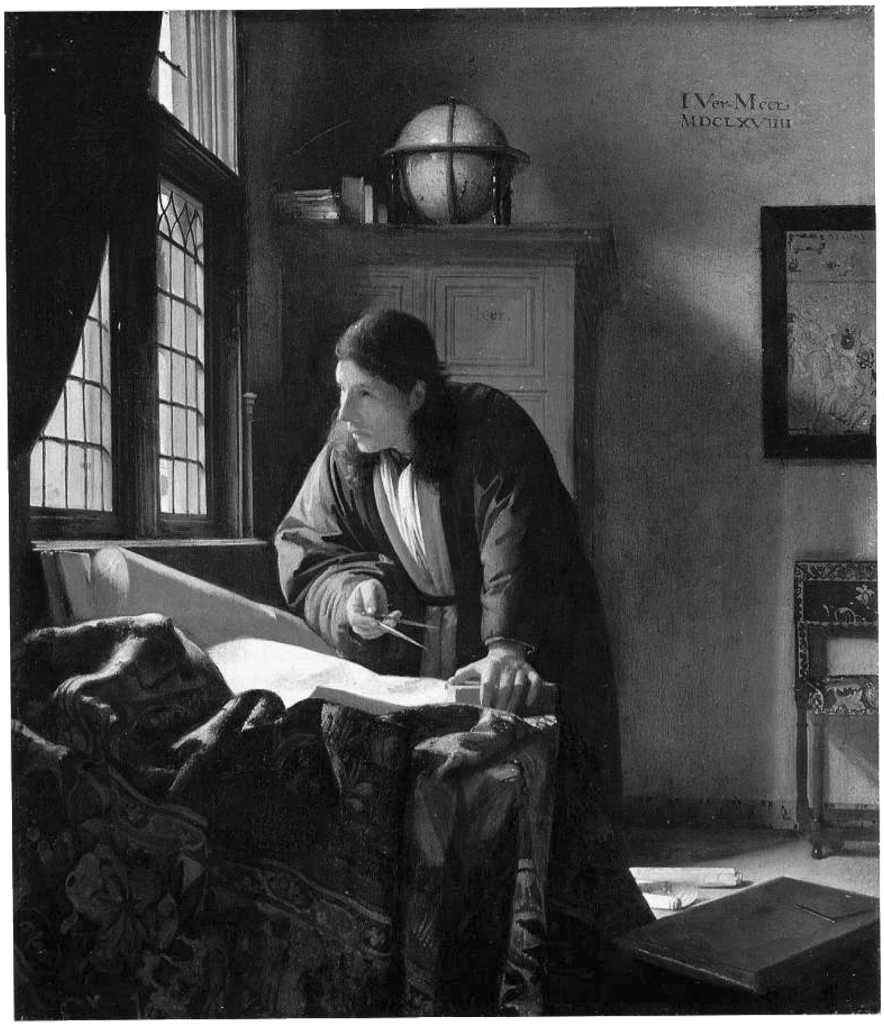


Figure 10. Vermeer, Geographer *1669. Frankfurt, Stadelsches Kuntstinstitut.*

remained the (still continuing) centuries of work to apply these tools to the survey of a planet. Development, change, and (dare I say) progress was manifested at a comparative snail's pace. The eighteenth century militarization of cartography hastened the separation of cartography from visual art, with the map ascending to a new status as a ground for contact among Enlightenment ideals, "the application of rational methods to practical ends" (Edney, 1994, p 18). Capping it all, the nineteenth century romanticizing of the figure of the artist in society and fiction, and the general course of development for art in the twentieth century, has done little to close the rift.

That romantiticization had its roots in the Renaissance and in the usurpation of the term 'creation' (hitherto reserved as an activity of deities) attributed to Michelangelo. In part it held that the act of artistic creation was of mystical or divine origin. In the nineteenth century this notion of artistic activity became very deeply entrenched in the cultural consciousness (even where it was ridiculed), but it was strongly challenged in the twentieth century by the Early Modernists. The Russian poet Mayakovsky (1970) spelled this challenge out quite plainly:

> Our chief and enduring hatred falls on sentimental-critical Philistinism... This facile Black Mass is hateful to us because it casts around difficult and important poetical work an atmosphere of sexual trembles and palpitations, in which one believes that only eternal poetry is safe from the dialectical process, and the only method of production is the inspired throwing back of the head while one waits for the heavenly soul of poetry to descend on one's bald patch in the form of a dove, a peacock or an ostrich. (p 11-12)
>
> Poetry is a manufacture. A very difficult, very complex kind, but a manufacture... The work of the verse-maker must be carried on daily, to perfect his craft, and to lay in poetical supplies... You mustn't make the manufacturing, the so- called technical process, an end in itself. But it *is* this process of manufacture that makes the poetic work fit for use. (p 57)

One of the disappointments of Early Modernism was its ultimate failure to oust and eradicate the engrained sentimental attitudes to art practice, which continue to haunt us. In some respects it was this rejection by the Modernists of sentimentality and romance, illusions dearly held by the general populace, which contributed to the alienation of art practice from the common experience. This agitation instead had the ultimate effect of widening that gulf which disallows the 'scientific' cartographic practitioner from accepting the existence and legitimacy of his or her own art practice.

"One of the disappointments of Early Modernism was its ultimate failure to oust and eradicate the engrained sentimental attitudes to art practice . . ."

I. Definition

I would like to get out of this section without falling into the trap of actually having to define art. Art must ultimately be explained in terms of art, and not from a non-existent 'outside'. I believe that the conceptual model I am putting forward, that of art as a means of expression rather like a language, obviates the requirement of that attempt. It is neither the dictionary, nor the grammar, the etymology, or any particular type or example of literature that defines any language; spoken, written or visual. Instead, I would point to the whole body of art, and to its constituent or participant aspects paralleling the participants of language just mentioned.

I am not writing a primer on art, and will not be dictating just how a conversance with aesthetics is to be obtained. In regard to a demand for a definition, I will again quote Pound (1960):

> I refrain from indicating the chief device here employed […] The student should find it for himself.
>
> He can only find it by listening and looking. If he can't find it for himself no amount of telling will make him understand it. There is a single clear principle employed.
> (p 152)

John Krygier (1995) examined the art-science dichotomy and, despite its widespread currency in various flavors, found it wanting as a model for cartographic practice. Krygier proposed a process-oriented view of cartography to unify this seeming split, and such a view might indeed suffice if the cleavage was only along that art-science line. A process, though, must have some guiding principle; there must be a rationale under which

the process can function. That principle is that the map is a persuasive argument, and the process (if one is to be identified) is the process of the construction of that argument. So, I would put forward, it is only through an understanding of the inherent and fundamental rhetorical nature of cartographic practice that the apparently disparate elements (be they art and science, or the rather more inclusive and less loaded terms that I have used: the cognitive, semiotic, and artistic) can be brought into an alignment.

V. CARTOGRAPHIC RHETORIC

"That principle is that the map is a persuasive argument, and the process is the process of the construction of that argument."

I have thus far discussed cartography from each of the three registers I outlined at the start of this paper: the cognitive, the semiotic, and the artistic. Throughout the discussion, I have maintained the assertion that the three registers are essentially the same phenomenon examined from different vantage points. A parallel might be drawn between the viewpoints established by these registers and the viewpoints utilized in an orthographic drawing. Unifying these disparate vantages is the concept of the map as a rhetorical instrument.

The most familiar definitions of rhetoric present it as "the art or the discipline that deals with the use of discourse, either spoken or written, to inform or persuade or move an audience" (Corbett, 1990, p 1). That rhetoric is an *'either spoken or written'* discourse, has been the commonly held, and generally rather pejorative, conception of rhetoric for many years. But Aristotle (1954) defined rhetoric as 'the faculty of discovering all the available means of persuasion in a given situation' (Corbett, 1990, p 1), which is a very much broader and more useful conceptualization. Certainly, Aristotle and the classical rhetoricians saw themselves as working their persuasions with words, and not as we are here, with a graphic product; but it is neither improbable nor unprecedented to insist upon extending the term in this way. It can be seen to be not improbable

> when one is reminded that the Greek word for persuasion derives from the Greek verb 'to believe', [and] one sees that Aristotle's definition can be made to comprehend not only those modes of discourse which are 'argumentative' but also those 'expository' modes of discourse which seek to win acceptance of information or explanation. (p 1)

". . . there can be a great deal to be persuaded about with any particular map. How can this persuasion be achieved?"

Precedent for the usage can be found in the recent focus on the issue of rhetoric in the fields of product and graphic design, significantly so in the writings of Richard Buchanan (1989). His work on "communication as rhetoric, the inventive and persuasive relation of speakers and audiences as they are brought together in speeches or in other objects of communication" (p 91) is significant to the wider understanding of rhetoric to which I refer.

> Although not so obvious at first glance, the themes of communication and rhetoric … exert strong influence on our understanding of all the objects made for human use. (Buchanan, 1989, p 91)

Central to this notion of 'communication as rhetoric' is a recognition that the aim of the endeavor is persuasion, to convince someone to believe something. As we saw in the discussion of extrasignificant codes and their function in construction of the mythical deployment of the map, there can be a great deal to be persuaded about with any particular map. How can this persuasion be achieved?

A. The rhetorical appeals

The classical rhetoricians recognized that a speaker has three means of persuasion: the appeal to reason (*logos*); the appeal to emotions (*pathos*); and the appeal of the speaker's character (*ethos*). Aristotle referred to these as the 'artistic' proofs to separate them from the five non-artistic proofs: laws, witnesses, contracts, tortures, and oaths. While the orator needs only *discover* the non-artistic proofs, s/he must *invent* the artistic. Some of the non-artistic proofs, such as tortures, are not generally available to the cartographer, while other proofs, for example, witness in the form of surveyor's data, are basic sources of mapping information. Many more examples of this type of documentation may be cited, and these make up important persuasive arguments for the map. The map, however, is *derived* from these sources (deeds, the surveyor's notes, etc.), from these *non-artistic* proofs. The map is *composed* by employment of the *artistic* proofs. Buchanan (1989) refers to these artistic proofs as 'design control elements', and I think that, for convenience, we can adopt Buchanan's vocabulary.

1. Logos

The rational appeal, or logos, is essentially a logical argument. It is an appeal to the understanding. The reasoning can be deductive (working from general principles to particular conclusions), inductive (from particular statements to general conclusions), or a generalization, but it is important to note that in rhetoric the burden of proof is not anything near as onerous as in strict logic. Rhetoric aims to convince the audience of probable truth, as opposed to logic's requirement to prove the conclusion to be logical. The contrast is the same as in criminal and civil law, where (in theory anyway) only in the former must the case be proved beyond a shadow of doubt. In rhetoric, as in civil law, only the probability need be established. The vocabulary of classical rhetoric acknowledges this by employing terms differing from those used in logic. The particulars of the vocabulary, however, are not essential to this discussion, if the ideas can be broadly grasped. The utility of the distinction was explained by Eco (1976):

"In cartographic design terms, the logos governs the fitness for use, the usefulness of the map."

> Almost all human reasoning about facts, decisions, opinions, beliefs and values is no longer considered to be based on the authority of Absolute Reason but instead intertwined with emotional elements, historical evaluations and pragmatic motivations. In this sense the new rhetoric considers the persuasive discourse not as a subtle fraudulent procedure but as a technique of 'reasonable' human interaction controlled by doubt and explicitly subject to many extra-logical conditions. (p 277)

In cartographic design terms, the logos governs the fitness for use, the usefulness of the map. In seeking to identify it we ask: what is the subject matter?, what is the theme of this map? The logos is the concept we would expect to be encapsulated in the title, and is the rationale for having a map at all. This logos is the aspect that a purely mechanical theory of communication would consider to be the totality. In its bald form the information might or could be as well presented as a table of numbers, a paragraph of text, or by some other means but there is a reason why it is presented in map form, a reason why a map is an appropriate form to be taken. It is important to not mistake the data itself for the logos; it is not the numbers

as numbers but instead the reason for presenting the numbers as a map at all that is of significance here.

2. Pathos

While some might argue that in an ideal world (the thesis of Voltaire's Doctor Pangloss notwithstanding) reason would guide all our thoughts and actions, it should be obvious that passions, prejudices, customs, and mythologies are more often than not the dominant influences. This is the place where pathos, the emotional appeal, operates. It works, that is, on the naturalized assumptions of the audience. These passions, prejudices, customs, and mythologies *may* be recognized for what they are (that is, as mythologies and whatnot) by the holders of the assumptions, but it is far more likely that they are not. Most probably the audience's world view has been internalized to such an extent as to be indistinguishable to the opinion holders themselves from self evident fact. An understanding of psychology, history, and culture, and of the functioning of mythology, is imperative to the employment of such an appeal; ineptitude in that employment can backfire disastrously. Still, the pathos of the map is not restricted to the overall emotional appeal. We should view this element as the manner in which the map is made usable. Logos, as we saw, is the way the map is made fit *for* use, while pathos is the manner in which it is fit *to* use. This fitness is made by means of what is referred to as design affordances, the handles (so to speak) by means of which the user gets a hold on the map content and makes use of it. A bicycle with a gel seat is more fit for use than one where the rider perches on a steel bar: the former has a more effective 'pathetic' appeal to fitness. Ergonomics is one type of affordance, while a map legend could be cited as another, and as, indeed, could be the map graphic itself. The surveyor's notes are transformed into a plan by application of the element of pathos, which allows us to see (as a laid out plan) the embodiment of the noted measurements. This particular example is at the most primary level, but the principle can be applied in all situations. Much of the research I have identified in the cognitive register is directed to facilitating effective emotional appeals: the user chooses the map which seems most useable, that is, the map which seems most accessible to their use.

". . . while pathos is the manner in which it is fit to *use."*

3. Ethos

The ethical appeal, that which is called the ethos, rests on the apparent or implied authority or character of the speaker or of the 'object of communication'; especially as that character is presented in that 'object of communication' itself. This appeal carries a great deal of weight, and indeed Aristotle thought that it could be the most powerful of the modes of persuasion. The designation of 'Official', or a governmental logo on a map, imparts an authority to the product that is hard to overestimate. It is very much easier to convince ones audience of almost anything if that audience can be first convinced of the high character of the speaker, and conversely very difficult (if not impossible) to make headway against the unfavorable prejudice of ones hearers. This appeal is of especial interest in connection to cartography, because of the special, and perhaps unique, position the map holds in the regard of much of the public. As has been noted before, the map is accepted as authoritative very much more readily by many persons than is speech or writing. Graphs have a similar power, but are more open to critical interpretation. Perhaps it is because the graph carries much of its constructive structure explicitly, in the labeling of its axis'

for instance, while much of the map's structure is less visible, and hence less well understood. Without doubt, the comparative, and often quite absolute, map illiteracy on the part of the community of map usage (i.e., the community of users) plays a significant role in the sometimes almost religious regard that public has for maps in general. To Gene Shepard's typical 'walking around type guy' a map often seems a thing that must have leapt into the world fully formed, just like Pallas Athena sprang from the head of Zeus (assuming he knows that story…). The indignation with which a discovered or perceived 'mistake' on a map is met is indicative of that regard.

However, as in our discussion of pathos, ethos is wider than these obvious aspects. The 'voice' with which the map speaks, the ethos of the map, shapes the desirability of the map. We have before us a map: it is useful (logos), and it is useable (pathos), but is it the *right* map?, the *appropriate* map?, is it the map we *want to trust*?, is it the map we *want to use*? This aspect of desirability is not one to be dismissed. Given a range of products with all aspects of usefulness and usability being equal, we will choose one: the desirable one. The desirable features we look for will vary with our needs and inclinations, but we will choose to use the map, object, or whatever in which we feel comfortable placing our faith. We place our faith in that which, apparently, deserves it. We chose different furniture for our offices, formal living rooms, and cottages because of the voice with which that furniture speaks; it is to the ethos of the design that we respond. Similarly we select or (should) design our maps to speak with the voice we expect or require. It is from and through each map that the ethos will speak. A 'Young People's Guide' to a city will have to speak in a very different voice from a 'Scenic Parks and Walks Guide'. The voice of either will be quite distinct from both del Tredici's *Nuclear Map of Canada* (2001) and from the officially sanctioned "Non-Ferrous Metals: Western Canada, 1970" in *The National Atlas of Canada* (1974). If the map speaks in an inappropriate voice, it will shout down even the best and finest work: simply stated, no one will believe in it. That voice shouting is the voice embodied by each individual map product as it is constituted in each instance to each user.

"Given a range of products with all aspects of usefulness and usability being equal, we will choose one: the desirable one."

B. Some examples

While every map utilizes each of the 'design control elements', or means of persuasion, individual examples may be identified that seem to exert a dominant or particular appeal. Let us look for these elements by looking at examples of three quite different maps. The first is an example of the early, provisional edition of the *Community Map* series produced by the Halifax Regional Municipality, the 'Bedford' sheet (*figure 11*). The second is the (1998 proposed) *Halifax Regional Municipality Visitor Map* (*figures 12 and 13*). The third map is *Voyage Beyond Three Seas* (*figure 14*), a map depicting the travels of Afanasy Nikitin, a fifteenth century Russian traveler. I designed each of these three maps with quite distinct goals and audiences in mind: the first is a provisional worksheet, the second a basis for a finished mass distribution map, and the third as an illustrative appendix to a topical book. (*see appendix for color version of maps*)

1. Community map of Bedford, NS

The Bedford map is quite spare. It is a street map of the community (the former Town) of Bedford, Nova Scotia. The streets are depicted as single lines, without hierarchical differentiation, with the streets named using an

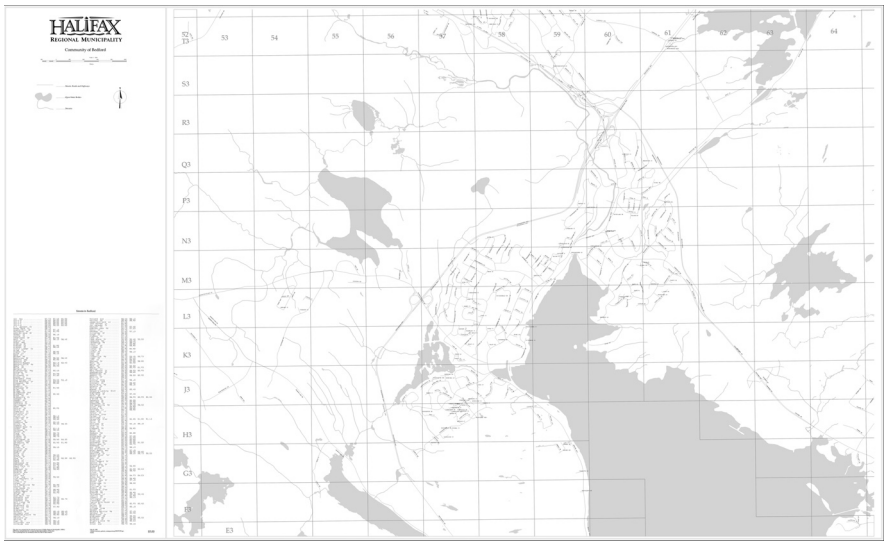


Figure 11. Community of Bedford, Halifax Regional Municipality, Nova Scotia – original: 55 inches x 33 inches. Bedford *from the* Community Map *series 1998. (see page 79 for larger scale)*

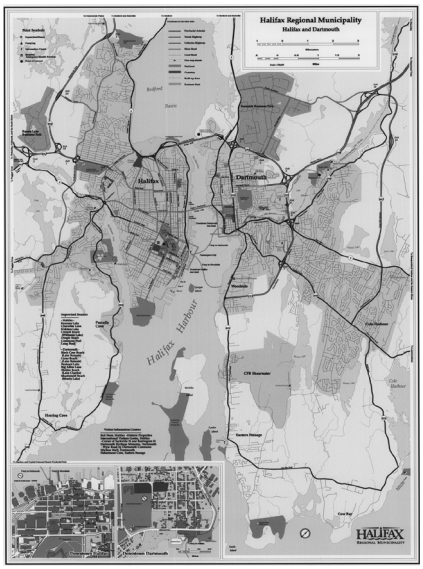


Figure 12. Halifax Regional Municipality Visitor Map*: side 1. M. Denil – Halifax Regional Municipality 1998. (see page 80 for color plate)*

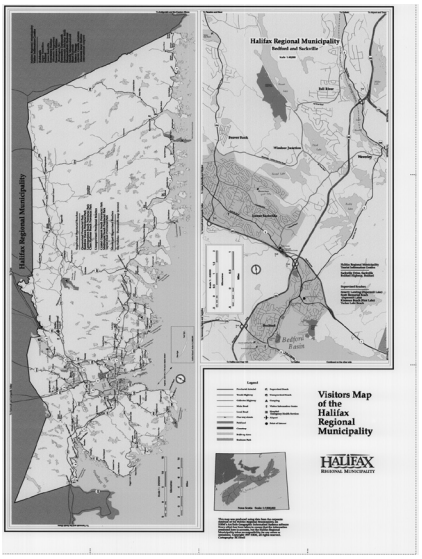


Figure 13. Halifax Regional Municipality Visitor Map*: side 2. M. Denil – Halifax Regional Municipality 1998. (See page 81 for color plate)*

automatic computer name placement routine. The text is in all capitals and may in some instances be less than ideally positioned. A locational grid is overlaid on the map, allowing grid locations to be identified by means of an alpha-numeric Cartesian designation. Along the left side of the map is a rectangular block with the map title, scale bar, north arrow, a basic legend, a legal disclaimer, and a street index. The street index identifies the geographic extents of the street in relation to the grid; not every grid area through which the street passes, but rather the furthest north, south, east, or west the street extends on this particular sheet. A short street entirely within a grid area will have only one designation, while a longer street may have up to four. If a street extends off the edge of the map into terri-

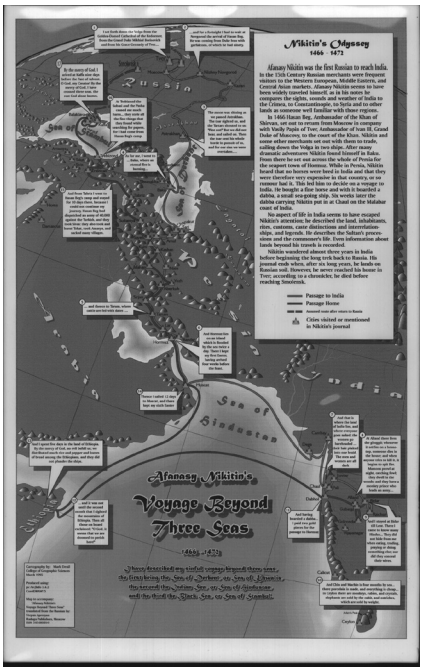


Figure 14. Voyage Beyond the Seas. *M. Denil. 1995. (see page 82 for color plate)*

tory that may, perhaps, be depicted on a different map of the series, only the portion of the street appearing on this sheet is listed in the index. The grid areas are not, as is often the case with such systems, squares but are instead rectangles; it is, in fact, the Province's geographically (latitude and longitude) based grid of 1:1000 map sheets for the area of the Municipality. Because the grid is a single one for the entire 5,000 odd square kilometers of the Regional Municipality, the relationship between the grid on this and any of the other maps in this series is constant. This *Community Map* series was a provisional one, and several design affordance elements were eventually incorporated in an improved version which is, I understand, still on sale in Municipal offices.

2. Halifax Regional Municipality Visitor map

The Visitor map is a two-sided affair, printed in color, and designed to fold to a handy pocket size. The street network here is divided into a five level hierarchy, indicated graphically by differences in the color, width, and complexity of the line symbols. The urban and suburban areas are depicted at various scales, and there is a relatively small-scale map of the entire Municipality as well as a location map showing the Regional Municipality's geographic situation in Maritime Canada. The folding scheme is planned in such a way that, by refolding along the existing creases, each particular area map can be viewed conveniently. There are a number of locations identified on the map(s); hospitals, points of interest, parks, beaches (supervised and not), etc., and depiction of the areal extents of the built-up and business park zones.

3. Voyage Beyond Three Seas

Voyage Beyond Three Seas is another color map, rather smaller than the other two. It was designed as a fold out illustration for the published journal of Afanasy Nikitin (1985), but has never been included in any publication of that book. The projection is a perspective one, an inclined view of the globe from the distance of a single global diameter. Mountainous regions are depicted by means of 'mole hill' or 'sugar lump' symbols. Beside an explanatory synopsis, various anecdotes excerpted from the text of the story are included in their appropriate locations along the route, and each city mentioned is identified as well.

C. Evaluating the appeals

The dominant or particular appeal of each of these maps could be identified as: Bedford = logos, Visitor = ethos, and Voyage = pathos. The spareness and directness of the Bedford street map situates its appeal close to the data, it identifies the overall tone of the map as a bald retelling of the information. The Visitor map's appeal is an argument from authority; this is OUR territory as WE see it. WE have decided the true, official, street hierarchy, at THESE beaches we will protect your safety, and so on. With the Voyage map the tug is on our emotions. One can see the vast distances this lonely traveler has wandered across the planet. Just look at the cities rising from the plains and the tracks winding through the mountains! What distances! What adversity! What determination!

What is it that allows us, or persuades us, to believe that these overall appeals are 'true' or 'correct'? Examining the situation from another level, we could say that we are really describing a part of the ethical appeal of each map; the rhetorical element that determines the desirability of that

particular map for its use. The ethos of the Bedford map, the voice with which it speaks, is that it *would have us believe* that it is 'close to the data'. The Visitor map *would have us believe* that being 'official' is the same as being 'true'. And the Voyage map *would have us believe* that Nikitin's was a journey of epic proportions. Each map is desirable for certain purposes, and each map speaks to us of its desirability.

"Each map is desirable for certain purposes, and each map speaks to us of its desirability."

These distinctions are important for understanding the functioning of the rhetorical appeals in cartography and by extension in other design work. Ethos *is not* authority, pathos *is not* soapy emotions, and logos *is not* a 'technical' or unadorned presentation (*nor is* logos the data); however, the ethos of each map may try to *make us believe* that it might be any of these. If that which we thought we had identified as the appeals are not, where then do we find the rhetorical elements? We have to go back to the ideas of logos, pathos, and ethos as governing, respectfully, usefulness, usability, and desirability. The ethical appeal of each of our examples has already been touched upon; what of the logical and emotional appeals?

The logos of each of the maps is located in the usefulness of that map; it is discovered by asking what the subject of the map might be. The subject of the Bedford Map is to be a guide to street location and/or to form a base map, or contextual ground, for other thematic data. That of the Visitor map is the ease of travel to all the varied and multitudinous places to visit and see in the Halifax Regional Municipality. The Voyage map's subject, and hence its logos, is the itinerary of our observant, wandering merchant.

"The logos of each of the maps is located in the usefulness of that map; it is discovered by asking what the subject of the map might be."

Pathos governs the usability of each map: it determines what elements are present and how they are presented (given the voice of the ethos). It is through the emotional appeal, through design affordances, that on the Bedford map the streets are depicted graphically. It is through affordances that they are named on the map face, that they are named in a list, and that there is a cross-reference in the form of a location grid. Each of these elements provides an access to the streets in Bedford, each alone and in conjunction with the others.

Let us imagine that we have a street name in mind, a street that may be in Bedford. The list tells us that a street with that name is on the map, a useful bit of information. The Cartesian coordinate reference listed with that name allows us to use the grid affordance to locate the street. Only once we get to this stage can the graphic representation allow us to determine the place of this street in the topology (connectedness) of the network, to discover how we get there. This is only one path (path that is, of discovery, not of travel down the street) and destination (where is this street?) afforded us through the information; many other query paths and destinations are conceivable. Without one or another of the design affordances utilized here, however, the range of possible paths to finding out what we wanted to know, or even what we could find out, would be more tightly circumscribed. As well, affordances could be added to enhance and expand the access; if the streets were classified hierarchically, we could better determine the best or most efficient route through the network, or could speed our visual search in other ways. A key, or location map would let us identify the area on this map in relation to a larger zone, and/or to other maps in the community series.

"Pathos governs the usability of each map: it determines what elements are present and how they are presented (given the voice of the ethos)."

Other affordances on the Bedford map determine, for instance, the existence and layout of the title block. So too is the way the map information stops one tenth of an inch from the neat line, creating a visual as well as a conceptual separation of what we might call map space from paper space. The other example maps, being of greater complexity than this one, naturally exhibit greater complexities in the affordances, in these appeals

to usefulness. One could cite the symbols employed, the supporting texts, the colors, the layouts, among other things. In other words, all the parts that make the map useable could be listed: the pathos uses the voice of the ethos to present the logos.

Naturally each appeal is interdependent on the others. If the emotionally determined affordances are not appropriate to the subject, then the voice with which the map speaks will not be the one expected. It is this very interdependence that makes a conversance with the rhetorical appeals imperative. The interrelationship between the logos, ethos and pathos is not fixed either, but relative. That is to say that no element of the three is ever 'left behind' in any decision or detail of the design process; at no point can one or another of the elements be disregarded. Together, these three appeals or design control elements make up the voice with which the map speaks. The ethos works with the pathos to serve the logos, just as the logos and ethos direct the pathos, while the pathos and logos underpin the ethos. Each control element meets and operates in each decision, and at each stage of the composition of each map from the earliest stages onward.

D. Summary thoughts on Cartographic Rhetoric

In order to gain and maintain a working control of the rhetoric of the map, the various registers of understanding I introduced in this paper must be marshaled. It is under the rubric of rhetoric that these registers—the cognitive, the semiotic, and the artistic—can be seen as simply distinct views or aspects of cartography. It is not cartography that changes, but the vantage or point of view. The quest of rhetoric is to employ all available means to persuade. Without a command of these registers of understanding, employed through the rhetorical appeals of logos, ethos, and pathos, all available means of persuasion are not in the cartographer's hands.

"It is under the rubric of rhetoric that these registers—the cognitive, the semiotic, and the artistic—can be seen as simply distinct views or aspects of cartography."

VI. CONCLUSION

We have seen how each of the more traditional approaches to cartography, which I have identified as the cognitive, semiotic, and artistic registers, can be recognized as integral supports of the rhetorical cartographic model. Each is, by itself or paired with one other, inadequate to describe the nature of cartography or to serve as a guide to practice or understanding. Only the threefold conjunction of the registers, united under the rubric of cartography's rhetorical nature, can provide the guide to practice that was sought at the beginning of this paper. The boundaries of the registers themselves are not critical, because other configurations of these approaches are conceivable, but the registers as I have framed them are a convenient categorization and happen not to leave any loose ends or awkward corners poking out.

Obviously, there can be no transfer of information, there is nothing that can be 'gotten across', which is not configured in a communicable form. The forms of communication are rhetorical; that is to say, ideas can only be conveyed with reference to an audience, and that reference must necessarily be subjectively infiltrated. A map is, in fact, a persuasive argument placed before an audience and like any proposition or argument, must be addressed to that audience.

A map is made for a map user who could be anyone (and may in fact be the map maker her or him self), but that user will in every case have certain needs that the map must address. The needs are for a useful map (a map they need), a usable map (a map they can use), and a desirable

map (a map they want to use; that they desire). These needs are brought to the map by each user, and a map will have to meet each need, or it simply will not be employed.

These human needs are addressed, as we have seen, by the design control elements which we have labeled logos, pathos, and ethos; terms taken from classical rhetoric. Logos, the reason for making a map, addresses the use of the map. Pathos is concerned with the ways the map is rendered usable to the audience. It is the part of the ethos to induce the potential user to choose a particular map; to convince the user to desire it, to believe it and to be guided by it.

The interrelation and interdependence of these rhetorical elements is often not properly understood by practitioners and theorists. In many situations the notion held would seem to be that somehow simply 'laying bare' the data will 'get across' the information without the taint of extraneous 'frills'. One upshot of this thinking is attempts to posit some kind of dichotomy of visualization and presentation, so-called 'GIS Visualization', as some have attempted recently. These attempts are predicated on an inherent fallacy; to wit, that somehow 'presentation' has been rendered extraneous by the advent of electronic data storage and manipulation. The fact is, one cannot talk even to oneself without some kind of code, that is to say without some kind of rhetorical framework which has some sort of valid meaning to the one addressed. Talking to oneself is not fundamentally different from talking to anyone else. It is less than obvious why the whole 'visualization' hooha has arisen.

"Hanno Ehses of the Nova Scotia College of Art and Design has proposed that this identification can be made in any graphic or other product by posing five basic questions."

In practice the question arises of how one is to identify and address the rhetorical design control elements of use, usability and desirability, or logos, pathos, and ethos. Hanno Ehses of the Nova Scotia College of Art and Design has proposed that this identification can be made in any graphic or other product by posing five basic questions. Adapted to a cartographic context, these questions are:

1. What is the subject of the map?
   What is the logos? To what use should this map be fit?
2. What is the voice with which we want the map to speak?
   What is the ethos? Who are we, and whom are we addressing?
3. How will we make this map useful?
   What is the pathos? What questions are likely to be put to this map, and how will this map be able to answer?
4. What is the argument forwarded by the map?
   What should this map be stating clearly? What does it attempt to say about the subject (the logos)? Note that we are not asking here what the logos is*, but rather what the map is saying about it.*
5. What is the purpose of the map?
   Why do we want a map, anyway? Why not something else?

The mapmaker (or user) can use these questions to construct (or deconstruct) the conceptual framework of the map. Ambiguities or contradictory aspects of the project or product can be identified and either corrected by the mapmaker or compensated for by the user. The questions should be addressed at the outset of a project, and reviewed at intervals throughout its progress. It must be clear to the map maker and to the client at every step just *what is to be spoken about*, *who s/he is that is speaking*, and *how the user will be able to take advantage of what is given*.

Each aspect must buttress and in turn be supported by the others: the appropriateness of each decision to the constructed argument is the arbiter. The voice of the map and the direct, immediate purpose for the pro-

duction of the map will figure largely in the selection and implementation of the design affordances. In other words; it is the voice of the map as a 'speaker', a speaker with a clear topic and agenda, which will dictate what 'words' are actually employed, and in what manner they are utilized, to construct the map's argument.

Since all the map can ever present to the user is an argument, it is the role of the cartographer, as rhetorician, to assure that the map presents the best and most convincing argument available.

Final Thoughts

I have attempted to analyze the nature of the cartographic activity itself, and to propose a manner of understanding that nature which is general, inclusive, and practically applicable. These concerns might be dismissed by some as an obsession, or of interest only to someone under the spell of a passion, and inexplicable to others who are not so charmed, but that would be a mistake. These issues are fundamental, and rightly stir profound passions. Pound (1960) put it succinctly:

> It is very difficult to make people understand the *impersonal* indignation that a decay of writing can cause men who understand what it implies, and the end whereto it leads. It is almost impossible to express any degree of such indignation without being called 'embittered' or something of that sort. (p 34)

Cartography is facing new challenges in these days of desktop application egalitarianism, 'quick and dirty' output, and a general discounting of 'mere cartographic concerns'. The questions surrounding the so-called new challenges to cartography can, under the rhetorical model be seen for what they are: questions relating to specificities of implementation. The challenge is to master the new tools, and to bring them to bear on the production of what is, underneath a sometimes gaudy skin, the same kind of cartographic arguments we have, as cartographers, been producing (with generally fair success) for quite some time. This is not to say that we can just trundle along in a naively secure fashion, cherishing the same quaint and curious notions about our service to 'science' and to 'truth'. No, we have got to come to grips with the nature of our activities and our conception of the nature of these activities has got to focus on what cartography is, rather than what maps have been thought up till now to be. Cartography is and has always been a rhetorical activity because the only reason for making any map is the presentation or preservation of some opinion, of some argument, of some value judgment. If we can recognize the centrality of rhetoric to cartography, and by corollary abandon the hallucination that cartography has any specific subject matter, then the future of cartography looks as bright, and promises to be at least as long, as its past.

"If we can recognize the centrality of rhetoric to cartography, and by corollary abandon the hallucination that cartography has any specific subject matter, then the future of cartography looks as bright, and promises to be at least as long, as its past."

CODA

> There is nothing either good or bad,
> *but thinking makes it so.*
> Hamlet [II ii 265-6]

The questions of what makes a good map, and how a good map is to be made, have been of concern to mapmakers for quite some time. Certainly, there is a tremendous body of literature about cartography, from Strabo (and perhaps earlier) to the present, examining the practice and products from all manner of angles and vantages, but it is conspicuous that no complete and consistently applicable theoretical description of cartography has ever been set out. It is not as if no one has ever found or made a good map; obviously good maps (or maps deemed good) have abounded, alongside others deemed perhaps not so very good, and still others barely identifiable as maps. How is one to judge? How is one to proceed? Is it just what one likes? If so, what does it mean to be likable, and how is the map rendered likable?

Some of the myriad writers on cartography have tackled these questions of what it is that makes a good map and have, from time to time, come up with answers of sorts. The usual process is to examine some maps and draw some conclusions; arguing from the particular to the general. The problem with this approach is the tremendous variety of things that can, have, could, and will be, and often or sometimes are made, seen and / or used as maps. In the absence of a theoretical grounding, examining any broadly representative sampling will highlight the variety of differences as much or more than the fundamental similarities. Non fundamental, anecdotal specificities of variety may lend itself to the construction of typologies, but any taxonomy of maps ends up resembling the categorization of animals:

> which doctor Franz Kuhn attributes to a certain Chinese encyclopaedia entitled *Celestial Empire of benevolent Knowledge*. In its remote pages it is written that the animals are divided into:
> (a) belonging to the emperor,
> (b) embalmed,
> (c) tame,
> (d) sucking pigs,
> (e) sirens,
> (f) fabulous,
> (g) stray dogs,
> (h) included in the present classification,
> (i) frenzied,
> (j) innumerable,
> (k) drawn with a very fine camelhair brush,
> (l) et cetera,
> (m) having just broken the water pitcher,
> (n) that from a long way off look like flies.
> (Borges 1999)

Neither this nor any other taxonomy would help us define animals in general. Similarly, it is not obvious how a theory of cartography would begin with a taxonomy of maps.

Another approach has been to focus on 'fundamentals' of cartography. Cartographic Fundamentalists have centralized the elemental manuals of mechanical procedure as the key to understanding mapping practice.

Certainly, there are a number of such manuals, and no one would seriously contend that competence in sound technical practice is without an important place in cartography. Centralizing technical practice, however, would imply that if everything is 'done right' the result would be a perfect map. Is a technically 'correct' map always a *good* map? Could it be that something beyond the textbook fundamentals is required?

What is it that is common to all things we might call a map? Is it not the need or desire to put forward some view? To present to some audience an argument about a situation (be it perhaps the lay of the land, the usual number of frost free days, or the nesting range of the Piping Plover)? It seems obvious that this is so. Not only does a map always, and necessarily, put forward a position, but it uses three main means of framing that argument to its audience. There must be a *reason* for forwarding the position, the position must be *understood* by the audience, and the position must be seen to be *believable* by that audience. No matter what the subject, no matter what the medium, no matter what the use, no matter what the audience: that an argument is forwarded in reference to an audience is common to all maps, each and every one. This argument in reference to an audience is the central defining nature of cartographic practice. If the map fails in this endeavor, it fails as a map; if it prospers in this, it succeeds.

The activity of forwarding an argument in reference to an audience is the definition of Rhetoric. Defining cartography as rhetorical conceptualizes the practice as one without specific subject matter and allows us to examine cartography itself as opposed to examining individual maps or processes of manifestation. It makes accessible as well the language and concepts of classical rhetoric to frame our investigation.

The three main means of framing the cartographic argument, as mentioned above, constitute the appeals of usefulness (the reason for a map), usability (a map that is understood), and desirability (a map that is believed). Other appeals the map makes are determined by the information presented or employed; this data is brought to the map and presented in a manner framed and controlled by the main appeals. The data is critical but it is not what runs the show on the map; that is province of the main appeals. All well and good, one might say, but how is this put into effect?

Classical rhetoric was based on speech and writing, and it developed an elaborate and detailed structure to describe and understand how spoken and written argument was constructed, presented and understood. The tropes and figures, along with the analysis of parts of an oration, examined and made available to the rhetor means and tools for constructing and presenting his arguments. Cartography has a large body of literature examining and describing the various aspects which play a part in the manifestation of a particular map. There is as well a large body of writing which is applicable to cartographic practice, but which may or may not be commonly tapped by cartographers. In the course of this investigation I organize these aspects attendant to cartography into registers of concern. It should be noted that these are not exclusive categories of maps, styles, materials, or methods, but are instead characterizations of analytic concerns making up what can be identified as viewpoints, any one of which is a valid and useful position from which to interrogate a map. In fact, not only is each valid and useful individually, but all, collectively united under the rubric of rhetoric, are necessary for a full understanding.

To recap: rhetorical argument is what the map does, forwarding appeals of usefulness, usability, and believability, grounded in data, through various mechanisms (organized here into registers). In the vocabulary of classical rhetoric, the map is composed by the invented appeals (useful-

ness, usability, and desirability), and derived from the discovered appeals (data), through the available means (the registers). Comparing a map to a wall, one could say that data are the bricks, the registers are the mortar, and the invented rhetorical appeals are the design and rational for the construction.

Rhetoric, as we can see, gives us a means of answering the questions about how a good map can be made, as posed above. It does so while, admittedly, leaving the term *good* somewhat unexamined. Obviously, the term is used here in a very narrow sense; a good map being defined as a map which functions well as a map in a context or situation. It could be argued that this approach to cartography is amoral; that it completely ignores the imperatives of ethical behavior and fails to examine the processes that give rise to the norms and conventions that have immediate day-to-day impacts on cartographic practice. It could even, I suppose, be argued that this could be an unprincipled guide for the cartographer as mercenary. I would not deny that it could; in fact it would be required to be so usable. Any complete theory of cartography would have to allow for and include all observed phenomena. Have we never seen 'misleading' maps? Have there never been maps that distort a situation in some manner to make some questionable point or mislead some person or persons to a particular conclusion? I think we can all recall examples. Do, however, *these* maps, in working this persuasion, use some means substantively different from that of any other map? I think not.

Ethical consideration should always direct the cartographer; ethical imperatives are, however, culturally determined (for instance in a society or within a business concern). Any particular culture will have quite specific drivers and responses to situational and political pressures that, while analogous and useful in comparison to another culture's response, would not be universal or common. I am not an ethicist; any discussion of situations or imperatives I could forward would be framed only by my own ethics and karma. My own ethics are, of course, beyond reproach, but an exposition of *my* ethics would be of little general value because it would simply constitute a specificity, out of place when we are looking for commonalities. The great Greek rhetorician Isocrates didn't claim to inculcate virtue either; he said, "let no one suppose that I claim that just living can be taught; for I hold that there does not exist an art of the kind which can implant sobriety and justice in depraved natures." (Isocrates 1928) The intention here is to present an understanding of cartography and cartographic practice that can serve as a stage upon which ethical considerations can stand exposed and play out their parts.

That said, it will be noted that in this paper I *do* discuss what I identify as the *ethos*, or ethical appeal of the map; it is this appeal which governs the map's believability. While I focus on the ethos the map *presents*, and which in many cases it only *pretends* to hold, I acknowledge that there must really be an ethical grounding present; however shoddy or fine it really is when the daylight shines upon it. Again, I only point to the place; *you* have to fill it yourself.

Very seldom is a cartographer in a position to be in control of his or her map's ethical stance. If the cartographer has naturalized and internalized the assumptions, prejudices and mythologies of his or her clients (patrons), then the cartographer is unlikely to ever detect any ethical dilemma. If, on the other hand, the cartographer finds him or herself questioning or in conflict with these framing assumptions, and fails to persuade others to go along with their views (assuming there is even a forum for or possibility of such a persuasion), there remains only the options of submission or resignation (the boss' way or the highway). Continued sur-

render lends itself to internalization of the dominate belief structure, as the cartographer learns to (at least) ignore the controversy.

I began to formulate this theory of cartographic design in the late 1990's, although the roots of the concerns and the inklings of the answers stretch back to my earliest studies of cartography. I was privileged in my graduate studies to work with Hanno Ehses of the Nova Scotia College of Art and Design. Ehses' work on rhetoric in graphic design, as outlined in publications such as *Design and Rhetoric: An Analysis of Theatre Posters* (Ehses 1986), and *Rhetorical Handbook* (Ehses and Lupton 1996), gave direction and structure to the ideas about cartography that I had been trying to organize for some time.

I have also been privileged to have so very often been in a position to explore and refine my theoretic investigations in my professional practice. Currently I am responsible for capacity building among, and the development of standards and conventions for, a large and diverse body of map-makers situated in offices around the world. These map makers may not always be full time cartographers, or even full time GIS technicians, and are making maps to address local, regional, and world wide audiences with widely differing concerns and expectations. The prospect of supporting (in a collaborative, non-authoritarian manner) such an enterprise is, I believe, furthered and made possible by the theoretical grounding I present here. Conversely, the situation also forms the crucible in which the theory is refined in the heat of real map use and production.

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reviews

World Views: Maps & Art
By Robert Silberman, in collaboration with Patricia McDonnell.
Essay by Yi-Fu Tuan.
Minneapolis: University of Minnesota Press, 2000.
80 pages, numerous maps and photographs of art works.
Soft cover, 8.5 by 11 inch format.
ISBN 0-8166-3686-9

Reviewed by Jim Ketchum, Department of Geography, Syracuse University

This thin volume serves as the catalogue for an art exhibition organized by University of Minnesota art history professor Robert Silberman in collaboration with the curator of the Frederick R. Weisman Art Museum, Patricia McDonnell. The exhibition, *World Views: Maps & Art* appeared at the Weisman, in the city of Minneapolis, between September 11, 1999 and January 2, 2000. The book includes two essays, one by Silberman and the other by Yi-Fu Tuan, emeritus professor of geography at the University of Wisconsin—Madison. Beyond these two essays, the book appeals mainly for the number of high quality images it contains. These include photographs of the art works from the exhibition, and the many excellent reproductions of maps important to the historical lineage of cartography (especially those in the Western tradition), most of which appeared in the exhibition. The exhibition included works by 18 artists or artist groups, including Jasper Johns, Claes Oldenburg, and Joseph Cornell. Three of the 18 artists (Mel Chin, Laura Kurgan, and Ilya Kabakov) were commissioned to produce installation works specifically for *World Views: Maps & Art.*

Maps impressively reproduced within the catalogue include Albino de Canepa's *Portolan Chart* of 1489, Martin Waldseemüller's *Map of the World on Twelve Gores for a Globe* of 1507, and Gerhard Mercator's *Description of the Northern Lands* of 1595, all of which appeared in the exhibition. Beautiful photographs of art works that appeared in the *World Views: Maps & Art* include *Mappa del Mundo* (1978) by Alighiero e Boetti, *Magallanes en la confusion encontró un océano* (1994) by Miguel Angel Ríos, and *United Shapes of America III* (1994) by Kim Dingle. Other full-color images in the catalogue provide context for the exhibition by recalling other works of art that have taken cartography as their subject, such as *Sphere of Influence* (1990-92) by Mike and Doug Starn, and *The New Ring Shout* (1995) by Houston Conwill, Josepf DePace, and Estella Conwill Majozo. All those images listed above appear in color; about half of all images in the book appear in black and white.

The book also includes statements written by the three artists asked to produce works specifically for this exhibition: Mel Chin (of the "Knowmad Confederacy"), Laura Kurgan, and Ilya Kabakov. These three artists were commissioned to produce art works "that would relate to maps and mapping and that would be appropriate for the millennial moment" writes the exhibition's curator, Robert Silberman. Of course, all three artists were previously known for working within the subject of mapping. It is never made clear, however, why these three artists (as opposed to any of the many other artists who work with mapping) were asked to create works for this show, or how these works relate to the other art works and maps presented in the exhibition.

Chin's work is actually a group work, which he initiates, directing his concept as then carried-out by a number of computer experts who Chin assembled for the task. The group calls themselves the "Knowmad Confederacy," and includes Rocco Basile, Emil Busse, Tom Hambleton, Brett Hawkins, Andew Lunstad, Chris Parrish-Taylor, Jane Powers, and Osla Thomason-Kuster. The work produced for the exhibition is titled *Knowmad*, the focus of which was, apparently, a video game about place that museum-goers could play. Unfortunately, neither the photographs of the installation, the description of the work by Robert Silberman, nor the artists' statement make very clear what the work of art actually consisted of as an object. Silberman refers to Chin's interest in the process of weaving rugs in Middle Eastern civilizations, then says Chin finally decided on a video game as the "focus" of *Knowmad*. What Knowmad consisted of beyond the video game is unclear. Silberman discusses these woven rugs in the Middle East as being important cultural objects full of significant meanings, and the video game appears to incorporate these designs. Yet, if the work is truly about place, as Chin and Silberman both suggest it is, it would make sense to be more specific in this book about exactly where these designs came from rather than simply attribute them to a civilization roughly defined as "Middle Eastern." Silberman states that, in this work "art and popular culture are deployed to raise consciousness through a lively experience," but it is quite unclear as to what important issue the audience is supposedly being made conscious, or what they are supposed to do once they have become enlightened. The artists' statement discusses the disappearing world of these tribal weavers, vanishing rapidly "due to a complex series of political and cultural changes." Still, how is the audience sup-

posed to understand those complex changes, or are they supposed to understand them at all? The stated desire of the artists is to "catalyze the desire to know more about cultural artifacts and human expression and accelerate beyond preconceived methods of mapping and artistic expression." That of course sounds good, but what is it exactly the audience is supposed to know, and what is supposed to happen once the audience knows it? There may be answers to these questions, but one couldn't tell what they are by reading this catalogue.

Ilya Kabakov produced a work for *World Views: Maps & Art* called *The Globe in a Different Topographical System*. This installation piece consisted of three (apparently) plaster models, one each of Europe, the United States, and Russia, each placed on one tier of a three-tiered platform looking like a staircase formed of straw. Unfortunately, the catalogue pictures the art works without providing any information regarding the materials out of which they are fashioned, a basic and very common piece of information which it seems strange to leave out, especially for installation pieces which use non-traditional materials. One would think that part of the effect of this work would involve an audience member's experience of the sensuous materiality of the objects themselves, yet Silberman continually refers to the form and structure of this work as viewed from a detached position, and completely ignores what one might easily suppose to be the main advantage of an "installation" piece—the opportunity to experience it through a variety of senses rather than merely observe it with cool detachment. Silberman so focuses on looking at Kabakov's piece, as well as the other commissioned installation pieces, one wonders why he had installation pieces commissioned for the exhibition at all. Kabakov positioned his straw-like structure at one corner of the gallery, next to a short, wooden staircase. From atop the stair, Silberman tells us, the viewer can look down upon the models of Europe, the United States, and Russia. A table with drawings of the installation stands nearby. At least with this art work, the book presents a good idea of what one might have encountered in the gallery. Still, it might be useful to know, for example, a few basics. Did the artist make the table and staircase himself, or did he simply acquire them for placement in the installation?

The two installation photographs of Laura Kurgan's piece, *Spot 083-264: Kosovo, June 3, 1999*, present the series of images hung upon two gallery walls as the visitor would have seen them upon entering the gallery. Her artist's statement is the most focused and informative of the three. Unfortunately, some of the images on the pages that follow the installation shots somewhat confuse the issue. Are these images from this piece, or another of Kurgan's work? After some reflection, it becomes apparent that these are closer views of some of the images from this exhibition, but the confusing design layout of these images and of works from the show on previous pages have by this time left the viewer skeptical and dazed enough to doubt the position of any image they encounter by the time they reach Kurgan's work on page 68. Kurgan's works consist of data images taken by commercial satellites. These are of the Kosovo conflict. The purpose of her works also seems to be the most understandable of any of the three commissioned pieces: the more we are able to apprehend the world at some distance, receiving details about world conflicts, the less we actually know about what causes those events. In fact, this superfluity of data may actually be used to obscure the relationships involved in producing those events, making them in effect more distant from our understanding.

The book includes two essays. The first is by Yi-Fu Tuan, the second by Silberman. Tuan's essay seems peculiar on several counts. First of all, Tuan never makes reference to any of the works in the exhibition. Of course, he would have written the essay long before the exhibition would have actually come together. Still, it would not have taken so much effort to view slides of the art works or read about them. Even if it was Tuan's intention to merely provide an essay about mapping to present some context for the exhibition visitor, it still seems somewhat odd that he never refers to the exhibition, even in the abstract. After beginning with some curious claims (such as that the "artistic urge" for design only comes into play when the materials involved are relatively permanent), Tuan latches onto what he sees as the key tension between maps and art: that maps are essentially tools of practical use that represent the arrangement of objects in the real world, while art is basically the expression of natural urges toward balanced design that are only inhibited by reference to the real world. He reports that in China, map-making never succeeded the way Western map-making did because too much artistic freedom was licensed in practice by Chinese cartographers (who were really more artist than scientist). Later on, Tuan tells us that "Cartography is Art," leaving this reader completely confused as to his definition of art.

Part of the problem with Tuan's essay is the struggle he engages in involving a dual purpose he sets up but never seems to resolve: to tell his museum-going, catalogue-reading audience something basic and informative about mapping,

while at the same time attempting to say something meaningful to scholars and other cartography-minded intellectuals. He is obviously aware that his audience will include both those who know almost nothing about maps and those who know a great deal already, perhaps because they are cartographers themselves. After praising Western cartography, Tuan launches into a confusing discussion of the map as a kind of portrait of place, comparing maps to self-portraits and then landscape paintings. He eventually lands on the claim that maps embody more of what we *want* to believe than they actually represent a scientific reality—a claim that seems strained by his earlier discussion of maps as outstanding Western scientific achievements that manage to effectively suppress the artistic impulse while incorporating it just enough to strike the perfect balance of natural urges toward objective reference and subjective artistic design. As Tuan's essay goes on, it seems to drift further than ever from the exhibition itself. In the end, although an interesting amalgam of entertaining claims and counter-claims, I am not sure what real context this essay provides for viewing the exhibition.

Offering a second opportunity to bewilder the reader is the essay by the *World Views* curator, Robert Silberman. Siberman refers to most of the 18 art works in the exhibition, even if many are attested to only sweepingly. However, it again seems somewhat odd that no internal referencing takes place, as Silberman neither refers to the substance of nor even acknowledges the existence of the essay by Yi-Fu Tuan. Presumably, the exhibition's curator wanted a respected geographer to fashion an essay for the catalogue that would somehow contribute intellectually to the curatorial effort. It seems odd then that Silberman's essay makes no such connection. In fact, there are few connections to be made at all in this book: between Tuan's essay and the exhibition; between Silberman's essay and Tuan's; between the many maps in the exhibition and the works of contemporary art present in it; between the three commissioned art works; between those three commissioned works and the themes in the two essays. Silberman moves easily and lightly from theme to familiar theme: from the various pleasures involved in looking at maps, to the map as reflective of the culture that produces it, to a listing of the many twentieth century artists who have approached the cartographic subject, to the claim that maps are the perfect vehicle for contemporary artists who wish to tackle problems of the contemporary social world.

In the end, it is my job to critique not the exhibition, but the catalogue of the exhibition. The exhibition itself may have been quite interesting. If it was, I'm sure it may have been for reasons that extended beyond the intentions of the curator. This is because I cannot tell, after having read and re-read the exhibition catalogue, what the curatorial intentions in fact really were. An exhibition should involve a core intellectual argument, like any good work of scholarship. Neither the images nor the essays provided in the book demonstrate any clues that an intellectual argument was being made in *World Views: Maps & Art*. Professor Silberman admits that he is new to the subject of mapping, and this project allowed him to follow-up his curiosity. I think part of the problem lies in that he does not follow it up more thoroughly. Although Silberman refers to other art exhibitions that have, over the last decade, taken as their subject the exploration of maps and mapping by contemporary artists, he never refers to the intellectual content of those exhibitions.

This catalogue reflects a serious lack of curatorial critical reflection. Although Lyndel King writes in the catalogue's "Director's Forward" that *World Views: Maps & Art* "explores the rich relationship between art and maps that has persisted from the first century A.D. to the present moment," I cannot say that I can recognize any real *exploration* of such a relationship at all, especially any critical exploration. This despite King's claims that this exhibition will offer "insights" into the topic to "art-sophisticated audiences and students as well as to visitors who may have less experience with art." If such insights were present in the exhibition, the catalogue of the exhibition has failed to demonstrate those insights.

Still, the catalogue remains essential for anyone interested in the connection between contemporary art and maps, or between contemporary art and geography more generally—if merely as background information regarding exhibition efforts that have been made to connect the two. Anyone who works with visual materials will appreciate the quality of the many reproductions of maps and art works on a fine paper of heavy stock. It is too bad that the binding cracked so easily, leaving the pages to come free, the book falling to pieces on my desk. This did not however cause any damage to the images I so prize in owning the book, and even less to the organization of ideas present in its pages.

Maps of Medieval Thought. The Hereford Paradigm.
By Naomi Reed Kline. Woodbridge: The Boydell Press, 2001. 261pp., 93 figures. Hardbound. ISBN 0 85115 602 9.

Reviewed by Karen Trifonoff, Department of Geography and Geosciences, Bloomsburg University

The fourteenth century mappae mundi located in the Hereford Cathedral in England has captured the interest of scholars in many disciplines, and in this volume, Naomi Reed Kline provides a look at the map from the perspective of the art historian. Her premise is that the careful study and examination of medieval mappae mundi can expand our knowledge and understanding of not only maps, but also medieval art and thought. This lavishly illustrated text, with a color frontispiece of the map and 93 black and white pictures and diagrams, provides a thorough analysis of the content of the map, and the context in which it was created.

The book is divided into four parts, and begins with an investigation of the use of the circle as a conceptual device, not only in mapping, but in other aspects of medieval life as well. The second section is devoted to the specifics of the Hereford map, with one chapter focused on its authorship and patronage, and a second on the medieval map audience. The third and largest component of the volume investigates the symbolization on the map, giving a detailed analysis of the types of animals, monstrous races, secular events such as the voyages of Alexander, and religious events such as the Crusades, that are portrayed on the map. The author concludes with a summary of cartographic context of the Hereford Map and explains how the model she outlines can be applied to the study other mappae mundi, in particular the Sawley, Dutchy of Cornwall, Psalter, and Ebsdorf maps. The book contains extensive annotations and footnotes throughout the text, a comprehensive bibliography with over 390 entries, and an index.

Maps of Medieval Thought undertakes the detailed examination of the Hereford map, and other circular world views from the Middle Ages, in order to discover how they functioned as objects of art during their own time. The author suggests that maps such as the one in the Hereford Cathedral were not simply representations of geographic space, but were used to illustrate the connection between the worldly realm of geography and the heavenly sphere of creation and the Last Judgment. Included in the volume is a thorough and meticulous categorization and explanation of the pictorial and text symbols on the map. The argument is that any understanding of the text and symbols must be framed within the map reading context of the medieval viewer, and that consideration needs to be given to the narrative role of the map as a device used to help interpret a series of events. By creating a guide for viewing and deconstructing the Hereford map, the author has provided a model that can be transferred to other medieval maps and artifacts.

This volume is well researched, and represents a major contribution to the scholarship regarding the Hereford map. Kline has done an admirable job of integrating the contributions from many disciplines, including cartography, art, and history, to create a useful, comprehensive summary of the literature regarding the Hereford Map. The unique characteristics of the map that allow it to warrant such detailed analysis are first its age, which at over 600 years make it one of our single most important map artifacts. The second noteworthy characteristic is the size of the map, over five feet in diameter on a single piece of parchment, which is a remarkable technological achievement. Kline provides us with the important details of the history and origins of the map and her record of its provenance is in concurrence with the findings of other scholars. In many ways the Hereford map shares several generic traits with other circular maps of the time period. But the author also notes its many custom details that indicate it was perhaps commissioned for a specific client, most likely, Richard of Haldingham. In that the map is also ornately inscribed with elegant text and related drawings suggests that it was intended for public viewing, so Richard may have commissioned the work in order to put it on display in the Cathedral at Hereford or elsewhere.

As the story of the Hereford map unfolds, several intriguing ideas are put forward by the author. She focuses on the role of the map as a storage device for information, and suggests that medieval viewers retrieved information from the map in a variety of ways. The function or purpose of the circular world map is similar to that of rotae, or circular diagrams, common in medieval schoolbooks. These diagrams work as visual and mnemonic devices to help the reader categorize and memorize the textual information. In the medieval audience both the reading and non-reading individuals may have used the many images on the map as prompts to recall tales and stories, giving the map a role within a larger narrative. One can imagine that the Hereford map was designed for display and perhaps used much as a wall map would be in a classroom today, with a teacher pointing out important places and relating the tales and stories of the various

figures on the map. Or perhaps a medieval museum guide could be found explaining the artistic nature of the map symbols to a group of medieval tourists. The author builds a good case for such a use of the map, and provides many supporting examples from both art and architecture.

One of the most engaging components of this volume is the extensive analysis of the many layers of the Hereford map. These layers include the worlds of animals, people, contemporary events, and events of religious significance. The author suggests that many of the animals portrayed on the map are similar to the animals mentioned in medieval bestiaries. These bestiaries were collections of animal lore that were often used as a moral handbook for Christians, sort of a combination of folklore and theology. These animal images are interpreted at many levels, as an indication of the real and imagined beasts, and also as symbols of the great diversity of all of Gods creation.

The analysis of these various worlds pays attention to the details of each symbol, and tends to focus on the objects themselves, rather than their arrangement in geographic space. For example, several placenames are mentioned in relation to the life and travels of Alexander and the Crusades, but the author tends to emphasize the event rather than the place. In the discussion of the travels of Alexander, the author notes that there are 69 placenames on the map relating to the events in Alexander's life. The spatial arrangement of these places seems to be minimized because of the stylized and abstract nature of the representation of space on the map. On page 98 the author notes that the animals are "...scattered like buckshot" on the map, and that place merely acts as a backdrop for the animal symbols. Also, the Crusades are emphasized as a spiritual journey, rather than the actual travel across the earth.

The volume contains useful and detailed schematic diagrams of the map, which function as guides to the location of various features discussed within the volume, such as the races of people, or types of animals. The diagram on page 50 looks at "The Frame as Time", with numbers added as a key to the various symbols adorning the border of the map. A table is included on the page facing the schematic, which then explains each numbered figure or symbol. For example, the three men in the lower left corner of the map frame are identified as surveyors, and the accompanying caption provides an explanation of their role on the map.

There are six of these schematics for different topics on the map: the cosmological wheel, the frame as time, the world of animals, the world of monstrous races, the world of Alexander, and the world of the Bible. But there is no single schematic for the various placenames on the map, though some places are included in the sections on secular and religious events. It might have been appropriate to include a section, or at least a schematic diagram, on "The Frame as Space", which could coordinate nicely with the chapter and diagram on "The Frame as Time". Placenames are mentioned several times throughout the text, and it is assumed that the reader would or should know where they are, both in reality and also within the context of the map. But this is not necessarily true, and without a guide to the placenames on the map, it is difficult for the reader to reconstruct the relationships among these places or pick them up from the other schematic diagrams. This lack of attention to the nature of geographic space creates an imbalance in the coverage of this volume. Even though this map is an abstract representation of geographic space, with scale not true across the image, some of the topological relationships remain important. At times, the author seems to maximize the role of the Hereford map as a compendium of information and a "universal chronicle" and minimize its role as the type of representation of geographic space that was familiar and known to the medieval viewer.

At times the use of lengthy and extensive annotations interrupts the flow of the narrative. Several pages have a few lines of text, with the remaining space devoted to parenthetical information. But these criticisms are minor and will not distract the true mappae mundi aficionado. And the extensive references provide a great starting point for newer researchers just discovering the world of medieval mapping.

The author makes a strong case for the inclusion of the Hereford Map within the greater tradition of medieval learning, and suggests it should take its place alongside the other remaining original images and texts of the medieval world. Kline's work will appeal to art historians, medieval scholars, and cartographic historians, and will provide a worthy challenge for the general cartography student. Kline is to be commended for providing cartographers with a glimpse of the artistic connotations of the Hereford mappae mundi. The art world could have benefited from a more detailed analysis of the geographic context, no matter how abstract or stylized it is rendered on the map. The fact remains that this image in the Hereford Cathedral is not a rotae, bestiary, building frieze, or painting. It is a map.

cartographic techniques

Raster data in multimedia atlases: benefits and challenges. Examples from the "Atlas of Switzerland – interactive"

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Introduction

Interactive atlases historically have not used raster data; instead vector data and graphics are used. It is important to note the difference between scanned maps, which fall into the category of graphics, and raster data. Raster data has attribute information that can be queried on a cell-by-cell basis—this is the most important quality raster data affords to an interactive atlas. Typically, this kind of querying of data has been the province of GIS software, but the richness of information and the ability to provide specific answers to questions about exact locations make raster data a logical choice for interactive atlases. Vector data values are typically pre-classified or have been averaged across areas that are much larger than the raster cells that were used to record the data.

The purpose of this article is to provide strategies for including raster data in digital atlases in order to create the richest experience possible for users. Possibilities and difficulties will be discussed. As the second edition of the "Atlas of Switzerland – interactive" will focus on environmental issues, environmental data in will underpin these discussions. Additionally, new tools that were created for, and examples from, the upcoming edition of the "Atlas of Switzerland" will be shown. Also attention will be paid to techniques for combining raster and vector data, as well as raster and raster data.

History of the Atlas of Switzerland

Two printed editions of the "Atlas of Switzerland" were published between 1965 and 1997. These contain nearly 600 individual maps. In 1995 the Swiss government planned a completely new edition, both a printed and a digital, to be published in four languages (German, French, Italian and English). The themes were mandated [Hurni et al. 1999]:

- Landscape and environment
- Population and society
- Economy
- Infrastructure and traffic
- Culture and politics
- International relations

The first interactive edition was published in the year 2000 as "Atlas of Switzerland – interactive" on CD-ROM and included 250 thematic maps on population and society. Additionally, statistical maps for Europe and a 3D topography tool that showed 3D relief maps, block diagrams and panoramic views were included.

The Atlas of Switzerland is currently being updated with new data and new functions; the most important of these are:

- Updated statistical data on society and population
- 400 new themes covering landscape and environment
- The design of the user interface and navigation tools
- Methods for query and display of data
- Substantial expansion of the use of 3D data

With new data the requirements changed; environmental data is rarely available as vector data, therefore raster data needed not only to be considered, but the challenge was really to find ways to include it.

Data in Multimedia Atlases

The Atlas of Switzerland team did not find any multimedia atlases that contained maps made with raster data, just vector data and graphics. Experience in working with geographical data sets showed raster data, especially in environmental research, is used at least as often as vector data. This leads to: why aren't raster data sets used in multimedia-atlases?

One idea is that traditional cartographic representation is a highly generalized and abstracted model of the real world. Traditional cartography is expected? Traditional cartographers did not have the benefit of an abundance of remotely sensed or photogrametric data. Interactive atlases offer an opportunity to break from the traditional and incorporate valuable data that logically belong as content.

Another response is that there are strong tendencies now, especially on the Internet, to replace raster graphics with ”smaller, more accurate” vector data. This is an unfortunate confusion of among other things accuracy and coordinate precision and that vector data is smaller in terms of bytes to be transmitted. The "Atlas of Switzerland-Interactive" must show the best data possible and whether the data is raster or vector should not be an issue. In fact, if a map must include raster, or raster and vector data to be optimal, then that is what must be.

Still, there is some allure to the idea that it may make sense to vectorize raster data. For instance, the attributes of rasters of different resolutions can be generalized

to polygons with nice presentable consistent edges. Beyond leading readers to falsely lofty assumptions about the data's accuracy, there are many disadvantages to this procedure. Most importantly it's a time consuming process that cannot be fully automated and therefore is very costly.

Comparing Raster to Vector Data

In this short review raster and vector data are compared (Table 1) and, advantages and disadvantages are listed (Table 2) and discussed.

The most important characteristic of vector data certainly is its topology; the data is "intelligent", redundancies are avoided and neighbors are known. Vector data consists of objects with clear borders that define regions where the data values assumed to be uniform. For many continuous phenomenon vector data representations are more abstracted than raster data. The information in raster data on the other hand is continuous and covers all space, which makes it suited for data modeling [Hohl 1998].

Data can be captured by digitizing (vectors) or scanning (raster). The latter is fast and therefore less expensive, digitizing, however, is a time consuming and highly repetitive job that requires skill and care. Once the data is digitized though, it's easy and inexpensive to update.

Raster data is less abstract than vector data. Depending on the cell size it is even possible to create realistic pictures of the landscape. Cells values can be, but do not need to be classified.

The big drawback of raster data is the storage space it needs, as every cell has information attached to it. Bigger cell sizes can reduce the storage need but result in less attractive maps. However, relative to vector data with many attributes, or that is highly detailed, raster data is no less difficult to store or transmit.

Looking at this synthesis, it's obvious, that it's not a raster vs. vector, but a side by side of raster and vector that will bring the maximum benefit. Raster data is excellent when using modeled datasets, as found often in environmental topics, where as vector data is optimal for the mapping of entities with clearly defined boarders such as lakes, streets, etc.

Raster	Vector
Neighborhood	Topology
Suited for data modeling (interpolation and comparative analysis)	Representational Accuracy
Stored as location (discrete units)	Stored as objects
Continuous geographic variation	Information within object seems to be uniform

Table 1. Characteristics of raster and vector data

Raster	Vector
Fast data capture (inexpensive)	Topology
Greater realism (less abstract)	Update easy
Overlays computationally faster [DeMers 2002]	Accurate
Variation greater (changes on a cell by cell basis	Easy to add attributes

Table 2. Advantages of raster and vector data

Raster	Vector
Storage	Data capture is time consuming
Not intelligent (no topology)	Expensive
Relative lack of spatial resolution	Storage
Bad for line representation	

Table 3. Disadvantages of raster and vector data

Raster	Vector
Good for environmental data, resource management, remote sensing	Good for mapping, surveying, utility information system
Fast but less precise	More graphical
Suited for complex modeling	Difficult to use for modeling
Interpolation of point data to surface	Symbolic, more cartographic

Table 4. Comparison between raster and vector data

Use of Raster Data in the "Atlas of Switzerland – interactive"

Given the above analysis of raster and vector data that the two would be used side by side in the upcoming edition of the "Atlas of Switzerland – interactive". Therefore the intent for the user interface was that it should remain unchanged and preferably all features and functionality for vector data should also be available for raster data--most importantly query functionality. There are a few features that are exclusively available for raster or vector data.

Features that allow little or no user interaction:

- Color interpolation: raster data sets are colored according to the cell values. Each value can be assigned an individual color, or a color can be assigned to a value-range. The colors are defined for the class bounds. If a cell value doesn't lie exactly on one of the class bounds, it can be colored with a mix of the two colors of its class bounds instead of being assigned to either one of the colors.

- Space interpolation: the viewing resolution of the displayed map is often different than the source raster data. This can be avoided by interpolating the map points (but not the underlying raster values), resulting in a consistent display.

- A "mute" layer can be added to active layer to embellish it: this layer usually consists of lines or points. This layer merely contains graphical objects that cannot be queried. It usually consists of line or point objects that enhance the meaning of the map. Fig 1 (page 83) shows the magnetic declination. The underlying raster layer can be queried, while the isogonic contours, the "mute" layer, cannot. But it helps the user to quickly make out areas of similar declination.

- 3D view of maps (See Fig 2, page 83): the DTM (digital terrain model) can be overlaid by a number of raster maps. Both, block diagram and panoramic views are possible. The maps can also be queried.

Following are the main functionalities for raster data that will be available to the user:

- Interactive query of cells
- Interactive change of color values and classification of cell values
- Overlay the current map with one of several pre-selected layers.

Method: Requirements for raster data

A multimedia atlas should be able to display data and produce interactive, aesthetically pleasing, screen maps. Therefore cartographic aspects are more important than analysis or GIS functions, e.g. the altering of the data. Thus we propose the following separation of analysis and visualization parameters within the data:

- Raw data: the discrete original values are stored in an appropriate format that meets the requirements given later on.
- Georeference: puts the data into its geographical context. This usually includes corner coordinates, cell size specifications, and coordinate system definition.
- Visualization definitions: needed to display the data on the screen. This can be done by a value classification and its class color definitions.

With this information we can produce a raster data map by adhering to the following formula:

Data + Visualization parameters = Map

It is essential to base maps on the original data and not any classified values or even color values (which in fact would be a graphic image). This way it is possible to incorporate any or many interpolation methods and create, for instance, a set of classified temperature maps where each still returns the true temperature values when a location is queried.

For storage efficiency and computational ease, data should be numeric. All non-numeric data can easily be converted to values that are later assigned the original text. This is because a potentially, a huge disadvantage of raster data is its size. For example, a raster with hectare-sized cells covering Switzerland with 4-byte integer values produces a raster of approximately 39Mb. This demonstrates that it is of utmost importance to reduce the data size both on disk and in the memory.

A simple and common way to reduce a file's size on disk is to compress it with one of the numerous compression algorithms available. Compressing the data is a good start, but it doesn't reduce the data size when loaded into memory.

In many cases the data's format space is over-specified, e.g. for a raster containing data values from 0 to 255 a single byte is sufficient to store a single value, but often 4 bytes are used. The appropriate data type for a raster dataset should be determined by analyzing the data it contains.

Another way to reduce the space the raster data uses in memory is to fragment the dataset into smaller tiles. This way only the tiles currently visible are loaded into the memory. The disadvantage of this technique is that the

Type	Value Range	Size per value
Floating point		4 bytes
Signed integer	-2'147'483'648...+2'147'483'648	4 bytes
Unsigned integer	0...+4'294'967'276	4 bytes
Signed short integer	-32'768...+32'768	2 bytes
Unsigned short integer	0...65'536	2 bytes
Byte	0...255	1 byte

Table 5. Data types and storage sizes

resulting grid has to be composed out of multiple tiles, which causes longer map composing times.

Clearly it does not make sense to directly use a raster with a 10m cell-size for a map with a 1km pixel resolution. Reducing the resolution 'on the fly' while generating the map is very time-consuming and usually ignores the data's properties as pointed out later. But if several rasters are calculated and stored in various resolutions in advance, loading time can be drastically reduced. When cutting the resolution in half step by step and storing all resolutions together 33% additional storage space is needed at most:

Reducing resolution has to be

$$\sum_{n=1}^{\infty} \frac{1}{2^{2n}} = \frac{4}{3}$$

done with care as the data's meaning could be compromised. It is no problem to resample a grid containing continuous data by using common interpolation techniques (nearest neighbor, bilinear interpolation etc.). With nominal data, resampling methods have to be used that preserve the data values (e.g. it's not possible to interpolate between water and agricultural use in a land use data grid).

These considerations show, that, to assure correct data resampling and to increase performance, it is mandatory to preprocess the data and to provide it in different resolutions.

Results: The Implementation

For the this edition of the "Atlas of Switzerland" a proprietary grid format, AoS Grid Format was created that meets the specific requirements of the atlas. It contains consecutive raster data of a numerical data type. It also contains all necessary header information like the georeference, cell sizes, data type etc.. The data block of the file can be compressed to reduce the file size and encrypted to protect the data. This file format is designed to contain a single grid in a single resolution.

For performance reasons the grid was pre-calculated in different resolutions and cut into tiles. Hence a "AoS Tile File" format was created to facilitate merging these multiple grid tiles and multiple resolutions. Through the header information this file provides direct access to any grid tile in its various resolutions.

The simplest use of the AoS Tile File is to store a single untiled grid in one resolution. In this case just some metadata is added (e.g. the file description string). In more complex cases the file contains the grid in multiple resolutions with every resolution tiled into any number of tiles. The different resolution layers even can have their own georeference.

The tile file format is designed to contain various kinds of data, not just grids. For example it can also contain an image or a digital elevation model.

Visualization

The Atlas of Switzerland software engine makes the final map. The required grid tiles are loaded and merged together, then the visualization definitions are used to assign every grid value a color. The resulting image must be resampled to fit the final display area. This resampling is delicate since it could change the map appearance unintentionally (e.g. by interpolating between the pixels).

The following example (Fig. 4, page 84) shows precipitation. The raster data has partially transparent vector data (gauging stations) draped on top. This shows how two sets of data and their respective visualization parameters have been combined to create one map.

Conclusion

For the new edition of the "Atlas of Switzerland – interactive" environmental data, typically stored in a

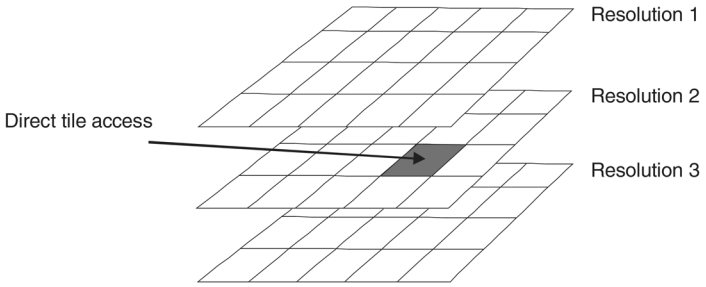

Figure 3. Data access in the AoS Tile Format

raster format, will be used. Raster data doesn't have to be vectorized, and it makes a great contribution to a multimedia atlas.

The "Atlas of Switzerland – interactive" uses raster data and fulfills the main requirement of an interactive atlas: that the data can be queried. In the "Atlas of Switzerland – interactive" continuous information can be queried on a cell by cell basis, returning unclassified values. Raster data is used side-by-side with vector data sharing the same user interface.

Fast data access is possible, mainly enabled by the use of an appropriate data model. The main characteristics of this data model are:

- Raw, numeric data is used with additional specifications given in description files
- Each data set is preprocessed and stored in proprietary file formats:
  - The appropriate data type (float, signed integer, byte, etc) is individually assigned. The data is stored in the AoS grid format.
  - Big raster data sets are resampled into several resolutions and fragmented into various tiles. Based on a map's scale, only the matching resolutions and tiles are loaded and thus memory use and loading time are significantly reduced.
- The final visualization is created by using information stored in separate description files.

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Cartographic Design: Rhetoric and Persuasion

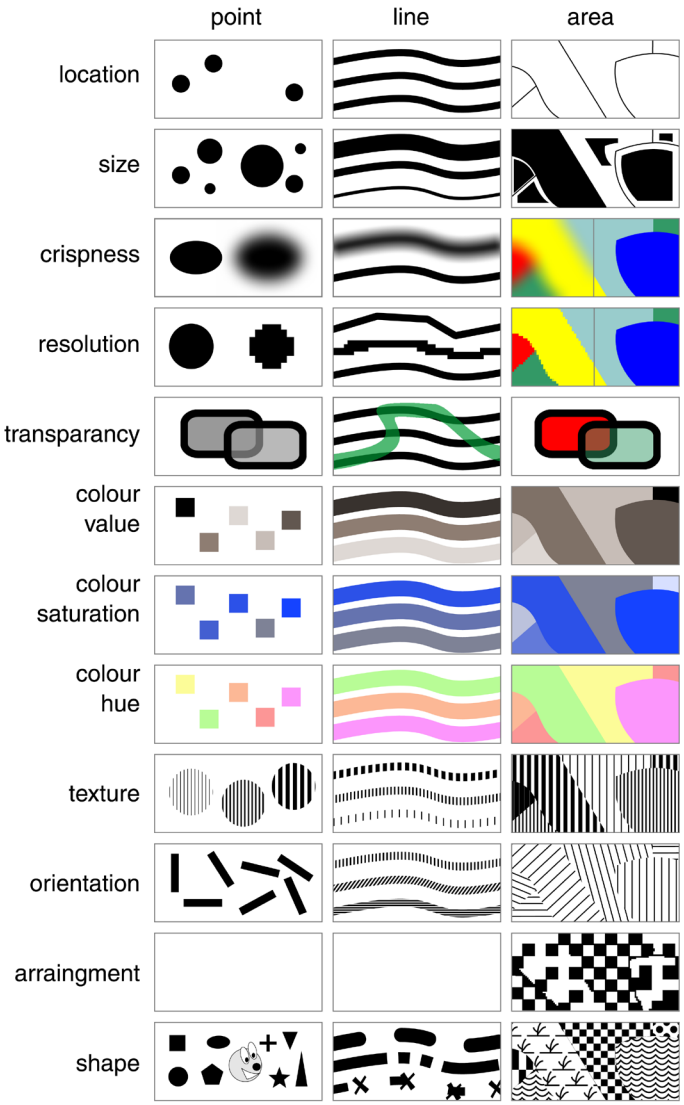

Figure 2. MacEachren's expanded graphic vocabulary. Adapted from Alan M. MacEachren, How Maps Work: Representation, Visualization, and Design, *(Guildford Press: New York, 1995), p 279.*

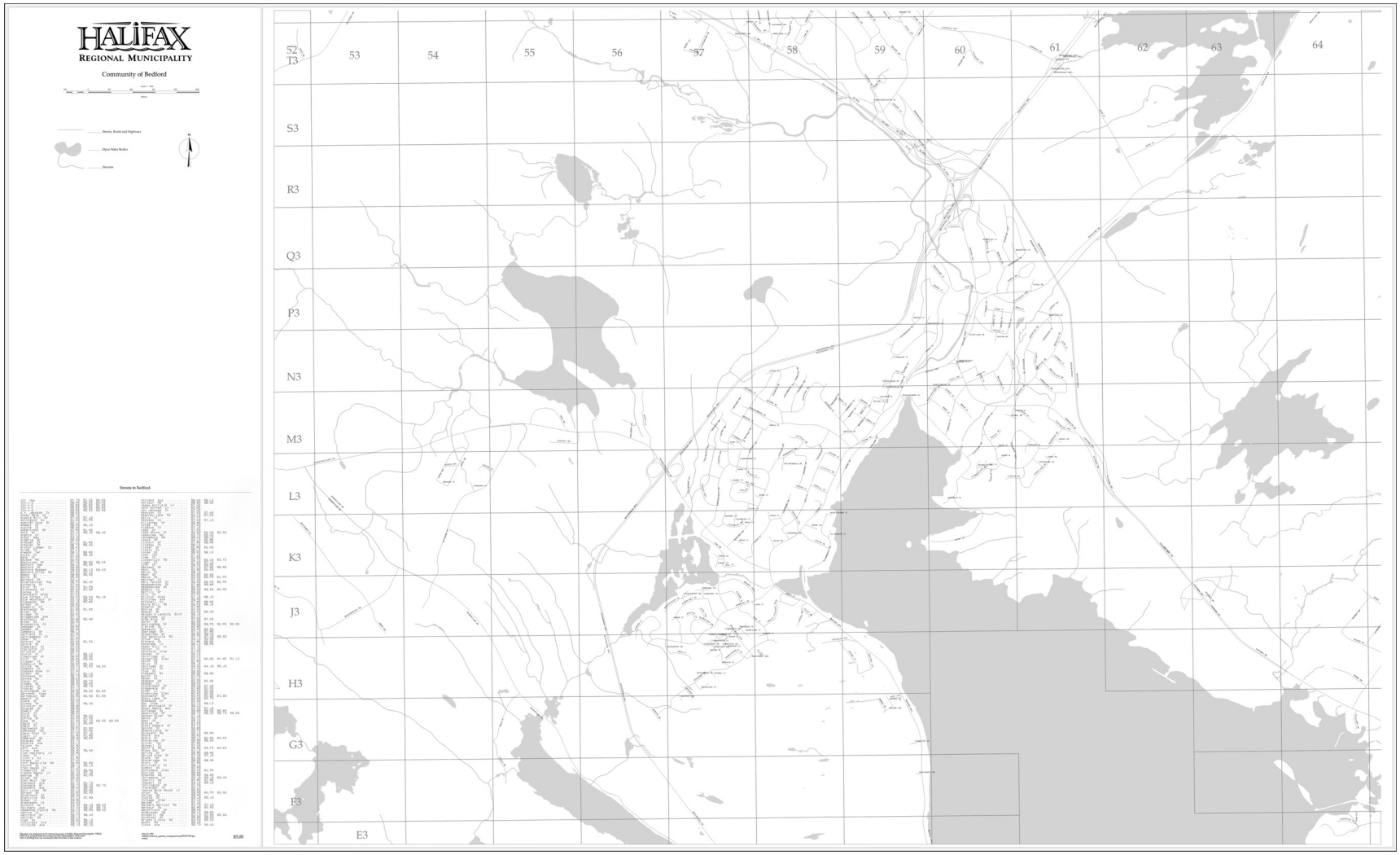

Figure 11. Community of Bedford, Halifax Regional Municipality, Nova Scotia – original: 55 inches x 33 inches. (Bedford *from the* Community Map *series 1998)*

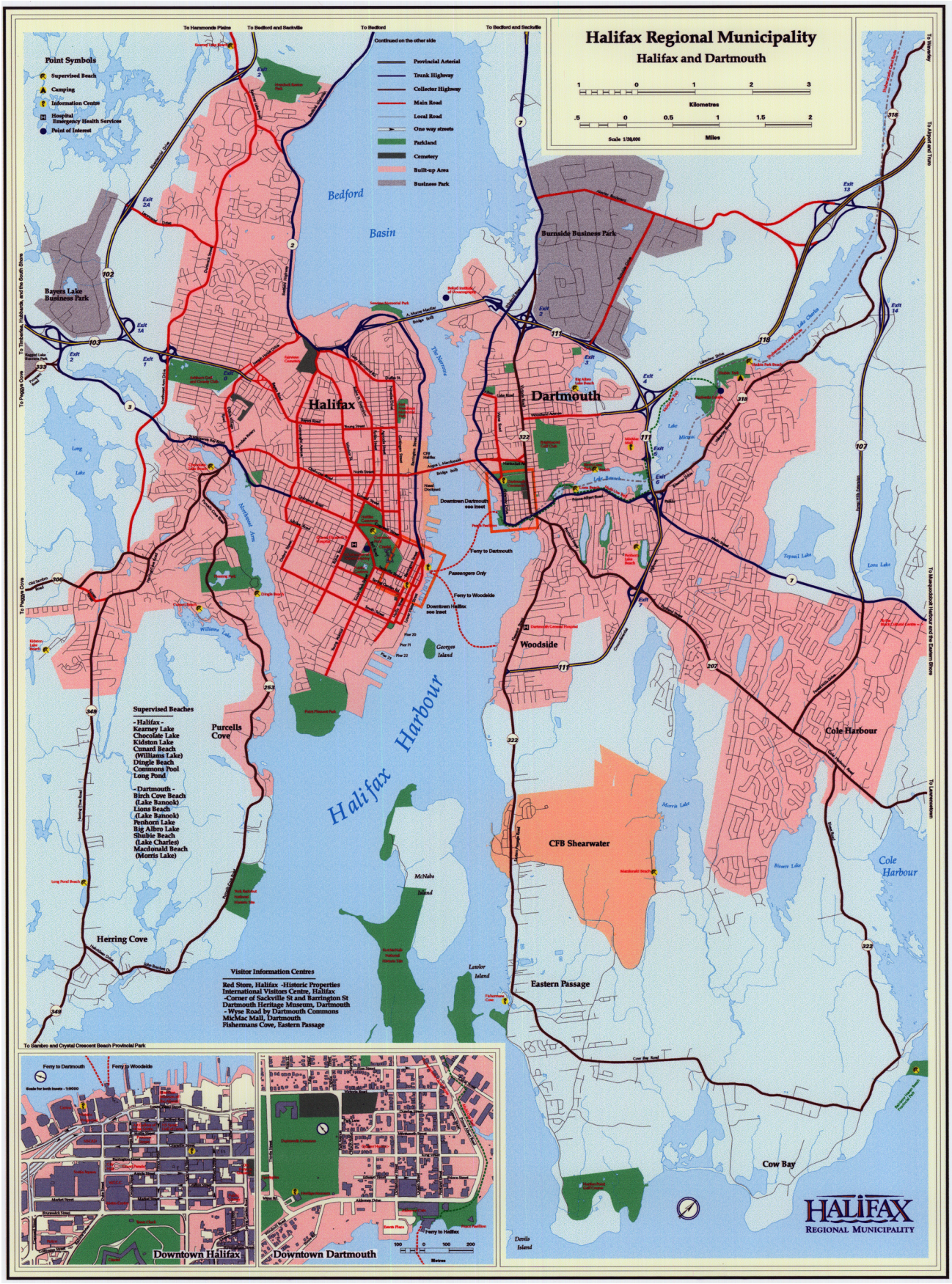

Figure 12. Halifax Regional Municipality Visitor Map*: side 1. (M. Denil – Halifax Rgional Municipality 1998.*

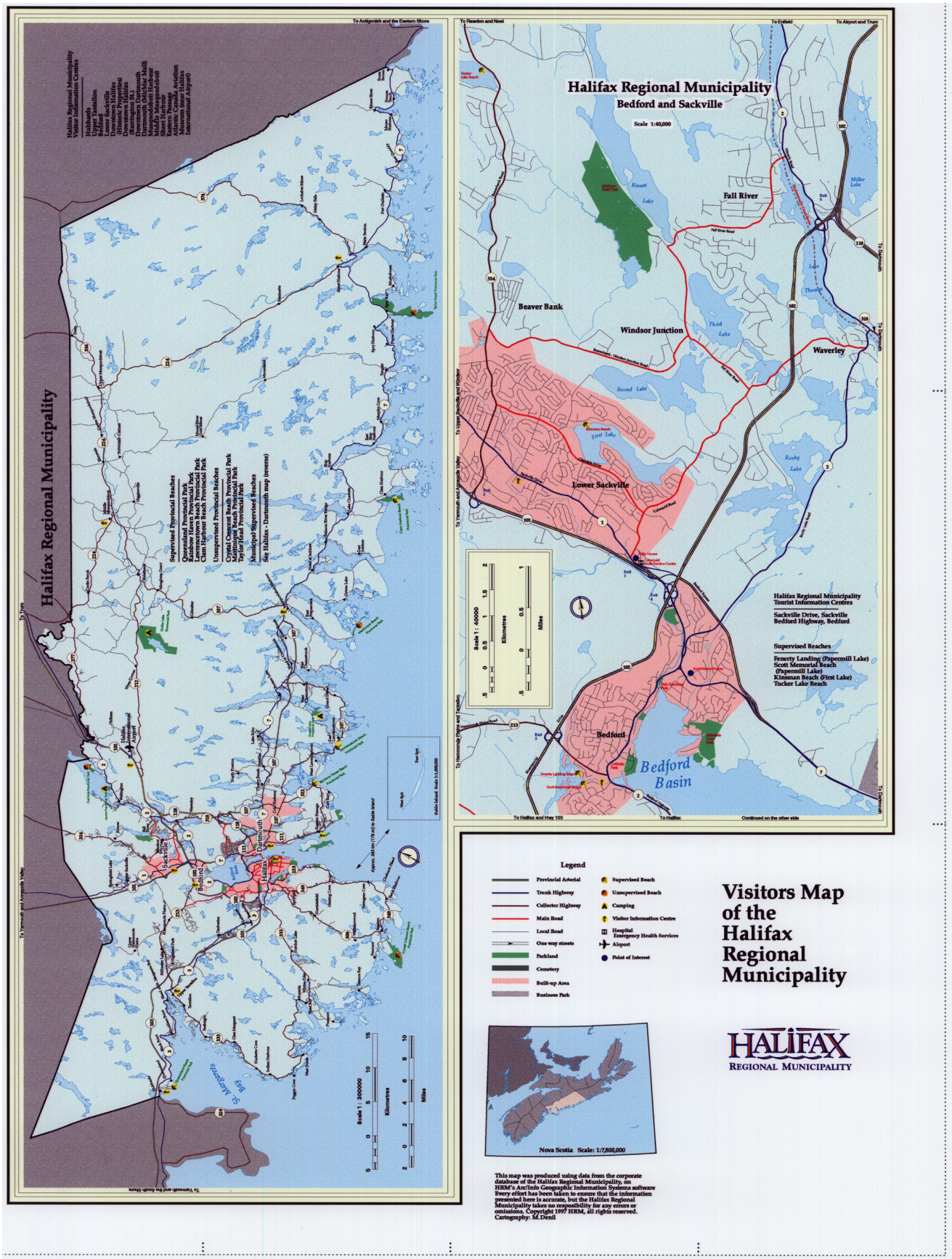

Figure 13. Halifax Regional Municipality Visitor Map: side 2. (M. Denil – Halifax Regional Municipality 1998)

Figure 14. Voyage Beyond Three Seas. (M. Denil. 1995)

Cartographic Techniques: Raster data in multimedia atlases: benefits and challenges. Examples from the "Atlas of Switzerland – interactive"

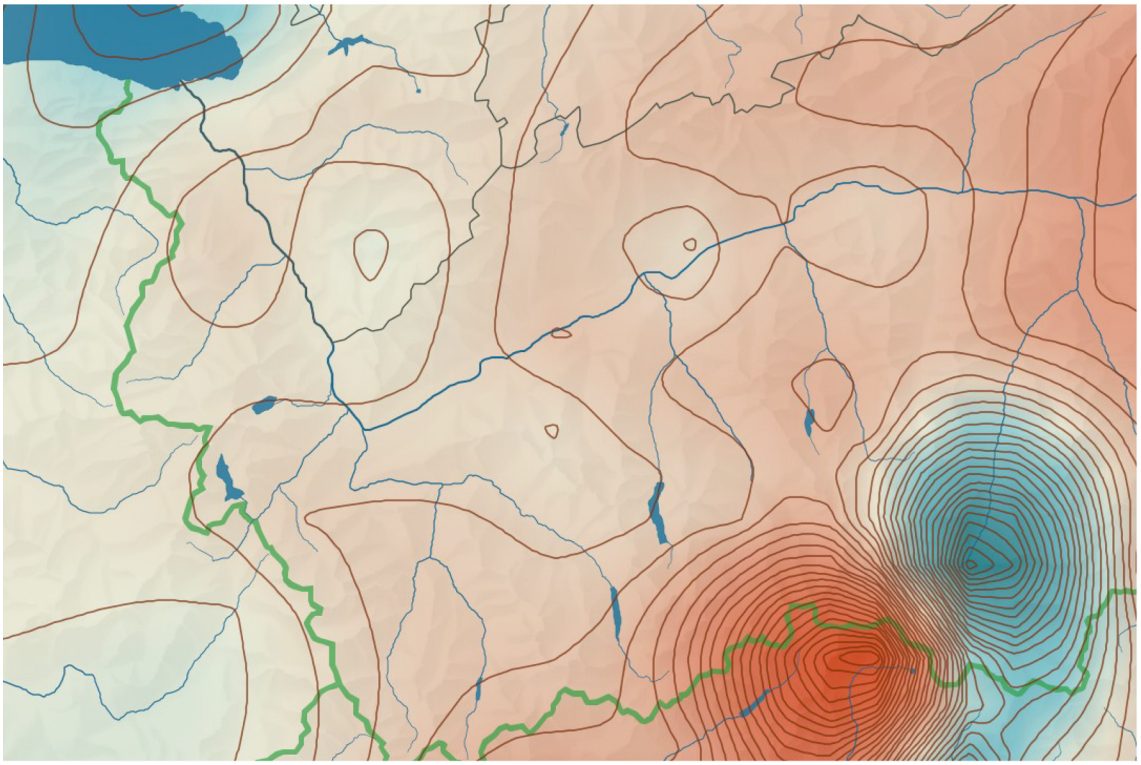

Figure 1. Mute Layer (isogonic contours overlying interpolated raster showing declination)

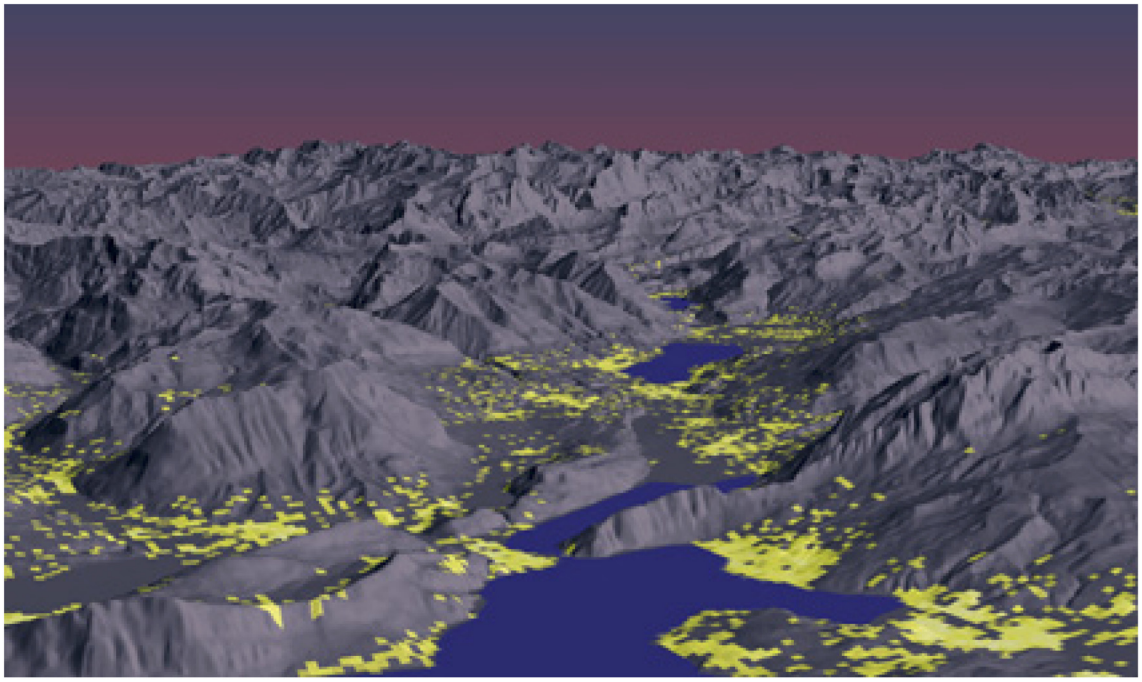

Figure 2. Panoramic view (interpolated raster showing distribution of population draped over a terrain model)

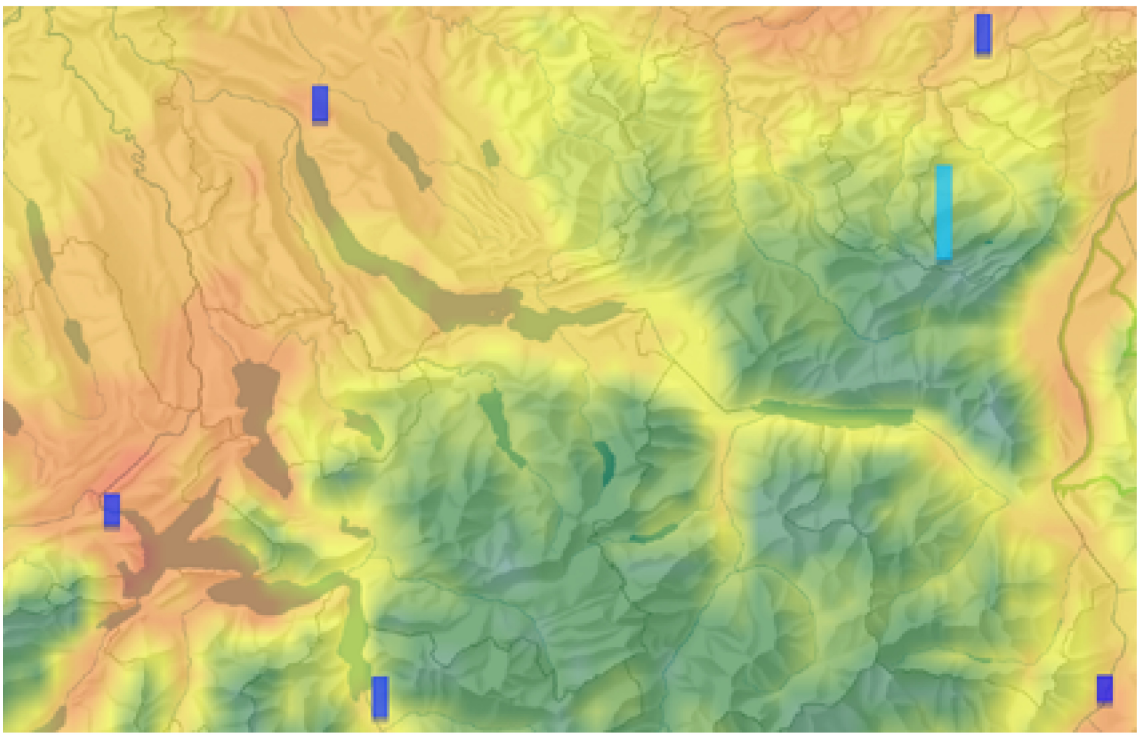

Figure 4. Example of vector data (gauging stations) integrated with raster data (precipitation) to produce contextually realistic, yet cartographic map.

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