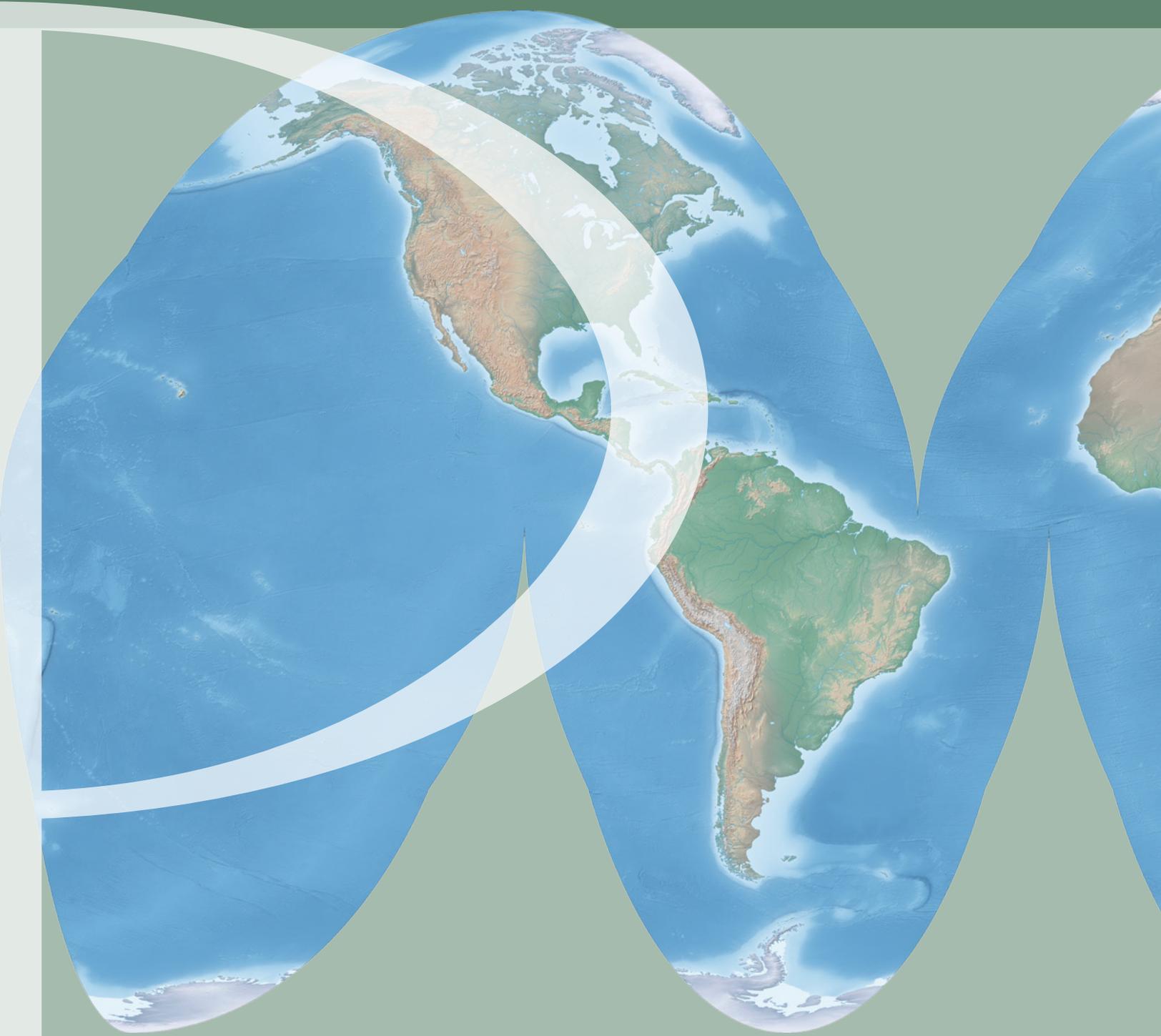


# $\Phi$ Cartographic Perspectives

*Journal of the  
North American Cartographic  
Information Society*

Number 69, 2011



# Cartographic Perspectives

Journal of the  
North American Cartographic  
Information Society

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# Cartographic Perspectives

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**ABOUT THE COVER:** The map on the cover is based on Natural Earth imagery, using the cross-blended hypsometric tint techniques described in the article by Tom Patterson and Bernhard Jenny on pages 31–46 of this issue. For additional information, see [www.naturalearthdata.com](http://www.naturalearthdata.com).

**WORD CLOUDS:** The word clouds featured in this issue were produced using Wordle (<http://www.wordle.net/>). Complete text from each article was included.

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## LETTER FROM THE EDITOR

After much anticipation, we at *Cartographic Perspectives* (CP) are proud to welcome you to our new website. There are many changes that come with this move that I would like to be sure you are aware of as we lay a course through the whorls of the world of a fully integrated online publication system.

If you are a reader of CP, it is a great time to be a member of NACIS. All members are subscribed automatically to CP, which includes online access to all content, and is one of many exciting NACIS member benefits. At our new journal site, we have posted all of the current articles and the most recent issues in various formats so that our content can be easily accessed from nearly any device with Internet access.

Perhaps you've heard, however, that CP is going "open access." Doesn't that mean anyone can access CP content? The answer is no. Non-NACIS members, in addition to enduring numerous other indescribable hardships, are not able to access many sections of CP, including Cartographic Collections, Reviews, Visual Fields, and Marginalia. In fact, only articles in the Peer-Reviewed and On the Horizon sections are openly available at present time.

The complexity of designing such an open journal system (or OJS, as it is often abbreviated) is a big reason that we are no longer on the NACIS website. Our new home at [cartographicperspectives.org](http://cartographicperspectives.org) (or [cartoperspectives.org](http://cartoperspectives.org)) is tailored in a way that we hope can meet and adapt to the changing needs of our readers, contributors, journal, and organization.

We hope readers find themselves visiting the CP website frequently. Issues will continue to be serialized, which, for the editorial team, is always a time of unbridled joy. With our new website, however, individual articles that will eventually be included in upcoming issues (beginning with CP 70) will be published separately. This new publication flow is designed to better meet the needs of our readers and authors by offering more immediate content while still collecting articles into electronic or printed issues for distribution to individuals or institutions.

If you are an author considering publishing with CP, changes are afoot. In this—our first—transition stage, our OJS allows authors of peer-reviewed manuscripts to

upload content for review. This process will help to minimize and standardize the huge amount of decentralized file sharing heretofore required of authors, reviewers, and myself. If you are interested in contributing to any of our other sections, for now continue to contact and submit to the section editor.

Authors submitting to our OJS are obvious recipients of many of the benefits of this construct. As soon as they submit, I can send along their manuscript to reviewers immediately, without concern for how much storage remains in my paltry university email account. Once accepted in its final form and copy edited, articles are not relegated to publication purgatory, waiting on the sins of the editor or other authors to be absolved. The article is immediately posted and searchable, both in our OJS and on the web, and able to be cited by other authors, even potentially a writer contributing to the same issue.

But enough about logistics for now; our OJS only serves to make the content you have come here to read more accessible. *CP 69* contains two peer-reviewed articles on very different subjects, but sharing design concerns near to the heart of many cartographers. Tom Patterson and Bernhard Jenny discuss their cross-blended hypsometric tints for representing terrain, color schemes that enhance historical color tints and are already popular and frequently utilized by mapmakers worldwide. Ian Muehlenhaus explains methods associated with quantitative content analysis, applying such methodologies to selected thematic maps from *Goode's World Atlas* over the last 80 years. Both articles are grounded in the work of the past, but focused on current design considerations.

In the Cartographic Collections section, Carolyn Hansen of the Brooklyn Historical Society (BHS) in New York describes outreach initiatives of this institution. She explains creative, online efforts to “unhide” the marvels of the map collection there. The article is beautifully illustrated with photographs of the BHS’s stately chamber and examples of its elegant maps.

In the Practical Cartographer’s Corner, Kevin McManigal offers tips on using Graphic Styles and Appearance palettes in Adobe Illustrator CS 5 for mapmaking. As Section Editor Alex Tait points out, these techniques can make time-consuming tasks less laborious, freeing the cartographer’s time to focus on design.

On the Horizon this issue features another contribution by the prolific Ian Muehlenhaus. Ian explains how to take maps created in Adobe Illustrator and publish them to the Android platform. In this manner, any map that a user has created in Illustrator can be converted to an “app” and sold through the Android Market. Any reader interested in maps on mobile devices should find this article of much interest.

The Reviews section includes four book reviews sure to be of interest to *CP* readers. Regarding this section, Mark Denil has decided to step down as Reviews Section Editor. Mark has worked tirelessly with reviewers for the past 16 issues, ensuring the highest quality of reviews for *CP* readership. Reviewers have made a point of praising his editorial work, and past, present, and future book reviews stand as testament to his dedication and professionalism as a section editor. Looking forward, I am happy to

announce that Lisa Sutton of the American Geographical Society Library has agreed to be the new Section Editor for Reviews. I welcome Lisa and invite you to contact her about potential or pending reviews.

The Visual Fields piece for this issue features the transit network diagrams of Cameron Booth. These eye-catching graphics display networks of roads and rails, and help the user, as Cameron states, “make visual sense of a vast and chaotic transportation network(s).” In the rotation for Marginalia in this issue is an interview with cartographer Patrick Hofmann, renowned designer of icons for Google Maps. Many lucky enough to see Patrick’s opening keynote address at NACIS 2011 were left wishing for more detail on his insight into icon design. Now, thanks to the efforts of former NACIS Student Board Representative Tim Wallace, we all have an opportunity to sit down with Patrick in a more intimate fashion and hear additional details on him and his icons.

With so many outstanding articles, it seems difficult to contain it all in one website, no matter how shiny new and well-built it is. So go ahead and share the open access articles in any way you see fit, as links, downloads, or prints. As for articles in other sections, enjoy the benefits of NACIS membership. Thanks for visiting us at [cartographicperspectives.org](http://cartographicperspectives.org), and we hope to see you here often.

- Patrick Kennelly

ERRATUM: In “A Search for a Radical Cartography” by Mark Denil, which appeared in *Cartographic Perspectives* #68, the organization Counter-Cartographies Collective was incorrectly abbreviated as “C3.” The correct abbreviation is “3Cs.” This has been corrected in the current online version, but digital copies previously downloaded may contain this error.





## INTRODUCTION

Numerous methods have been embraced over the years to study the history and evolution of thematic map design. Many of these methods have been descriptive. Research on thematic map symbolization in particular is typically episodic and non-cumulative; a single or small sample of maps is often analyzed and summarized in a manner resembling the discussion of fine art. An example of this is Robinson's (1982) empirical overview of the development of thematic cartography. Though insightful and more extensive than many other studies, it is neither systematic in its analysis nor very precise in its conclusions.

One method that has not regularly been used in the study of map history is content analysis. Largely ignored in cartography, *quantitative content analysis* (QCA) is not only a viable method for comparing map design over time (Muehlenhaus 2011), but may prove useful in examining changes in thematic map design. In particular, it is argued that QCA can be used to achieve the following analytical objectives (Muehlenhaus 2010):

- 1) Count and measure the number of particular data and graphic elements found on a multitude of maps for comparison by publisher;
- 2) Allow for the relatively quick analysis of a large sample of maps simultaneously;
- 3) Allow for the quantitative comparison of different compositional traits among maps in a sample; and
- 4) Allow us to quantitatively measure and compare data longitudinally (e.g., changes in map styles and techniques as they occur throughout time).

The goal of this article is twofold. First, it will illustrate the usefulness and drawbacks of using this method on a series of thematic maps published over the past 80 years in the *Goode's World Atlas*. Second, it will provide a practical introduction of this method to other researchers who may be interested in using QCA to study their own map sets.

The rest of this article proceeds as follows: first, QCA is defined and its core methodological concepts are reviewed. Then, using this method, the reader is taken step-by-step through an analysis of changes in symbolization and representation found in certain thematic maps from *Goode's World Atlas* throughout the past 80 years. Throughout this case study, care is taken to point out key parts of the methodological process and to highlight several of the potential pitfalls and nuances researchers may come across. The article concludes with a critical review of the benefits, drawbacks, and limitations of using this method for historical map analysis.

### WHAT IS QUANTITATIVE CONTENT ANALYSIS?

Content analysis was originally designed to help researchers discern patterns, themes, and repetition within and across numerous text documents. It has since evolved into an established method for analyzing media images, as well.

*Largely ignored in cartography, quantitative content analysis (QCA) is not only a viable method for comparing map design over time (Muehlenhaus 2011), but may prove useful in examining changes in thematic map design*

For example, it has been used by geographers to critically analyze images in *National Geographic Magazine* (see for example Lutz and Collins 1993), iconic maps (Edsall 2007), and the genealogy of persuasive maps (Muehlenhaus 2011). As opposed to other methods of deconstruction, which often concentrate on uncovering different contested meanings and representations in a single or handful of visual image(s), content analysis is useful for answering research questions about the nature of many images at once (Riffe, Lacy, and Fico 1998; Rose 2007). In many cases, it also allows for the statistical analysis of map elements and data types within a dataset.

There are two broad types of content analysis: qualitative and quantitative (Krippendorff 2004). *Qualitative content analysis* is less concerned with counting differences within data samples and more interested in drawing parallels between objects (Rose 2007). In contrast, *QCA* is a particular method of content analysis primarily used for the analysis of visual media (Riffe et al. 1998). Riffe et al. (1998, 20) summarize *QCA* as:

“...the systematic and replicable examination of symbols of communication, which have been assigned numeric value according to valid measurement rules, and the analysis of relationships involving those values using statistical methods...”

Research questions fuel the method in *QCA*. Before analysis begins, one must know what one is seeking to answer about the data sample (Krippendorff 2004; Riffe et al. 1998). For example, if using *QCA* on a series of weather maps, researchers need to know what they are looking for on the maps before beginning. If analysts were exploring how weather patterns are represented on maps differently depending on what country a map is published in, they would likely spend time focusing on two key components: (1) each map's country of origin, and (2) what type of map symbolization was used. The importance of determining the country of each map's origin is self-evident. Researchers could not compare one country's maps to another without this information. On the other hand, if the research question is about different weather pattern symbolization, analysts would be foolish to spend time critiquing each map's use of a graticule. Researchers using *QCA* can limit and specifically define the scope of their analysis via a process called coding.

*QCA* is dependent upon clearly defined codes (categories). Codes are the operational rules that specify the definitions and intensities of different components in the maps being analyzed. The goal of using codes is twofold: (1) to systematically evaluate and analyze each map in the *exact same manner* so that the results can be compared; and (2) to allow for additional analysis by other researchers in the future. Whereas most qualitative approaches are non-replicable due to the nature of their anecdotal descriptors (e.g., what one person labels “provocative” another may label “tame”), *QCA* defines, identifies, and quantifies the attributes of nominal data. Essentially, it makes it possible to compare apples to oranges.

For the method to be useful, codes must be explicitly developed and rigorously applied to the maps. Once codes are established, one can go through a series of maps and analyze each one systematically using the same, pre-defined codes. With well-defined codes, anyone trained in the coding should be able

to replicate the results of the original analyst. In the end, one can perform quantitative analysis on different images using the codes as the variables of analysis. For example, if a researcher wanted to explore how *Goode's Atlas* symbolized world population on its maps, and whether this symbolization changed at all depending on the edition number, a map symbolization code would be created. This map symbolization code would be defined by established cartographic symbolizations as found in the literature. Then, each map in the sample would be evaluated for its symbolization, and the resulting code for each map would be one of the cartographic symbolizations—such as choropleth, proportional symbol, cartogram, or isopleth.

Though its usefulness in large-sample, comparative studies is well-established, QCA has been critiqued for three perceived shortcomings. First, QCA is *not* capable of answering all of the questions cartographers may want to ask about maps. For example, in the case of map production, QCA focuses on the end product (i.e., the map) and completely disregards analysis of the subjective processes that are involved in the design of a map (i.e., the bias of map producers) and the cognitive steps necessary to interpret the map (i.e., the map readers). Second, regardless of how well one breaks down a map with codes, the image itself cannot be used to determine the communicative intention of the cartographer. Other methods, such as semiotics (Wood and Fels 1992), account for the receptor of the image as well as those designing the map; QCA does not. Third, the method is also incapable of highlighting how effective a map design is or how map readers interpret what is being coded. These limitations aside, however, the strength of QCA rests in the fact that it has the ability to compare, quantitatively, what is found on maps in a large dataset.

The rest of this article will walk the reader through a case study using QCA to explore how particular thematic maps in *Goode's World Atlas* have, or have not, changed throughout time. Due to the fact that *Goode's* has been produced for 80 years and has consistently mapped similar data, this atlas provides an ideal opportunity to explore QCA's usefulness as a method for the longitudinal and comparative study of thematic maps. Each methodological procedure in this case study will be accompanied by an explanation of how things have been done, as well as advice on things to think about when running your own QCA analysis in the future.

## STEP 1: DECIDING ON RESEARCH QUESTIONS

Before anything else, you must know what you are trying to answer. Deciding upon your specific research questions is one of the most important decisions you will make in the research process. As will become evident, you cannot easily go back and change the questions you are investigating once you have begun. Because you will be quantifying variables deemed important in answering preselected research questions, you cannot simply use the collected data to infer correlation or causation in other arenas. Be certain that you are asking all of the research questions you want to answer; research questions should never be formulated after your analysis is done.

Assuming you only have weeks or months to devote to this project, not years, coming up with research questions that are limited in scope can be a real time saver. If you are truly interested in only one dimension of map change, you can limit what variables you look for to those dealing with this facet of cartography, saving massive amounts of time and energy.

For this particular case study, two questions were proposed:

1. Did the style and types of thematic representations used in *Goode's World Atlas* change dramatically over eight decades?
2. If so, in what ways and when (i.e., were there any trends among the maps)? If not, which styles and representations remained consistent?

Obviously, if you are investing a large amount of time in the research, or if your dataset is large, you may want to ask more questions than are proposed here. However, given the context of this exploratory project, these two questions were deemed adequate.

This research was originally conducted for a 20-minute presentation at a conference session dealing with the 80<sup>th</sup> anniversary of *Goode's World Atlas*. Whereas other session presenters were tasked with reviewing the biography of John Paul Goode (the atlas's founder), the complexities of transitioning an atlas from the darkroom to digital databases, and the future of the atlas, my role was to review how map presentation and symbolization have changed in the atlas over the past 80 years. Given the time constraints, both in the amount of time available to complete the study and the brevity of the presentation, I limited the study to the two questions above. As I was not certain what aspects of thematic cartography may have changed in 80-plus years of atlas production, the questions were left vague enough to encompass any variations dealing with thematic symbolization and map presentation—or what I call “style” in the research questions. More specific research questions than these will be preferable in most circumstances.

I also limited my research to thematic maps for several reasons. First, the amount of maps that could be selected from any *Goode's World Atlas* was very large, and the time for presentation limited; I needed to limit the scope of the analysis. Second, after a qualitative assessment of the atlases, it was determined that aside from toponym and border changes, reference maps in *Goode's Atlas* were less prone to dramatic presentation and symbolization change. Of course, in the future, one might conduct a separate study on reference maps in *Goode's World Atlas* and compare the results.

## STEP 2: SAMPLING MAPS

Different studies will call for different sampling techniques. Ideally, random samples should be used. However, the ability to select random samples of maps will vary from project to project. Sometimes random samples will not allow you to answer the questions you are exploring. In many cases, convenience

samples or selective sampling must be used. This is acceptable, as long as you mention this in your analysis and realize that different types of sampling will have implications on the veracity of your results (Riffe, et al. 1998). It is particularly important to note that if a sample is not randomly selected, it is impossible to infer your results upon a larger population of maps.

As for this case study, there were actually two sampling procedures. First, the selection of atlases was a convenience sample, as not every edition of the atlas was available to me. Thematic maps were selected from the 1923, 1939, and 1950 editions of *Goode's School Atlas*, as well as the tenth (1957), eleventh

(1960), thirteenth (1970), fourteenth (1974), sixteenth (1982), nineteenth (1995), twenty-first (2005), and twenty-second (2010) editions of the *Goode's World Atlas*.<sup>1</sup>

After analyzing the table of contents from each of these editions, thematic maps were selected for analysis based on whether or not they were found in all, or nearly all, of the editions (i.e., a selective sample). An attempt was also made to find thematic maps that used different levels of measurement—e.g., nominal, interval, and

ratio level data. (Ordinal data was excluded due to a lack of thematic maps having data with this level of measurement.) The purpose of choosing maps based on levels of measurement was that different levels of measurement often require different types of symbolization (MacEachren 1994, 1995). As symbolization is one of the key components in my research questions, it was necessary to look at as many types of potential symbolization as possible. The following 13 maps in Table 1 were chosen and analyzed in each atlas that contained them:

Again, a random sample would have been ideal, but that may have also precluded answering my questions. If only nominal or ratio level maps were selected, for example, I would be missing other important varieties of map that use alternative forms of representation.

<sup>1</sup> The atlas was originally entitled *Goode's School Atlas*, but all editions are referred to as *Goode's* or *Goode's World Atlas* throughout the rest of this article.

Nominal Level of Measurement
North American Vegetation
European Languages
Predominant Economies
Ocean Currents
Interval Level of Measurement
Asia Level of Measurement
World January Temperatures
Ratio Level of Measurement
Import/Export
Wheat
Coffee
Copper
Population Density
Petroleum/Energy/Production
Ocean Traffic

Table 1. Maps that were coded from the different versions of *Goode's World Atlas*

### STEP 3: DEVELOPING ANALYTICAL CODES

*Developing codes—i.e., strict definitions of what you will be looking at in your map sample—is the most crucial facet of any content analysis*

Developing codes—i.e., strict definitions of what you will be looking at in your map sample—is the most crucial facet of any content analysis. To ensure that the method will help answer the questions being asked, codes must fulfill three obligations (Rose 2007, 64–67). First, the coding must be extensive—any aspect of a map that is relevant to answering the research question should be coded for (Riffe, et al. 1998; Rose 2007). Second, each code must be exclusive (Riffe et al. 1998; Rose 2007). An aspect of a map that has been coded for already cannot be coded for again, or some maps might be counted twice in the final analysis. (This is particularly likely to occur when running cross-tabulations.) Finally, the codes must be enlightening (Rose 2007); they must break down the maps in a manner that is analytically relevant and interesting. Much time and consideration should be put into creating codes that: (a) account for every variable that may play a role in the questions you are hoping to answer; (b) are indigenous from one another; and (c) can actually help you answer your questions.

These codes were developed based off of the researcher’s knowledge and previous research in cartographic design. Many of the codes were borrowed or adapted from those developed and tested by Muehlenhaus (2010, 2011) in his comprehensive study of persuasive cartographic manipulations. Other codes were based on what is often considered standard practice in Western atlases. For example, some atlases include data sources with their maps, whereas many do not. Thus, a code was developed to determine whether or not data sources were included with *Goode’s* maps, and whether inclusion or exclusion changed by edition. After looking through many editions of *Goode’s*, codes specifically relevant to this publication were also developed. For example, comparing the color and layout conformity of many maps to one another within a given edition, it was interesting to notice that title placement and style seemed to vary widely across and within editions. It was assumed, correctly, that coding for title placement and style might highlight specific changes in the large dataset.

Your codes *cannot* be specific enough; you must write down thorough definitions of each to refer to when questions arise during the coding process. (And questions will arise!) Once your analysis begins, strict adherence to the codes’ definitions is crucial to the integrity of your study. To make sure that the codes are vigorous enough for large sample coding, it is advisable to conduct several pilot studies. Often a code you create while dreaming up a research project actually does not have any legitimacy or is so poorly defined as to be worthless. By conducting pilot studies, you can easily go back and rectify codes that need reworking, rethinking, or deleting. You can also add new codes that you had not previously thought relevant.

In this case study, I was interested in analyzing the thematic representations and symbolizations of maps in my sample. Thus, the codes I devised (see Table 2) dealt with a variety of data and graphic traits that were found to some degree in each and every map. I tested my codes on a variety of random

Codes	Definitions
<b>Map Edition</b>	The edition number that the map appeared in.
<b>Map Name</b>	The name of the map according to the table of contents.
<b>Map Page Number</b>	The page(s) in the atlas on which the map was found.
<b>Level of Measurement of Data Being Mapped</b>	The level of measurement that the thematic data is provided in. The definitions of these levels are listed below.
Nominal Data	Measurement that involves grouping/categorization of thematic data but no ordering.
Ordinal Data	Measurement that involves both categorization and ordering of thematic data.
Interval Data	Measurement that involves both an ordering of thematic data and a specific numerical difference among categories.
Ratio Data	Measurement that involves an ordering of thematic data, includes a specific numerical difference among categories, and has an absolute zero.
<b>Number of Themes</b>	The number of themes shown on the map, determined by counting the number of themes referred to in the title and/or legend.
<b>Number of Representations</b>	The number of different cartographic representations used on the map. The types of representations accounted for are based on the definitions provided in the front matter of <i>Goode's Atlas</i> Editions 10 and 22. The types of representations included in this study were: Area Classification; Dot; Flow; Isoline; Proportional Symbol; Range Graded Symbol; Pie Chart; Choropleth; and Cartogram.
<b>List of Representations Used on Each Map</b>	A list of the types of representations (based on the definitions found in the list above) present on each map.
<b>Number of Visual Variables</b>	The number of visual variables used to actually map the thematic data. The visual variables that count are based on the eight variables commonly referred to in the literature (Slocum et al. 2008).
<b>Type of Visual Variables Used</b>	Each map was coded for which types of visual variables were used to represent the thematic data. The types coded for are defined below.
Color Hue	The use of color hue as defined in Slocum et al. 2008.
Color Lightness	The use of color lightness as defined in Slocum et al. 2008.
Color Saturation	The use of color saturation as defined in Slocum et al. 2008.
Spacing	The use of spacing as defined in Slocum et al. 2008.
Size	The use of spacing as defined in Slocum et al. 2008.
Perspective Height	The use of spacing as defined in Slocum et al. 2008.
Orientation	The use of spacing as defined in Slocum et al. 2008.
Shape	The use of spacing as defined in Slocum et al. 2008.
Arrangement	The use of spacing as defined in Slocum et al. 2008.
Lightness	The use of spacing as defined in Slocum et al. 2008.
Text	The use of text instead of, or in addition to, visual variables to highlight the quantity or category of the thematic data.
<b>Accompanying Charts</b>	If a map has a pie, bar, or any other type of quantitative, graphic representation of data, it is coded as having a chart. If it does not have such an item, it is coded as not having a chart.
<b>Chart Characteristics</b>	
Number of Proportional Symbols	The number of proportional symbol charts accompanying the map.
Number of Pie Charts	The number of pie charts accompanying the map.
Number of Other Charts	The number of other types of charts accompanying the map.
Three-Dimensional Charts?	Yes, if any of the charts are drawn using a three-dimensional perspective. No, if all of the charts accompanying the map are two-dimensional.

<p><b>Map Scale</b></p> <p>Include a Scale Bar?</p> <p>Is a Map Scale Available?</p> <p>If so, what is it?</p>	<p>Does the map include a graphical scale bar or graticule?</p> <p>Does the map include a mathematical ratio or word statement scale? Yes or no.</p> <p>List the scale of the map.</p>
<p><b>Data Source Inclusion</b></p>	<p>Does the map list a data source for the thematic data being mapped (on the same page or near the same page as the map itself)? Yes, if it does include a data source. No, if no data source is printed with the map.</p>
<p><b>Legend Inclusion</b></p>	<p>Is an area clearly devoted to being a legend found on or near the map? If yes, a legend is included. If not, it has no legend.</p>
<p><b>Title Style</b></p> <p>Caption</p> <p>Headline – Small Type</p> <p>Headline – Largest Type</p> <p>Title in Legend</p> <p>No Title</p>	<p>Title is a caption.</p> <p>Title is at the top of the map but does not use type that is the largest text on the page.</p> <p>Title is at the top of the map and is at least as large as the rest of the text on the page.</p> <p>The map title is inside of the legend or appears to be the title of the legend itself.</p> <p>The map has no title associated with it.</p>
<p><b>Colors</b></p> <p>Number of Colors</p> <p>Colors Included</p>	<p>Number of different hues used on the map. Hues are limited to the following generic colors: black (80% K or more); gray (79% K or less); blue; brown; green; orange; purple; red; white; yellow; and other.</p> <p>A list of all the colors found on the entire map, not just the symbolizations of thematic data. The definitions of these colors are based on those above (in Number of Colors).</p>
<p><b>Base Map Projection</b></p>	<p>The type of projection used. These projection types are based off of the definitions provided in the 16th edition atlas's front matter. The projections coded for include: Albers Equal-Area; Goode Condensed; Simple Conic; Goode's Full; Lambert Azimuthal Equal Area; Lambert Conformal; Miller; Mollweide; Polyconic; Robinson; Sinusoidal; and Other.</p>
<p><b>Relief Type</b></p> <p>Contours</p> <p>Hachures</p> <p>Shaded Relief</p> <p>Other</p> <p>None</p>	<p>The type of relief on a map was broken down into four types.</p> <p>A map has contour relief if it uses isoplethic or isarithmic lines to delineate elevation.</p> <p>A map uses hachures if it represents elevation using line work that is not isoplethic or isarithmic.</p> <p>A map uses shaded relief if it represents elevation using a remotely sensed image or raster shading scheme.</p> <p>If relief is shown but none of the other codes accurately describe the method, the map is classified as "Other."</p> <p>A map that does not depict relief.</p>
<p><b>Map Labeling</b></p> <p>Extensive</p> <p>Limited</p> <p>Extremely Limited</p> <p>None</p>	<p>Labeling was based on an ordinal ranking system following the definitions below.</p> <p>Labeling is common and even across the entire map, including country names, cities, oceans, and more.</p> <p>Only reference cities and meridians are labeled. Fewer than 15 countries can be labeled.</p> <p>Labeling of meridians and up to five additional objects only (e.g., cities, seas, islands, etc.). No countries are labeled.</p> <p>No labels whatsoever. Simply a base map with a thematic representation occurring over it.</p>

Table 2. Codes and their definitions

maps collected from different atlases. I quickly discovered which codes I might want to add and which may not be so relevant. For example, I originally did not have any code for map labeling. However, during my preliminary coding tests I soon realized that different thematic maps from different editions used labeling differently.

For the sake of an organized analysis, I broke down the codes into two separate categories—data model variables, and graphic variables—based on what they were identifying in each map. Data model variables are those that are influenced by the geographic nature of, and cartographic decisions made with, the data being mapped. For example, a map's projection, orientation, data level of measurement, and classification scheme would all be data model variables. These have less to do with the graphic representation of the map but are typically manipulations of the data themselves. You do not necessarily need to divide your codes into categories, but for the sake of this write-up and my analysis, I found it helpful to break codes down into these groups by the cartographic traits they were being used to analyze.

### **GOODE'S WORLD ATLAS DATA MODEL VARIABLES**

The first place to start was with each map's projection. Obviously, this was typically Goode's Homolosine Interrupted Projection. Next, each map was coded for whether it included a map scale, either via scale bar, written sentence, or ratio—or two or more of these methods. It was also noted whether each map provided a data source for the data being mapped. The number of themes being shown on each map was counted. For example, if a single map showed both global coffee production areas and cotton production areas, then it was coded as mapping two themes. Along with coding the number of themes, the level of measurement of each theme was also noted (using nominal, ordinal, interval, or ratio). The style of the map's title was coded as one of the following: caption, largest type, prominent but not the largest type, attached to the legend, or no clear title. Finally, the clarity and detail found in accompanying map legends was ranked using a five-point Likert scale (ranging from overly simplified to overly complex). If maps had no legend, this was noted. The specific definitions for each of these codes can be found in Table 2.

### **GOODE'S WORLD ATLAS GRAPHIC CODES**

The maps were also coded for a variety of graphic and visual elements. If a thematic map displayed physical relief, the type of representation was noted (contours, shaded relief, hachures, or other). Place-name labels were also coded for, as well as an ordinal category describing how many were on each map (many, limited, none). In order to decipher change in color over time, colors used on both the base map and in the thematic or referential symbols were coded for. Many maps in *Goode's World Atlas* are accompanied by graphs and charts of various types. Thus, the number of charts accompanying each map was noted, as were the types of charts used (pie charts, bar charts, or other types of charts). In

addition to coding for the number of thematic representations found on each map, as discussed earlier, the types of thematic representation were also noted. These codes were based on the basic types found in cartography textbooks—i.e., choropleth, proportional symbol, dot, isarithmic, and area maps (Dent, Torguson, and Hodler 2008; Slocum, McMaster, Kessler, and Howard 2008). Finally, codes were developed for the number and types of visual variables used to map thematic data on each piece. These were counted and the types noted, including: size, shape, orientation, texture, spacing, focus, color hue, color contrast, text, and color saturation. Most of these are considered standard visual variables and are found throughout the literature (Bertin 1983; MacEachren 1995; Slocum, et al. 2008). Codes should typically be based on previously established norms found in scientific literature. For example, I did not devise my own visual variable categories. By using pre-established visual variables, the results of this study can be couched within established cartographic theory. The definitions for the graphic variables can be found in Table 2.

## STEP 4: THE CODING PROCESS

*Consistency and concentration are the fundamental components of successful coding*

The actual process of coding can be a bit mysterious. There is no ideal software for coding or one way of going through the process. Consistency and concentration are the fundamental components of successful coding, and hopefully, if you have conducted several pilot studies, you will quickly become familiar with what setting and method work best—or do not work—for you. Some people prefer to set up a spreadsheet in which to enter their codes. For this study, I created a spreadsheet in SPSS and set up labels, which allowed for quick input and output of the results. Several applications designed for content analysis can also be used (e.g., Atlas.ti). Most of these programs export to SPSS or MS Excel format as well. However, unless you have the time and ability to scan and import the images directly into the Atlas.ti program, it may not be as efficient as merely entering numbers into a spreadsheet. You can, of course, also code your results using paper and pen. Regardless of how you code, you will eventually want to import the data into a statistical software package, so be prepared to enter all of your data into a spreadsheet later on if you do not do so initially.

Once you have your software and setting established, reserve ample time to actually do the coding. Coding is mentally exhausting and is impossible to do well for long periods of time. I found that setting aside two- to four-hour timeslots was ideal. I rarely used the entire four hours, as I often lost the ability to continue after two hours. It is crucial that you remain focused while coding, as the legitimacy of your data depends on it. I have found throughout my experiences in this case study and others (see, for example, Muehlenhaus 2011), that some maps are remarkably easy to code and take no more than a few minutes. Yet others can be completely confounding and require numerous checks of code definitions. In this case, the coding took several weeks to complete. In all, 118 *Goode's* maps were coded. At least 11 thematic maps, and up to 13, from each of the editions were included. In only one case did a

thematic map disappear from a newer edition and then reappear—the *Ocean Traffic* map.

Ideally, a QCA has multiple researchers coding exactly the same maps to ensure that the study is replicable. In this case study, I do not. (It should be pointed out, though, that other methods looking at the evolution of map design have had no replicability test whatsoever.) If two or more analysts agree on the codes given to the maps, the study is considered replicable. This is one of the main benefits of content analysis. If discrepancies arise, the coders can then attempt to figure out where and why their interpretations differ. Using only one coder in your study will severely limit the reliability of the results, and at least two coders are strongly recommended. The lack of a second coder is, admittedly, a major shortcoming in this specific case study and prevents me from saying that this study is replicable with any level of certainty. Having two coders would prevent this shortcoming.

## STEP 5: DESCRIPTIVE ANALYSIS

After spending weeks doing data entry, one of the most satisfying moments in the entire research process is opening up your spreadsheet to see all of the rows and columns completely filled. Exhilaration can quickly turn to dismay, however, when you realize that you now have thousands of cells of data, and there is no single roadmap showing you how to answer your research questions. Congratulations; you have collected all of the pieces comprising your research puzzle. Now you must figure out how to solve it!

Fortunately, simple introductory statistics will often provide you with a wealth of knowledge about your dataset and give you clues as to where to look for answers. A lot of information can be gleaned from perfunctory descriptive statistics, such as average counts of variables, and frequency of map element occurrence. Sometimes this data proves the most insightful of all the tests you will run. If nothing else, it will quickly tell you which variables are not worth examining any further.

A quick descriptive analysis of the maps sampled from *Goode's World Atlas* shows that they follow predictable cartographic patterns. Most maps illustrated only one spatial theme per map (63% of all maps), though sometimes two themes were placed on the same map together (32% of the time). Two to five visual variables were used to highlight thematic data on 88% of the maps. The use of a scale bar was largely arbitrary (58% of maps did not have one) and generally only used on larger-scaled maps. Legends were a common feature (97% of the maps had one). The style of the titles varied slightly, but by and large it was the largest type near or over the map (46% of the sample), and when not floating by itself, attached to a legend (27%). Interestingly, 87% of the thematic maps did not show physical relief on the base map. Of those that did, more used contour shading methods (8%) than shaded relief (5%).

Labeling on *Goode's* thematic maps is rare. Across all of the years, 90% of the maps had limited, extremely limited, or no map labeling. Offsetting this outcome even more was the fact that relief maps of Asia comprised almost all of the maps with more than limited labeling on them. Surprisingly, only 27%

of maps provided any data reference or source. Also, many of the maps do not change at all from edition to edition—sometimes not even once over the course of 30 years. Lacking data sources, and showing little visible change in the representation of the data, it might be argued that the major change found among different versions of the atlas is the edition number on the binding. However, as will be shown in the next section, stopping analysis here would have missed several interesting evolutions the editions have gone through.

Supplemental information graphics were also a common feature in *Goode's World Atlas*, regardless of the edition. Just over 30% of the maps sampled were accompanied by at least one proportional symbol chart. Such charts were most likely to be found individually or in groups of three (12% of the sample each). Pie charts were less common than proportional symbol charts; pie charts were only found in 14% of the maps. However, when they were used, they were always found in groups of two or more. Other types of charts were even rarer, with only 13% of maps having accompanying figures that were not pie charts or proportional symbols. Of tangential interest is the fact that not a single photograph has been published in a *Goode's World Atlas* to accompany a map, something that has not changed in recent editions, even as other atlas publishers began integrating photos with their map collections (see for example *Perthes World Atlas*).

## STEP 6: CROSS-TABULATIONS AND RELATIONSHIP TESTING

Although they often tell us what we need to know about the nature of our dataset, descriptive statistics will sometimes fail to provide enough information for us to explicitly answer our questions. Depending on the nature of your research, whether you are looking for correlation or causation, more refined statistical methods will prove useful. This is what sets QCA apart from previous descriptive methods; not only can we describe what we saw on each map using descriptive statistics, but we can numerically analyze relationships among variables that we might not have noticed via descriptive analysis alone.

In this case study two cross-tabulations were done. First, each map data type (e.g., versions of the coffee production map, versions of Asian land relief, etc.) was cross-tabulated by the cartographic representations used to map the data (e.g., proportional symbols, dots, choropleth, etc.). Second, all of the coded variables were cross-tabulated by the edition numbers of the atlas to test whether and how different editions used design and data techniques differently.

Cross-tabulating the map type variable by thematic representation variable provided count data highlighting how often the thematic representations have changed over the past 80 years. Tellingly, four out of the 13 varieties of maps in this study never evolved thematically; they illustrated the data using exactly the same thematic representation. These included the *European Language* map, the *Economics/Occupations* map, the *North American Vegetation* map, and the *January Temperature* map. *Energy Production* changed the most over 80 years; this data was represented using four different methods: points, flow symbols, proportional symbols, and pie charts. Four maps changed their representations

three times: *Imports/Exports*, *Population Density*, *Ocean Currents*, and *Wheat*. *Copper* shifted once in the mid-1900s, changing from point data to range-graded symbols. *Ocean Traffic* and *Asian Land Relief* also had one change in their 80 years of representation. The maps dealing with agriculture in this sample shifted from area classification maps to dot maps (i.e., the *Coffee* and *Wheat* maps). Also, several thematic maps were originally designed as proportional symbol maps, but eventually, dynamism was added to these via flow map representation (e.g., *Ocean Traffic* and *Imports/Exports*).

The number of visual variables found on maps, and how this number increases or decreases throughout time, can also be an indicator of change in graphic representation. Thus, the number of visual variables used on each map was cross-tabulated with edition numbers to see if the same data was emphasized differently. The answer was: rarely. Only three maps shifted dramatically in their use of visual variables over time; *Coffee*, *Energy Production*, and *Import/Export* maps had the most variation (one to five visual variables, depending on the edition). Still, none of these variations were very large, and were only noticeable due to the quantifiable nature of the analysis.

The conclusion: styles and methods of symbolization in *Goode's World Atlas* have not changed dramatically over 80 years. In fact, rather than identifying radical change, QCA was useful at providing evidence that regardless of the edition number, *Goode's World Atlas* frequently illustrates the same data in the same style. However, QCA successfully identified when an edition did go through an evolution. Such changes, though minimal, are highlighted below.

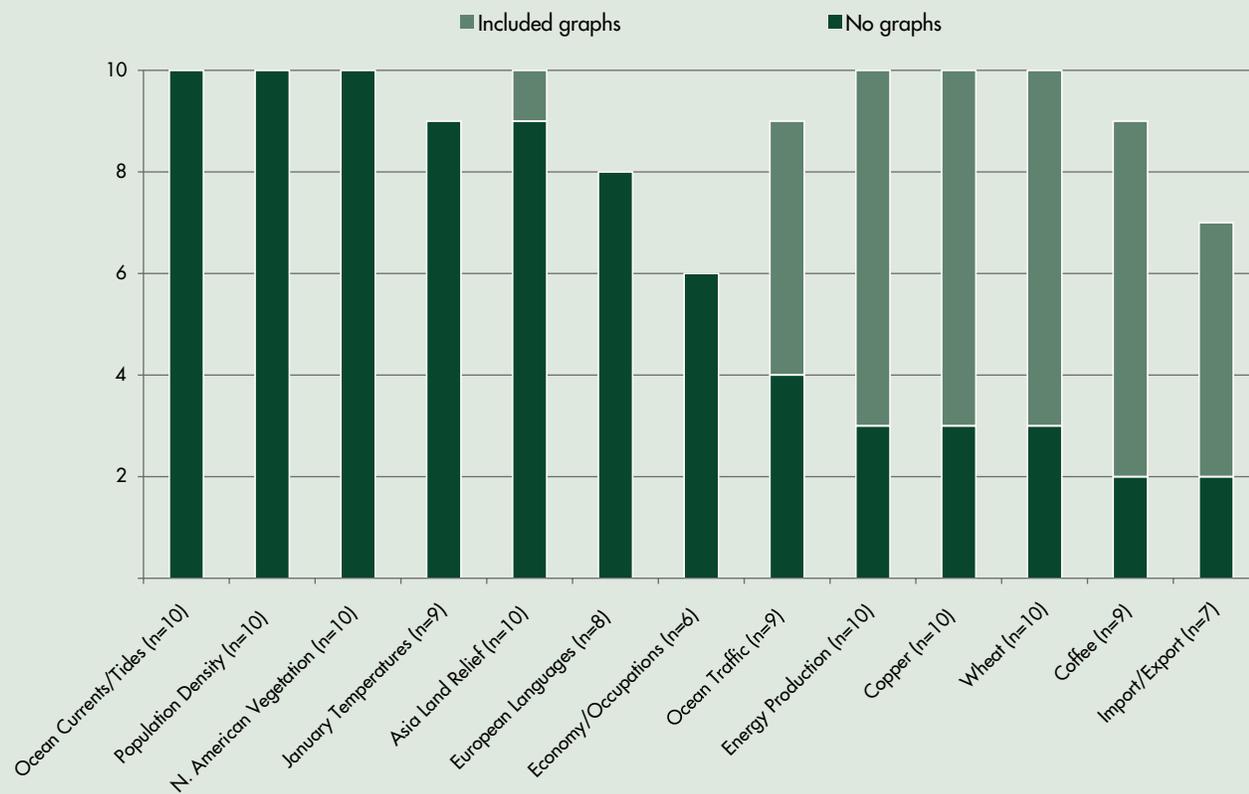


Figure 1. Frequency that each map type included at least one supplemental graph

## CHARTS AND GRAPHIC ACCOUTREMENTS

Though *Goode's* thematic maps did not change much in symbolization over 80 years, there were often other graphics included with the maps that did change. Many maps were accompanied by graphs, and each map was coded for a variety of graph variables. These results showed more variability. As Figure 1 highlights, some maps had at least one graph included half the time (e.g., *Ocean Traffic* and *Import/Export*); others, only once (e.g., *Asia Land Relief*); and several, like *Coffee*, nearly always had a graph. Many maps never had an accompanying graph, including: *January Temperatures*, *Predominant Economies*, and *North American Vegetation*.

Graphs themselves changed via edition too. Beginning in the 1990s, graphs became increasingly three-dimensional. This design decision contravenes best practice guidelines supported by cognitive research: cognitive studies have consistently shown that humans are not very adept at comparing volumes (Ware 2004). Only in 2009 were all graphs redrawn yet again in a strictly two-dimensional form, following editorial deliberation and discussion (Veregin 2009).

The number of graphs included with each map changed depending on the edition (Figure 2). Some maps were simply never accompanied by a graph (e.g., *Ocean Currents*, *Population Density*, *January Temperatures*, and *European Languages*). Many maps, however, saw changes in the number of graphs accompanying them (including *Wheat*, *Ocean Traffic*, *Copper*, and *Energy*).

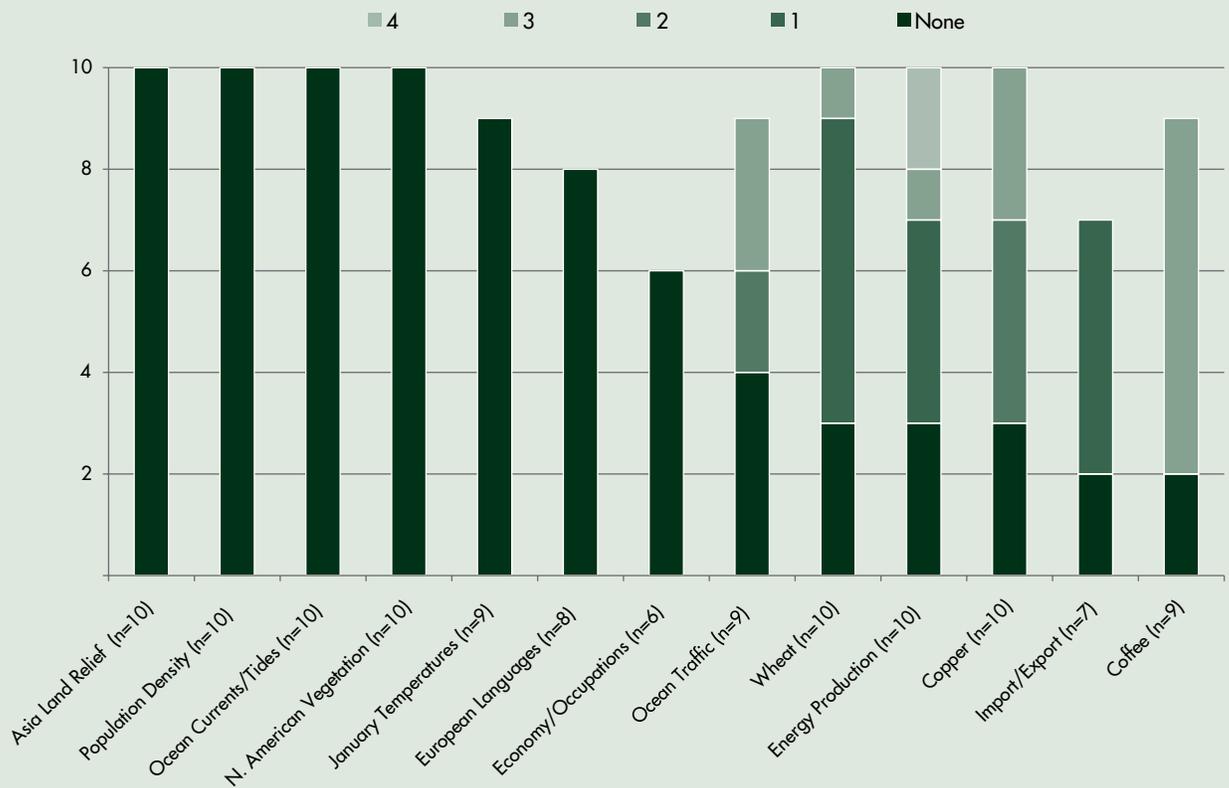


Figure 2. Number of Graphs Accompanying Different Maps

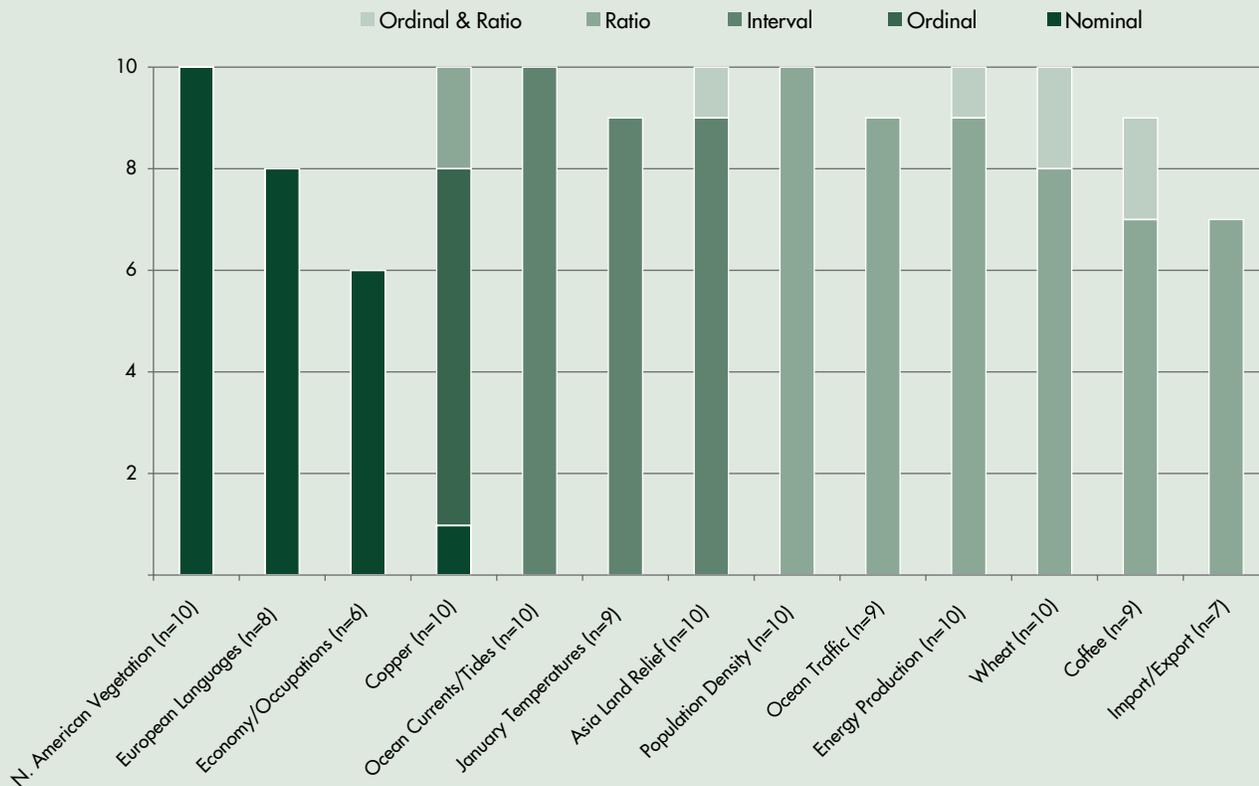


Figure 3. Levels of Measurement Used on Each Map

### DATA MODEL VARIATION

How certain data were measured typically did not change throughout the different editions. Most data continued to be mapped at the same level of measurement, regardless of the era; however, there were several exceptions (Figure 3). *Copper* changed the most. Copper data were originally mapped nominally (showing primary areas of copper mining), and eventually evolved into an ordinal level of measurement (showing primary areas of copper mining ranked into three categories based on production).

### MAP SCALE

Map scale was rarely included in *Goode's World Atlas*, regardless of the era. Scale was more regularly included on maps in the 1960s and 1970s, but began to disappear again in the 1990s and into the new millennium (Figure 4). Including a map scale on global-scaled maps is often misleading due to map distortion away from the secant lines. Yet, whether a map was global-scaled or not had no relationship with whether a scale was included. Global-scaled maps of *Coffee*, *Copper*, and *Wheat* never included a map scale, regardless of the edition. Global-scaled maps of *Ocean Currents* and *Population Density* always did. Global-scaled maps of *Ocean Traffic* and *Occupations of Mankind* included a scale more often than they did not.

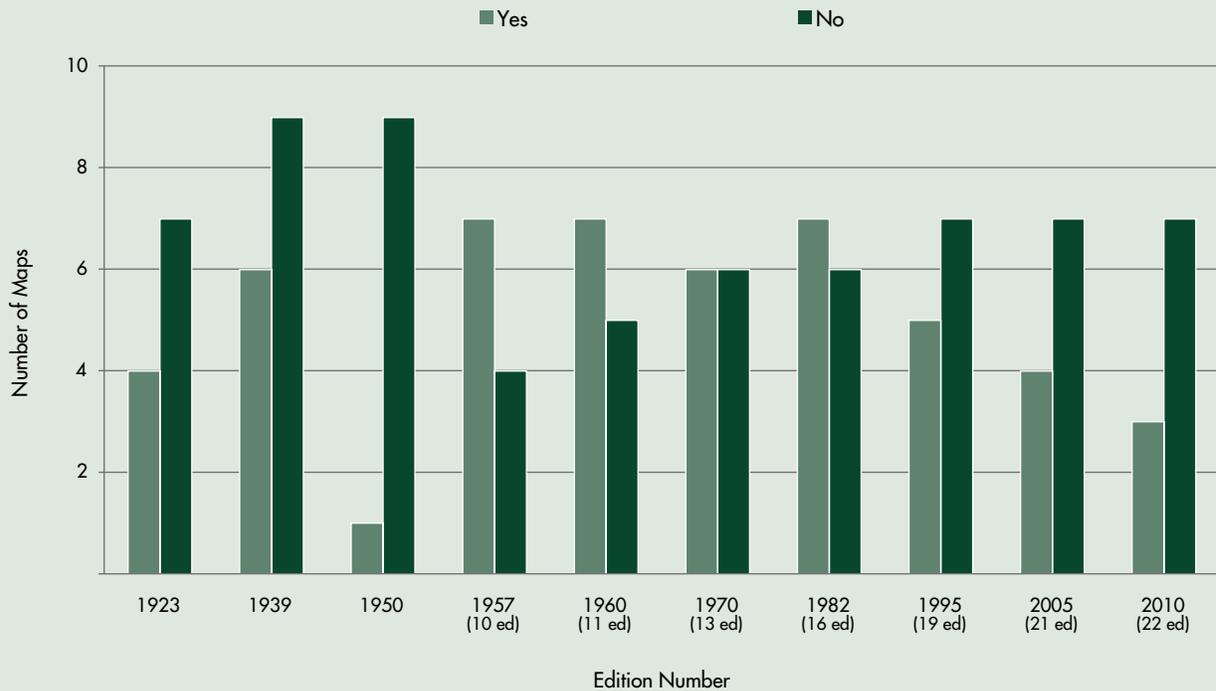


Figure 4. Map Scale Provided with Map

### LEGEND INCLUSION

Legends were almost always included with maps (Figure 5). In earlier editions, legends were regularly omitted, but between the sixth and twenty-first editions, only one map had no legend. The newest edition omitted the legend from two of the sampled maps.

### DATA SOURCE

The inclusion of a data source with the map varied slightly throughout the different editions, but most of the time data sources were not available to the map reader (Figure 6). Much of the data used in the atlas appears to have been simply republished from edition to edition, with minimal or no change. Over many editions, the same printing plates were simply reused or minimally updated, rather than recreated from scratch, by the publisher (Hudson 2009; Veregin 2009).

### LABELING

Throughout all of the editions, a majority of the thematic maps sampled did not have any text labels (Figure 7). In fact, *Goode's World Atlas* maps might be characterized by their uncluttered, label-less appearance.

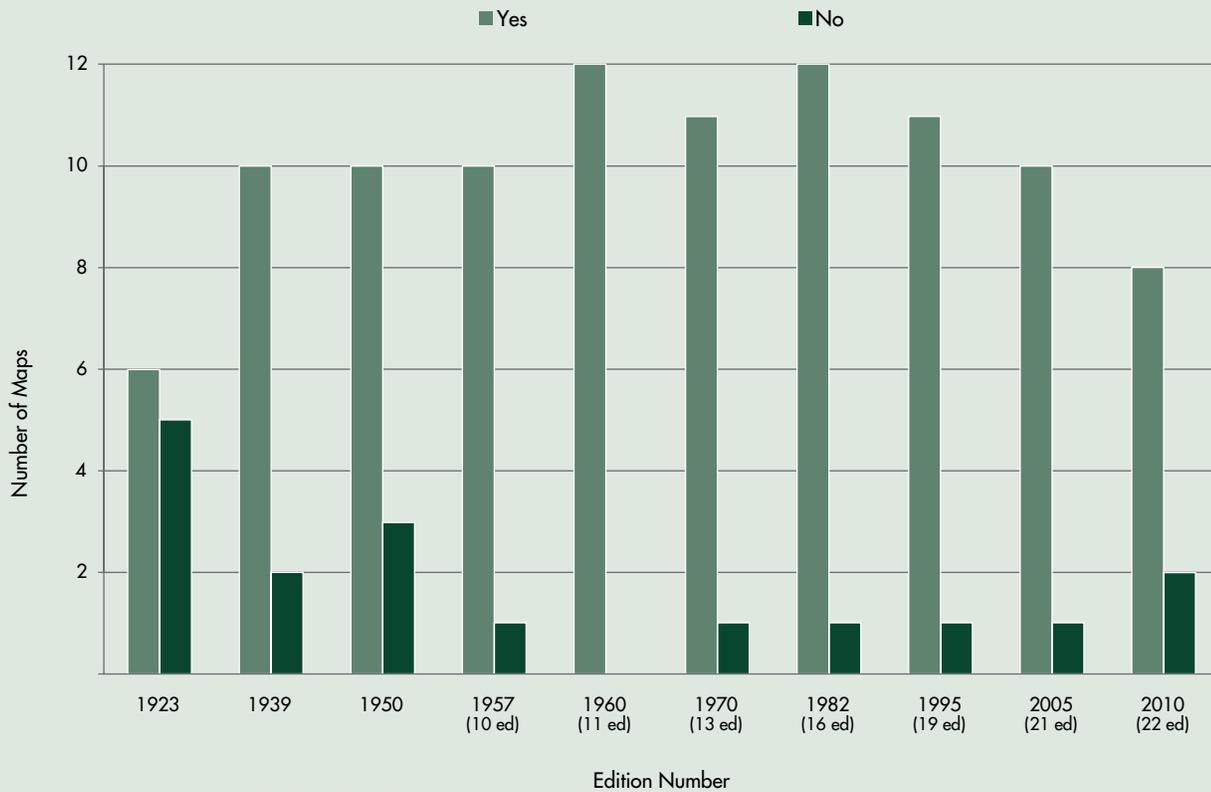


Figure 5. Legend Included with Map

## STEP 7: ANSWERING THE RESEARCH QUESTIONS

Once you have analyzed the data, it is time to return to your original research questions. In this case, there were only two questions, but often you will have cause to ask many more depending on what you are researching. Again, it is crucial to think about any and all questions you may want to answer before beginning the coding process.

*Did the style and types of thematic representations used in Goode's World Atlas change dramatically over the past eight decades?*

Throughout *Goode's* different editions, change has been relatively gradual in graphic symbolization, thematic representation, data model decisions, and style of map accoutrements (i.e., graphs and charts). In fact, from 1960 afterward many of the maps did not change in content at all—merely slight, cosmetic color value differences are used. The biggest noticeable shift in data representation came when certain maps began using shaded relief (the eleventh edition advertises this new development boldly by using shaded relief as its cover illustration).



Figure 6. Data Source Included

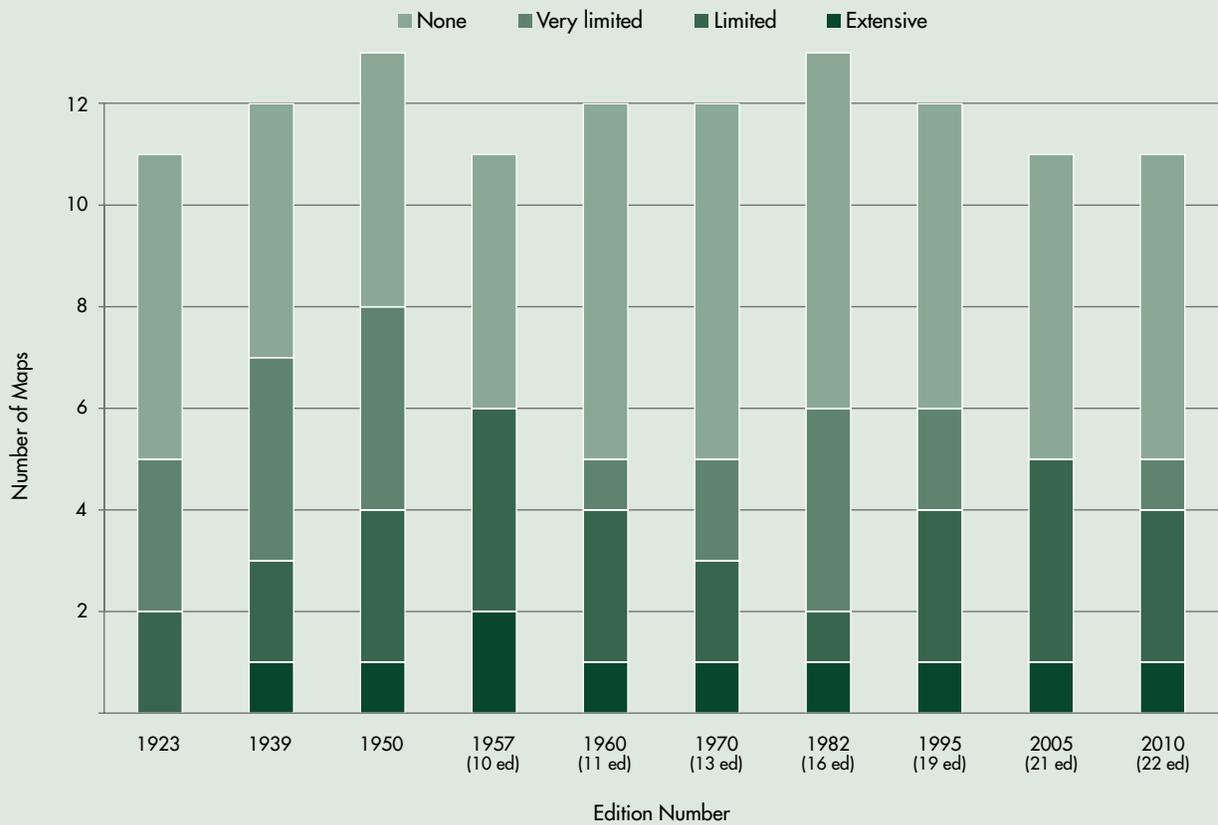


Figure 7. Use of Map Labels on Thematic Maps

*In what ways and when did these changes occur? What styles and representations remained consistent?*

The two most recent editions—the twenty-first and twenty-second—show the greatest amount of change in thematic map style from others. The atlas editors have increased the use of satellite imagery. Choropleth maps were never used in the other sampled editions, yet are quite common in the twenty-first and even more regular in the twenty-second edition. These editions also include more cartograms, more contemporary representations (e.g., choro-graduated symbols), and new thematic maps dealing with contemporary issues—including carbon dioxide emissions, sea level change, and network connections. The twenty-first edition incorporated some of these changes, but the twenty-second ushered in the most changes of any edition in this study. Tellingly, the twenty-first edition was designed under a new editor, Howard Veregin.

Though not proposed in the beginning, another question that needs to be asked is whether QCA was effective at revealing changes in the maps themselves. The design of maps in *Goode's* certainly did not change much over time, but QCA was effective at finding miniscule shifts in design and content. An example would be the shifts in color use—there were noticeably more colors used in editions published after the 1950s. This is likely linked to the decreasing cost of printing in color and the evolution of printing technology as a whole. Changes in the number and types of graphs accompanying the maps were also easily identified with this method.

### **WHY USE QUANTITATIVE CONTENT ANALYSIS?**

Unearthing and highlighting idiosyncrasies of thematic representation in different versions of *Goode's World Atlas* was but one goal of this article. The principal goal was to highlight how QCA may prove a useful method for the systematic analysis of many maps at once and to give a primer to cartographers who might be interested in using this method themselves. In this study, QCA successfully allowed for the analysis of trends over time, and variations among representations of the same themes. Once codes were established to answer predefined questions, the coding itself was meticulous, consistent, and relatively quick. Moreover, the results were not episodic; if I wish to add more data to the sample for further comparison at a later date—i.e., if new editions of *Goode's World Atlas* are published—I can. This method allows for continual data accumulation and analysis.

At the beginning of the article, Muehlenhaus's (2010) four methodological benefits of using QCA were summarized. A quick review of how well QCA lived up to these benefits in the *Goode's* case study is in order. First, could QCA be used successfully to count and measure the number of particular data and graphic elements found on maps? The answer is yes; it was very useful for quantifying map attributes that other methods typically only discuss categorically. Second, did QCA allow for a quick analysis of many maps at once? Again, the answer was yes. Though analysis of these maps took roughly 40 hours to complete, this was likely faster than if each of the 118 maps was individually scrutinized and described. Third, did QCA facilitate the systemic comparison of different compositional traits among maps in the sample? Again, the method

proved effective at doing this. For example, with the click of a button in SPSS, it was possible to quickly ascertain that certain global-scaled maps included a map scale whereas others did not. We could also determine which maps shared traits and which did not. Finally, did QCA allow for the analysis of how thematic maps have evolved throughout time in *Goode's World Atlas*? Again, it did.

The fact that the maps coded in *Goode's World Atlas* have changed so little over time should not be viewed as indictment on the utility of QCA, although it does signal how slowly developments in thematic cartography can disseminate to the publishers of atlases. QCA was effective at picking up many of the minor map design changes throughout the *Goode's* editions. Such subtleties may have been difficult for small sample methods to pick up on, as the changes occurred across such a long stretch of time. For example, the variation in graph style and type over the course of the different editions was readily apparent using this method, as was the fact that certain global-scaled maps always had a map scale and others never did. If one were to use a less holistic method, details such as these may have been overlooked.

Another advantage of QCA compared to other methods is that it allows researchers to avoid delving into the role of the map reader and the intent of the cartographers. As discussed earlier in the methodology, this is often viewed as a limitation of QCA, but in research dealing solely with map composition—not the contextual forces behind the composition—it can prove useful. Whereas many other forms of map analysis (e.g., semiotics) attempt to analyze a map, its creator's intentions, and how the map is interpreted, QCA focuses solely on the map itself. Maps are analyzed merely as visual compositions to be compared to other maps in the sample.

With the benefits of any research method come certain shortcomings. One disadvantage of QCA here was that coding limited what could be identified and how it could be labeled. This leads to less than inspiring analysis and write-ups compared to more descriptive methods. For example, though QCA caught individual design differences throughout the editions, the resulting analysis was numeric and somewhat mechanized. It might be argued that there is a slight disconnect between the results and the subject matter—frequencies are detailed but may not always be the most effective way to present changes in cartographic style. If a picture is worth a thousand words, how many numbers is a map worth? A mixed method of analysis—for example, using QCA in conjunction with a descriptive overview—would prove more engaging in many circumstances.

## CONCLUSION

The goal of this study was twofold. First, it was meant to display the potential effectiveness of using quantitative content analysis for map research. Though there were limitations in the case study presented—including a non-random sample, a single coder, and a dataset that did not vary much over the past 80 years—the method was effective at discerning certain long-term cartographic

trends and minor changes with the sample *Goode's* thematic maps. However, it was incapable of providing insight into why certain cartographic decisions were made within the atlas. It also resulted in number-laden analysis that lacked some descriptive qualities that other methods—such as semiotics and deconstruction—might offer. As previously mentioned, QCA may be more effective if used in conjunction with a qualitative approach. Sample size may play a role in the staidness of this analysis as well. Though 118 maps are more than are studied in many pieces of historical map research, it is a relatively small sample size for a QCA. Finally, for the sake of replicability, a minimum of two coders would need to be used. This particular case study has not yet passed this litmus test.

The second goal of this article was to promote the method among other cartographic historians. It is hoped that by describing the analytical process in a step-by-step manner, other researchers can soon adopt and adapt this method for their own research. QCA is already well established in media studies, and as this case study has shown, there is no reason it cannot be employed effectively for the analysis of maps. It is the hope of this author that more researchers begin using QCA to create cumulative datasets that allow for ongoing research rather than anecdotal case studies. That being said, it appears that a mix of quantitative and descriptive methods may be ideal.

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## INTRODUCTION

Hypsometric tints (Imhof 1982)—cartographic jargon for elevation colors—have been a staple of map design since the early- to mid-nineteenth century. From the ocean shore to the highest peaks, they bring to maps the pleasing greens, beiges, yellows, reds, and whites that depict elevation zones in a systematic manner. Although most people are unfamiliar with hypsometric tints as a term, and probably not keenly interested in elevation zones, they have likely admired these colors on wall maps in homes, offices, and classrooms. They are still widely used today in a diverse range of products, including atlases, airline in-flight maps, television weather maps, and wall maps. Many a cartographer has made a living meeting the demands of this market.

The market success of hypsometric tint maps, however, does not necessarily correspond with reader understanding. There is general concern in the mapping community that students and other inexperienced map readers confuse hypsometric tints with environmental phenomena (Wiegand 2006) such as vegetation, land cover, and climate. The evidence is mostly anecdotal. The classic example is a typical hypsometric tint map that applies dark green—the standard hypsometric tint for low elevation—to the shores of the Persian Gulf. Because green is the color of growing vegetation, some readers may wrongly perceive this serene region as having luxuriant forest or intense cultivation.

This paper discusses the development and rationale of cross-blended hypsometric tints as a partial remedy for the potential problem just described (Figure 1). These new tints depict elevations on small-scale maps in a manner that can take into account regional environmental differences. A pragmatic “if you can’t beat them, join them” approach served as the basis for developing cross-blended hypsometric tints. If readers often get elevation colors confused with the environment, then why not cater to this predisposition by having them represent both?

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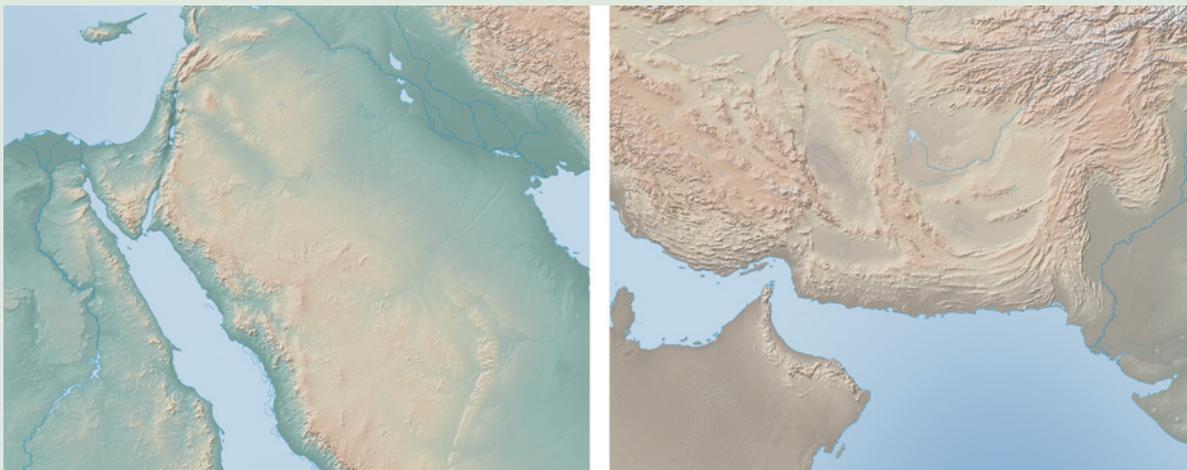


Figure 1. Conventional hypsometric tints (left) use a green lowland tint everywhere, suggesting that southwest Asia is lush (shaded relief has also been applied). Cross-blended hypsometric tints (right) use varying lowland colors tailored to specific regional environments, in this case arid land.

## BACKGROUND

Cross-blended hypsometric tints are a variant of the more-or-less conventional hypsometric tints that emerged in the mid-twentieth century from a disparate range of prior tint schemes, some with origins in the nineteenth century. To better understand why cross-blended hypsometric tints look the way they do and the factors influencing their development, one must look back to an even earlier time.

Perhaps the first map with hypsometric tints is Leonardo da Vinci's Map of Central Italy, c. 1503–04 (see references for URL). This manuscript map has indistinct brown tints applied with washes and chalk that depict elevation differences. Darker browns represent higher elevations. Leonardo da Vinci's map almost certainly does not derive from surveyed elevation data. Nevertheless, in an era when terrain on maps typically appeared as hump-shaped mountain drawings, his technique was a major advancement, predating other hypsometric tint maps by three centuries. The next phase of hypsometric tint development would have to wait until scientists started collecting surveyed elevation data.

With the development of the barometer around 1800, measuring elevations became possible, which resulted in the compilation of lists of spot heights. In France, François Pasumot was probably the first to publish a “table comparative” in 1783 with 83 spot heights (Engelmann 1966). Various contemporary scientists compiled tables with spot heights, including such geographic notables as Alexander von Humboldt, Carl Ritter, and Wolfgang von Goethe (Kretschmer 1986 and 1988). Contemporaneously with collecting spot heights came development of new methods to visualize them. These methods included cross-sectional profiles, and on maps, labeled spot heights and interpolated contour lines, particularly on large-scale maps.

Coloring the area between contours was the logical next step in visualizing elevation. French engineer Jean Louis Dupain-Triel is the first to have done this on a contour map produced in 1791, which he later modified to include elevation tinting (Thrower 2008). Austria was an early center of hypsometric tint innovation. In the late 1820s, Franz von Hauslab drew manuscript maps with elevations represented as color layers. The widespread adoption of his technique started a decade later with the advent of chromolithography, the first color printing technology. Hypsometric tint maps soon afterwards became popular for school maps, atlas plates, and other types of small- and medium-scale maps—it was a reign that would last until the end of the twentieth century and the advent of natural color maps based on satellite land cover data (Patterson and Kelso 2004).

The years between 1840 and 1870 were a pivotal time for hypsometric tint development (Kretschmer 1986). Two categories of tints emerged then that have relevance to modern mapmaking:

*Polychromatic tints:* Also known as spectral tints, early maps with this scheme used a series of colors selected for maximum contrast in an unmethodical arrangement. A classic map of this type is August Papen’s “Höhen-Schichtenkarte von Central-Europa” [layer tints map of Central Europe], published 1857–1859. The assignment of colors to elevation zones on this map would puzzle contemporary readers—for example, Papen uses blue to depict a middle elevation (Figure 2A). The overall effect is not unlike the diverging “rainbow” colors used today by scientists for computer-generated visualizations. Imhof (1982) states that with these contrasting color schemes the continuity of the terrain is lost, and the combination with other map features is difficult. Because printing a large number of colors proved expensive, cartographers began replacing spectral sequences with more systematic schemes by the mid-nineteenth century (Kretschmer 2000).

*Continuously progressing tints:* Tonal tints is another name for this category. Reacting to unstructured polychromatic tints, cartographers developed a more orderly and cheaper alternative by varying the intensity of a single color tone or ink, typically gray or brown (Figure 2B). For example, cartographers in Leipzig, Germany, preferred brown for school and wall maps, modifying that color according to “the higher, the darker” principle (Kretschmer 2000). Placing lighter tones in lowlands serves a practical purpose. Because lowlands generally cover more area than highlands on small-scale maps, and a greater density of map labels is generally found in lowlands, placing lighter tints there improves overall legibility. Despite this advantage, later the practice of combining shaded relief and hypsometric tints proved the death knell for “the higher, the darker” tints. Printing dark shadows over dark tints results in excessively dark mountains that dominate all else on the map, illegible or poorly legible labels, and the lack of a three-dimensional appearance. Today, most hypsometric tints employ “the higher, the lighter” principle to avoid this problem—although the relatively dark lowlands are less than ideal when combined with other map information.

The elevation tints introduced in 1878 by Scottish cartographer John Bartholomew, Jr. (1831–1893), were the next major development (Figure 2C). Bartholomew’s colors have a decidedly modern appearance, ranging from delicate greens and tans in the lowlands to rich orange-browns and purples in the highlands to white on the loftiest peaks (Gardiner 1976). His hypsometric tints were not an instant success. According to Gardiner (1976, 25):

“Cartographers of the period, notoriously conservative, seemed to consider it a catchpenny trick, liable to take the mystique out of geography and make it intelligible to laymen.”

And that is precisely what happened. Within twenty years, hypsometric tints were widely adopted by atlas publishers everywhere. Bartholomew & Sons, Ltd. employed a variant of their tints on *Times* atlases, becoming a hallmark of those influential reference works.

## **BECOMING CONVENTIONAL**

The early-to-mid twentieth century was a time of intense debate by academic cartographers over which elevation colors best gave terrain a three-dimensional

appearance on a flat sheet of paper. “Farbenplastik” (color plasticity) was the term then used for this desired effect (Kretschmer 1988). Two competing schools rose to the forefront of the debate. Karl Peucker (1859–1940), from Vienna, was among the first to systematically analyze the use of elevation tints (Figure 2D). He distinguished colors according to their brightness, saturation, and hue. Peucker proposed the principle “the higher, the richer the color,” starting with dull gray-green in the lowlands and ending with bright red in the highlands (Kretschmer 2000). Peucker selected these colors based on supposed physical and physiological considerations, as well as on real-world observations (Imhof 1982). His “sequence should give an optical stereographic impression,” which would “increase the impression of plasticity” (Kretschmer 1986). Peucker’s assumption was that certain colors would appear closer to the eye than other colors that would have the opposite effect and appear further away. Many have heavily criticized this assumption. For example, Eduard Imhof (1895–1986) questioned Peucker’s mathematical and physical bases for his claims (Imhof 1924; 1982, pp. 304–305), but agreed with Peucker that a hypsometric color sequence should imitate the effect of aerial perspective, which attenuates more distant lowland colors (Kretschmer 1988).

Imhof, from Switzerland, favored a green (or blue green), light yellow green, light yellow red, and white progression from low to high (Figure 2E). He developed these tints in 1962 for the “Schweizerischer Mittelschulatlas” (Swiss Middle School Atlas). Imhof’s tints are notable for being both spectral and tonal. Unlike Peucker who has a discontinuous bright yellow tint at mid elevations, Imhof’s more subtle tints progress evenly from dark lowlands to light highlands. Taking this idea even further, he advocated doing away with layered steps in favor of smooth blends to improve topographic modeling. The aerial perspective effect, which suggests lowlands partially veiled by a light bluish haze, is another trait of Imhof’s tints (Imhof 1982).

Looking back from today, neither Peucker nor Imhof completely won the hypsometric tint war. Peucker’s tints in their original form are now rarely, if ever, used. Imhof’s tints are still widely used in Switzerland, including the most recent edition of the Schweizer Weltatlas (the current edition of the school atlas initiated by Imhof), but less so elsewhere. What has happened instead is a general synthesis of their styles, exemplified by the 1962 International Map of the World (Figure 2F and G). The lower elevation colors on this 1:1,000,000-scale map series are much like Imhof’s, starting with light blue-green that transitions upwards to yellow. And, in a nod to Peucker, medium red-brown depicts mid elevations; however, this scale does not end with red-brown. It introduces light gray-violet at next highest level and finally ends with white. The addition of these last two colors suggests the earlier influence of John Bartholomew, Jr.

The hypsometric tints developed for the International Map of the World have become commonplace, even conventionalized. Today, one sees variants of these tints in The DK World Atlas, Goode’s World Atlas, Raven Maps, and countless other maps published worldwide. This popularity, however, comes with a compromise. The tints just described abandon the principles underlying Imhof and Peucker’s originals. The sequence of colors is not perfectly tonal—they do not blend evenly from dark to light—nor does rich red occupy the highest elevation. These tints clearly show their mixed pedigree.

Imhof (1982, 300) noted the tendency of mapmakers to select hypsometric tints arbitrarily:

“Objective considerations alone have not always been the deciding factors. Tradition, partiality and whim, preconceived opinions, aesthetic sensitivity or barbarity of taste often play leading roles in the selection of colors.”

His observation was prescient. With the ongoing democratization of cartography, an “anything goes” approach to hypsometric tints has emerged. The combination of free elevation data and easy-to-use software has swelled

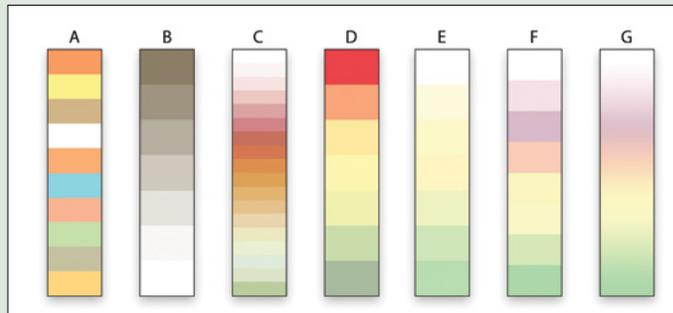


Figure 2. Hypsometric tints: A) August Papen’s polychromatic tints, B) Continuously progressing tints—higher is darker, C) John Bartholomew Jr.’s tints, D) Karl Peucker’s tints, E) Eduard Imhof’s tints, F) International Map of the World tints, and G) International Map of the World tints as a gradient. Illustration primarily adapted from Imhof, 1982. The Bartholomew tints derive from Gardiner, 1976. Note that the illustration colors vary somewhat from the originals.

the ranks of amateur mapmakers, some who willfully make maps with unorthodox colors (Chilton 2007. See references for URL). Creating visual drama is often the chief objective.

The development of so many hypsometric tint styles has come with a large number of terms describing them, which are loosely used. General terms for hypsometric tints include scales, sequences, series, and progressions. More specifically, blends, gradients, and ramps usually refer to smoothly transitioning tints with no discernible breaks (Figure 2G). And intervals, layers, and steps are terms referring to discrete elevation zones that contrast with one another (Figure 2A–F).

## MORE THAN ELEVATION

The premise of this paper, that map readers could mistake hypsometric tints for climate or vegetation, was not a concern of Imhof and Peucker. Why not? The possible answers to this question shed light on why hypsometric tints have become less popular today.

First, both men were a product of their time, and—for maps at medium and small scales—focused on mapping terrain alone. During their early careers, national topographic surveys were delivering accurate elevation data for the first time; therefore, finding ways to visualize these data on maps took precedence. The tints that they devised achieved this singular objective very well. Because global vegetation and land cover data were not available in their day, it was reasonable for them to assume that readers would not mistake elevation colors for a data type that did not yet exist.

Second, their choice of elevation tints is at least partially related to the natural environment in which they lived (Thrower 2008). For example, Imhof's tints generally mimic the colors observed in the Alps, a region of lush valleys and glacier peaks illuminated by warm alpenglow from the setting sun. Green lowlands, yellow mid elevations, and white highlands are logical color choices for that location. Nonetheless, one must wonder if they had lived in places with markedly different physical environments—Phoenix, Reykjavik, or Nairobi—whether their color schemes would have been different. Would brown or gray now be the standard lowland color?

Third, they lived in countries that take geographic education seriously and teach map reading in schools—for example, every Swiss middle school student receives a world atlas. Regardless of which hypsometric tints were used on maps, they could expect that their fellow citizens would learn what they meant.

The possible reasons for why Imhof and Peucker focused exclusively on mapping elevation are no longer as valid today. There is now an abundance of climate, land cover and vegetation data covering the entire world. Thus, map publishers have an alternative to hypsometric tints for small-scale physical mapping by combining land cover with shaded relief. However, land cover colors—green, yellow, brown, and white—are similar to those used for hypsometric tints, which could confuse readers. As a result, Oxford University Press–Australia & New Zealand has recently abandoned hypsometric tints in favor of land cover for the physical maps in their student atlases (see references for URL).

Another consideration is the lack of commitment to geographic education in much of the developed world, particularly the United States, according to the 2006 National Geographic-Roper Survey of Geographic Literacy (see references for URL). Cartographers cannot assume as they once did that their audiences have had training on how to read hypsometric tints. Research indicates that many US students also perceive elevation colors as representing environmental phenomena (Patton and Crawford, 1978). The many maps with hypsometric tints and with no legend identifying them—for instance, TV weather maps—only increase the potential for confusion.

Despite these recent trends that argue against the continued use of hypsometric tints, this venerable map type may still be relevant to modern audiences in the modified form described next.

## CROSS-BLENDED HYSOMETRIC TINTS

Unlike conventional hypsometric tints that apply a single sequence of elevation colors uniformly to all areas of a map, cross-blended tints vary from place to place depending on the regional environment. They attempt to indicate both elevation and colors that people presumably associate with the natural environment. On a world map with cross-blended hypsometric tints, for

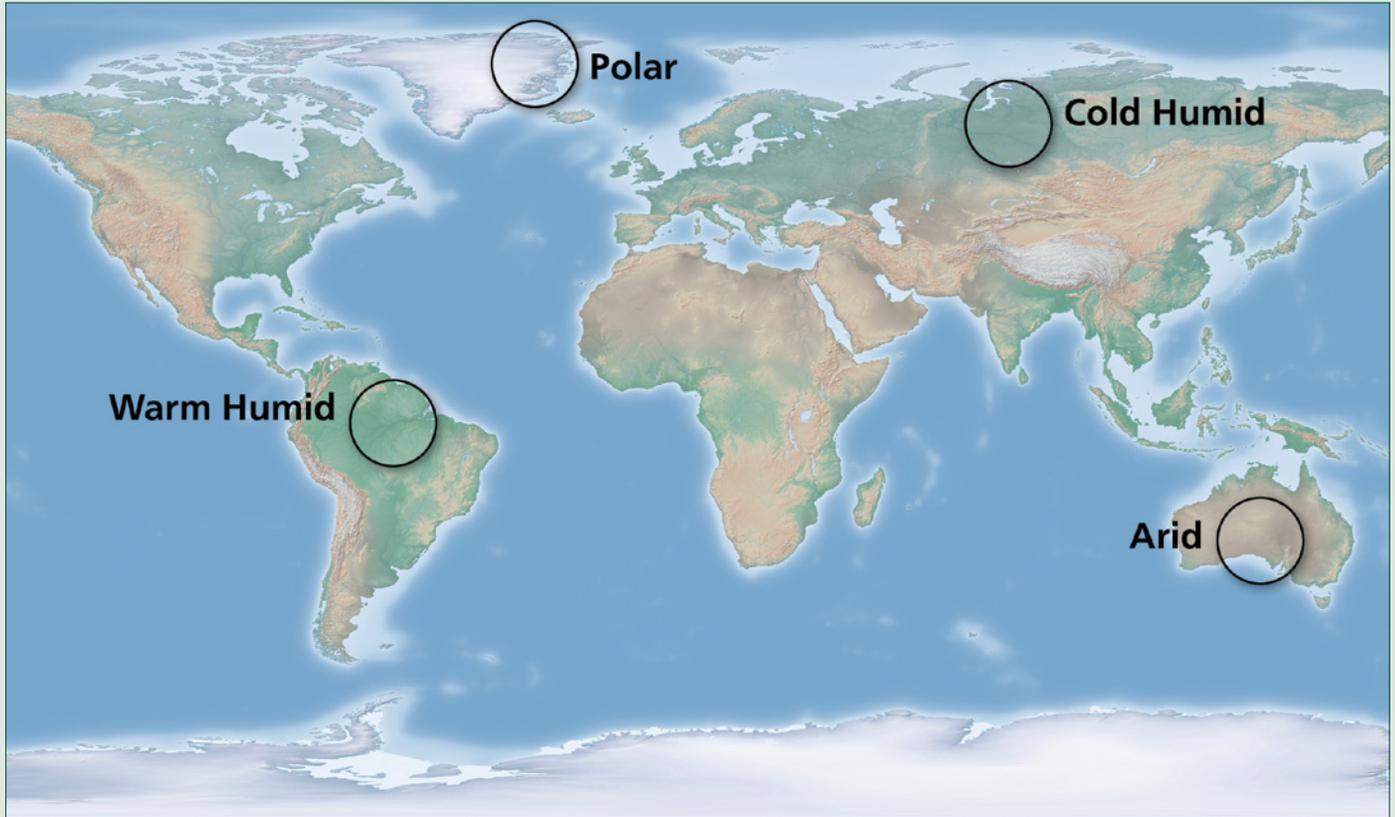


Figure 3. Cross-blended hypsometric tints combined with shaded relief on a world map. Lowland colors vary according to the generalized natural environment of world regions.

example, interior Australia is dusty brown, western Siberia is boreal forest green, the Amazon basin is jungle green, and Greenland is icy blue-gray. As in nature, the map colors gradually blend into one another across regions (x and y axis) and from lowlands to highlands (z axis), hence the name cross-blended hypsometric tints (Figure 3).

A pragmatic “design for all” philosophy guided the development of cross-blended hypsometric tints. Most of the world’s population receives little or no map reading education. Rather than educating 6.9 billion people on how to read hypsometric tints, a quixotic undertaking unlikely to happen anytime soon, we adapted the tints to match people’s preconceptions. The goal was to do what Bartholomew did 133 years earlier: take the mystery out of geography and make it intelligible to laymen (Gardiner 1976). In their portrayal of the world, cross-blended hypsometric tints offer a fusion of elevation and environment

mapping. This duality recognizes that diverse audiences are likely to perceive hypsometric tints differently. For example, a person identifying the brown tone along the Persian Gulf shore as low elevation is correct; so too is the person who identifies this color as desert. And another person who sees this area as both lowland and desert is doubly correct.

## DESIGN AND PRODUCTION

Cross-blended hypsometric tints are a raster dataset with a color scheme applied to world elevations introduced in 2009. With these data, professional mapmakers can produce small-scale maps intended for general audiences. Cross-blended hypsometric tints are available in multiple sizes, in versions with and without shaded relief, and are downloadable for free. They are available at [NaturalEarthData.com](https://www.naturalearthdata.com), a map data website sponsored by NACIS.

The starting point for production was a world base map with conventional hypsometric tints generated from SRTM30Plus elevation data at 30-arc-second resolution. The conventional hypsometric tints on this base were similar to those developed for the 1962 International Map of the World, with modifications. Designed to give a relative impression of elevation differences, they use a continuous color ramp with one color blending into the next instead of stepped intervals. Additionally, the yellow found at mid elevations is slightly darker, the red at the next highest elevation is slightly lighter, and, higher still, the gray is much lighter. With these adjustments the sequence of colors conforms more closely with the “higher is lighter” principle of tonal scales. Hypsometric tints applied to elevation values below 1,000 meters—which comprise most of Earth’s total land area—have more tonal variation than do the tints found in higher areas. The *Physical Map of the Coterminous United States*, a previous project by Patterson (2006), was the first test of these tints (see references for URL). Informal querying of colleagues about their preferences guided the color selection, which was ultimately a subjective decision. (See Appendix A for CMYK and RGB color values).

A pragmatic “design for all” philosophy guided the development of cross-blended hypsometric tints

## ENVIRONMENT COMPONENT

The next step involved changing the ubiquitous green lowlands on the world map to colors that better represent different regional environments. Limiting the environmental regions to only four—warm humid, cold humid, arid, and polar—was a deliberate decision to avoid unnecessary complexity. We judged the cross-blended hypsometric tints as more successful when altitude data rather than environmental data were the primary generators of tonal variation. Representing slightly different environments with slightly different colors—say, shades of yellow representing tropical grassland and tropical savanna—was deemed beyond the threshold of recognition. Additionally, shaded relief printing on the subtle cross-blended tints would further obscure their meaning. The four environments depicted on the final map are easily represented by distinctive colors: warm humid regions are rich yellow-green, cool humid

regions are blue-green, arid regions are khaki brown, and polar regions are cold gray. Each takes up a roughly equivalent amount of land area on Earth's surface.

Determining the fuzzy, generalized boundaries between environmental regions involved references to climate maps in atlases. For example, polar regions are commonly defined as having an average temperature below 10 degrees Celsius for the warmest month of the year, typically July in the northern hemisphere and January in the southern hemisphere. Importing this isotherm as an Adobe Photoshop layer mask and blurring it provided an effective way to map polar environments. Similar methods based on the Köppen-Trewartha climate classification system allowed for the mapping of other environmental regions across the entire Earth (*Goode's World Atlas* 1983). In the Köppen-Trewartha system, the Af and Am classification designate warm humid (tropical) climates; Db, Dc, and Dd designate cold humid (continental) climates; and, Bs and Bw designate arid climates (Figure 4). Precipitation maps in atlases aided the identification of arid and humid regions. Attempts at using gridded climate data (Kottek et al. 2006) for production proved less than ideal, because of the excess detail and abrupt boundaries between the climate regions. Depicting environmental regions as broad, generalized swaths is the preferred method for creating cross-blended hypsometric tints.

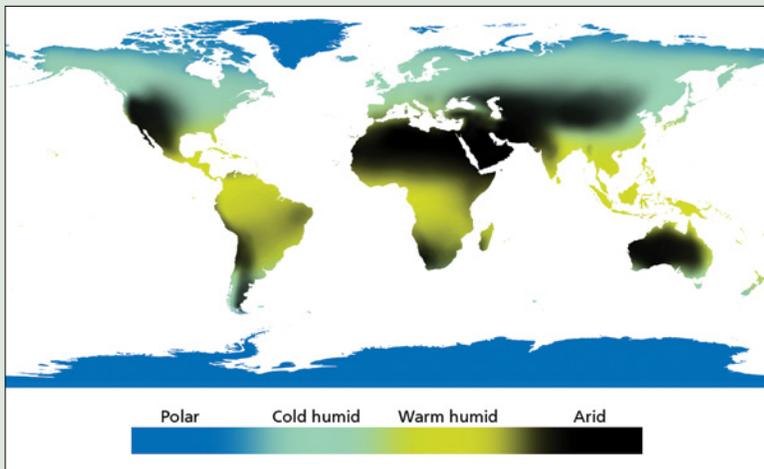


Figure 4. The generalized environment zones depicted with false colors used to create cross-blended hypsometric tints. The fuzzy edges of the zones emulate the transitions that occur naturally.

Using false colors rather than the final cross-blended hypsometric tints to create masks of the four environmental regions made it easier to visualize the subtle transitions (Figure 4).

## SELECTING COLORS

Selecting the regional environment colors required considerable experimentation. The khaki brown used for arid lowlands was particularly challenging. This environment accounts for nearly all land that is below sea level

on Earth (these low spots tend to fill with water in humid areas, becoming lakes, and with ice in polar areas)<sup>1</sup>. Giving the brown lowlands a value (i.e., darkness) equivalent to that of the green lowlands resulted in vast areas of the world becoming somber and uninteresting. Adding too much red, a color that many map readers associate with upper elevations, to the brown presented the problem of the lowlands no longer appearing as lowlands. In the area north of the Caspian Sea where arid and cold humid lowlands merge, identifying complementary colors was difficult. Taking into account all of these issues, the compromise solution was selecting a neutral brown for the arid lowlands. It is slightly less dark (two percent when converted to grayscale color mode) than the greens found in humid lowlands (Figure 1).

With the exception of polar regions, the different environment colors occur only in areas that are below 1,000 meters in elevation. Above that the hypsometric tints are conventional—and identical, regardless of the environment. Aesthetics were the reason for this compromise decision to preserve the reds, grays, and whites at middle and upper elevation that readers seem to respond to favorably.

In the case of cross-blended hypsometric tints, the mid- and high-elevation colors are the visual bait that attracts attention. After that, the low elevation colors are there to deliver a subtle message to a potentially large audience—the 74% of the world’s people who live in places under 500 meters in elevation (Cohen and Small 1998). A person reading a cross-blended hypsometric tint map is likely to see his or her home represented by a color that is prevalent in the local environment.

Polar regions are a special case. They differ from all other regions in that they dispense with the yellows, reds, and whites at the upper elevations in favor of a tonal scale ranging from gray-violet lowlands to nearly white highlands. Antarctica and Greenland are unique enough to warrant this special treatment, as warm yellow and red are inappropriate for an icecap environment. In the past, many conventional hypsometric tint maps sidestepped this problem by representing these regions with a flat white color and a few blue contour lines. Now with cross-blended hypsometric tints, the

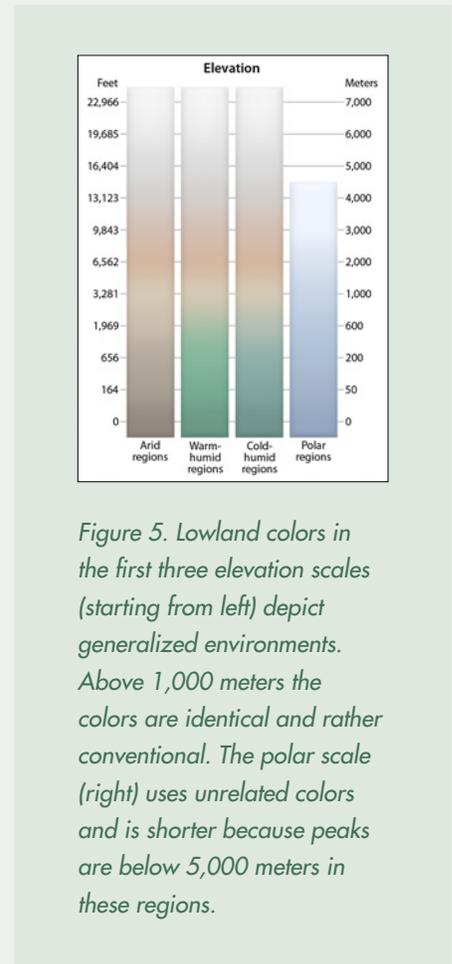


Figure 5. Lowland colors in the first three elevation scales (starting from left) depict generalized environments. Above 1,000 meters the colors are identical and rather conventional. The polar scale (right) uses unrelated colors and is shorter because peaks are below 5,000 meters in these regions.

<sup>1</sup> The Caspian Sea, which is below mean sea level, is an exception: there is a narrow strip of humid lowland along its southern shore.

full range of elevation tones is present. And they look appropriately icy. Having these cold colors at high latitudes provides a visual counterbalance to the warm colors dominating the low latitudes. At the fringes of the polar zone in the northern hemisphere, the polar zone merges with the cold humid zone to suggest an intermediate tundra zone. The polar elevation colors do not extend as high as the hypsometric tints of other regions because of the comparatively lower maximum elevations found there (Figure 5).

The grays and whites found at high altitudes elsewhere in the world are similar in appearance to the polar tints, but with less blue, because of their similar environments—both are cold and inhospitable. The high-altitude tints gradually make their appearance above 3,000 meters in the Andes, Himalayas, Tibetan Plateau, mountains of Central Asia, and other lofty areas.

### SHADED RELIEF COMPONENT

The final production step added a light application of shaded relief to the cross-blended hypsometric tints. So as not to muddy the hypsometric tints, the overprinting shaded relief does not contain gray value in flat areas, allowing readers to see the subtle hypsometric variations in these areas as pure colors. Moving to higher ground, shaded relief becomes increasingly important as a source of terrain detail. Shadowed slopes are semitransparent, becoming slightly darker and more contrasting only on the highest mountain crests. Illuminated northwest slopes on the shaded relief interact with the hypsometric tints below, creating lighter tones. The overall effect of these adjustments is lighter shaded relief that has a three-dimensional appearance and that minimizes interference with the background tints. Glancing at the final map, one sees the cross-blended hypsometric tints as the primary information (Figure 3).

## CONCLUSION

Cross-blended hypsometric tints are certainly not a panacea for every map needing to show elevation colors. They are best-suited for small- and medium-scale maps for geographic areas that have distinctly different environments adjacent to one another. A map of North America would be an appropriate use, for example. By contrast, any of the US states east of the Mississippi River do not have enough natural variation by themselves to warrant the technique. Large-scale topographic maps are another inappropriate use. In addition, the softly blended colors of cross-blended hypsometric tints are not ideal for mapping terrain for the precise reading of elevations.

Whether or not to use a map legend on a small-scale map with cross-blended hypsometric tints depends upon its use. For a physical map, the answer is yes. A legend in this case will give readers a general sense of relative elevation and environmental regions. In the case of using cross-blended hypsometric tints as a secondary backdrop for other thematic data—an airline in-flight map, for

instance—the answer is probably no. In another example, the official map of the US National Park System, which functions primarily as a poster, does not explain the tints in the legend but, appropriately, describes the various park types in detail (see references for URL). Without cross-blended hypsometric tints this map would be duller, less apt to be displayed, and as a consequence the parks possibly less well-known.

The cross-blended hypsometric tints described here are not the only design solution. Varying only the lowland color on otherwise conventional hypsometric tints possibly limits their effectiveness. The yellow and red tints at mid elevations often occur in areas with humid environments, such as the coastal mountains of British Columbia. This may lead readers to wrongly conclude that these areas are arid. One possible solution: the cross blending of revised tints without red at mid elevations. For example, humid areas could use a tonal scale comprised primarily of green, transitioning to light green-yellow and then white at the highest elevations. And in arid areas the scale would start with brown. Patterson (2004) discusses this method for mapping the contiguous United States (see references for URL). One of the challenges of devising cross-blended hypsometric tints in this manner is the potential for drabness. Adding shaded relief comprised of warm yellow-reds on illuminated slopes and blue violet on shadowed slopes could counteract this, brightening the appearance. This is a technique that merits further exploration.

Since being introduced in October 2009, cross-blended hypsometric tints have had 25,172 downloads, surpassing the popularity of other raster datasets on the Natural Earth Data website (see references for URL). By comparison, Natural Earth I, a land cover map of the world, had 13,554 downloads in the same period. Considering that the files are very large, ranging up to 385 MB apiece when compressed, and in geospatial TIF format, casual web surfers probably do not much frequent the site.

Those who make maps presumably are the ones downloading cross-blended hypsometric tints—that the data are free no doubt contributes to their appeal. What remains unknown, however, is whether those who read maps (i.e., the general public) interpret cross-blended hypsometric tints as both elevation and the environment, as is intended. Do people really get it? A forthcoming user study by the authors of this paper will attempt to answer this question.

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## APPENDIX A

### CROSS-BLENDED HYPSONETRIC TINTS: CMYK AND RGB COLOR VALUES

Elev. (m)	Arid	Warm Humid	Cold Humid	Polar
7,000	3c 2m 2y 0k 245r 245g 245b	3c 2m 2y 0k 245r 245g 245b	3c 2m 2y 0k 245r 245g 245b	Not applicable
6,000	6c 5m 4y 0k 235r 235g 237b	6c 5m 4y 0k 235r 235g 237b	6c 5m 4y 0k 235r 235g 237b	Not applicable
5,000	12c 9m 10y 220r 220g 220b	12c 9m 10y 220r 220g 220b	12c 9m 10y 220r 220g 220b	Not applicable
4,000	16c 14m 16y 0k 212r 207g 204b	16c 14m 16y 0k 212r 207g 204b	16c 14m 16y 0k 212r 207g 204b	4c 2m 0y 0k 241r 245g 254b
3,000	17c 22m 27y 0k 212r 193g 179b	17c 22m 27y 0k 212r 193g 179b	17c 22m 27y 0k 212r 193g 179b	5c 2m 0y 0k 239r 243g 252b
2,000	17c 27m 34y 0k 212r 184g 163b	17c 27m 34y 0k 212r 184g 163b	17c 27m 34y 0k 212r 184g 163b	13c 7m 1y 0k 218r 226g 239b
1,000	17c 17m 29y 0k 212r 201g 180b	17c 17m 29y 0k 212r 201g 180b	17c 17m 29y 0k 212r 201g 180b	19c 10m 3y 0k 201r 214g 231b
600	21c 22m 30y 0k 202r 190g 174b	36c 13m 38y 0k 169r 192g 166b	31c 16m 29y 0k 180r 192g 180b	26c 15m 4y 0k 185r 201g 224b
200	31c 29m 36y 0k 180r 170g 158b	49c 12m 43y 0k 134r 184g 159b	45c 19m 32y 0k 145r 177g 171b	32c 17m 8y 0k 171r 192g 213b
50	35c 33m 39y 1k 170r 160g 150b	56c 17m 47y 1k 120r 172g 149b	52c 24m 38y 1k 130r 165g 159b	36c 22m 10y 0k 164r 180g 203b
0	39c 36m 42y 2k 160r 152g 141b	59c 20m 51y 1k 114r 164g 141b	56c 25m 41y 1k 120r 159g 152b	43c 27m 12y 0k 149r 169g 196b
-400	44c 42m 45y 5k 146r 136g 129b	62c 25m 51y 3k 106r 153g 135b	59c 30m 44y 3k 112r 147g 141b	Not applicable





cartographic resources, BHS' maps had almost no online presence. The maps had not been cataloged, nor was there a collection description or inventory online. Our maps were, quite literally, hidden from the public by a lack of discovery tools. We needed to promote the collection, but the promotion would have to fall within certain parameters. In short, it would need to be fast and inexpensive.

This article will describe the map outreach campaign at BHS; in particular, how our library prioritized outreach under budget constraints, created successful workflows, and employed tools to help patrons discover the map collection. Although this is an ongoing process, we have already seen an increased public awareness of our map collection as a result of these initiatives; for example, patrons are visiting the library and requesting to see the maps, and hundreds of people view maps on our blog each month. While our discovery tools are not perfect—and incorporating outreach into already full calendars has been challenging—the public response has been extremely encouraging.

Before discussing our outreach methods, it is important to describe the history of the map collection at BHS and, in particular, why our maps were hidden in the first place. Living in 2011 presents certain technological expectations



Figure 1. BHS' Othmer Library, circa 2008. Courtesy of the Brooklyn Historical Society.

to librarians, and our library has felt this acutely. Patrons expect the map collection to be cataloged and fully digitized, but we are still working to catalog the collection and do not have the infrastructure to digitize the maps. The reasons why we are behind technologically are linked to our institutional history.

BHS was founded in 1863 and the organization moved into its current building in Brooklyn Heights, New York, in 1881. In the late 1990s, the entire building was closed for renovations, which meant that all of the library collections were moved into off-site storage. The building did not reopen until almost a decade later, and collections were brought back gradually over time. This presented enormous challenges for the library, especially in terms of physical and intellectual control of the collections. Simply put, outreach could not be a priority when the library was understaffed and struggling to reopen after a decade of being closed. It is a testament to the hard work and dedication of our staff that the library did successfully reopen, gain control over its collections, and begin outreach initiatives. Then, in December 2009, the library received a significant grant from the Council on Learning and Information Resources (CLIR), to catalog its 19th century holdings (including the map collection) as well as archives and manuscripts. It was under the auspices of this grant that I was hired to begin cataloging the map collection.

## THE COLLECTION

BHS' map collection consists of approximately 3,000 maps and atlases spanning the years circa 1570–2011. The main geographic scope of the collection is Brooklyn, New York City, and Long Island, although there are outliers due to previous collecting policies that were more geographically inclusive. The collection contains a wide variety of different types of maps, including, but not limited to: physical maps, political maps, transportation maps, property maps, survey maps, pictorial maps, manuscript maps, topographic maps, cultural maps, and nautical charts. Among the collection's highlights are rare items such as the first state of Bernard Ratzel's "Plan of the City of New York" and unique materials like 19th century manuscript maps of Brooklyn created by the Bergen and Pierrepont families. The following images showcase some of our most popular items.

## THE CHALLENGES OF OUTREACH

Although the need for map outreach was not in dispute among our staff, there were significant challenges to actually working on it.<sup>1</sup> These challenges were a result of our institution's limitations, specifically, a lack of funding, staff, and technological infrastructure. However, the primary challenge was (and continues to be) the opportunity cost for working on outreach. There are only

<sup>1</sup> I would like to stress that map outreach is part of a larger, institution-wide outreach campaign. BHS library staff is currently working to provide access to all of our resources, including special collections, archives and manuscripts, photographs, and oral histories.



Figure 2. "Novi Belgii: Novaeque Angliae nec non partis Virginiae tabula multis in locis emendata." Nicolas Visscher. circa 1684. Brooklyn Historical Society Map Collection.

so many hours in a day and prioritizing one thing over another means that the other activity is not getting done. In other words, any time I spent on outreach was costing time cataloging or working on collection management. The question became "How can we incorporate outreach into existing workflows without jeopardizing other tasks?"

The answer to this question was to approach outreach in a smart and systematic fashion and to employ strategies that made it as time-efficient as possible. The first of these strategies is very basic, but it underlies all of my outreach activities: *work small*. By this, I mean concentrating on small, clearly defined tasks as opposed to big projects. The benefits of working on small activities are three-fold: first, they will actually get done; second, they help prevent staff burnout by giving us the satisfaction of completing tasks; and third, they limit the opportunity cost of working on outreach. A second, related strategy is *pare it down*. By this, I mean isolating a problem and stripping away all superfluous aspects until you are at the problem's core, and then designing solutions to solve the problem. By approaching outreach with these strategies in mind, I have successfully incorporated it into my schedule without feeling like it has subsumed other priorities.

## USING THRIFTY TOOLS

All of our outreach tools are designed to be user-friendly, simple, and effective. These include more modern tools like WordPress, Facebook, and Twitter, as well as traditional tools like MARC (machine-readable cataloging) catalog records. The first tool that I will discuss is WordPress ([wordpress.org](http://wordpress.org)), the web software used to create blogs or websites. Our library uses WordPress for both our blog ([brooklynhistory.org/blog](http://brooklynhistory.org/blog)) and our catalog Emma ([brooklynhistory.org/library/wp](http://brooklynhistory.org/library/wp)).

In general, blogging can be an excellent means of communicating with users and displaying images of your collection, but it needs to be done efficiently. For me, this meant applying my general outreach strategies, particularly *pare it down*. I thought about my posting as a means to solve problems and asked myself: *How can my posts help users learn about the collection? What needs aren't being met?* Through conversations with staff and patrons, I came to two basic conclusions: users needed to know of the collection's existence and they needed to see images of it. Once these needs were identified, it was possible to design strategies to meet them. The first strategy was to blog monthly about some aspect of the collection and the second was a series called "Map



Figure 3. "Map of the village of Williamsburgh, Kings County: as laid out by the Commissioners appointed by the Legislature in 1827: reduced from the large map in possession of the Trustees of the Village." D. Ewen. 1833. Brooklyn Historical Society Map Collection.

of the Month (MOTM),” which featured one map from our collection every month. Modeled after an existing BHS series called “Photo of the Week,” MOTM was a very simple idea designed to increase images of the collection online. Since we did not have the infrastructure for a digital gallery with formal metadata, the blog could serve as our temporary gallery. In order to maximize efficiency, the posts would not be text-heavy, containing only a brief description of each map’s contents. The workflow consisted of one session per year, in which I would photograph the maps, upload images, write posts, and save them as drafts in the WordPress queue. By working on all of the year’s posts at one time, I had the satisfaction of finishing the task while preventing future procrastination.

In addition to MOTM, I would also blog monthly about a feature of the collection. These posts showcase my general outreach strategies as well as my key blogging strategy: *show, don’t tell*. What I mean by this is that posts should be heavy on map images and light on explanatory text. Since maps are so visually compelling, their images can be the focal point of the post in a way that something more cerebral, like a series of letters, cannot be. Map librarians should take advantage of this and trust that their maps are strong enough to tell a story without pages of footnotes or interpretive text. In terms of workflows, *show, don’t tell* also has the added benefit of reducing the time it takes to create posts. For example, my monthly posts do not take more than two hours to complete, including time to photograph maps and upload images. The frequency of my posts would not be possible without the *show, don’t tell* strategy.

In addition to blogging, our library uses WordPress for our catalog Emma, which provides collection-level description of the library’s archives, manuscripts, and special collections. Emma was created in 2008 by library staff as a means of

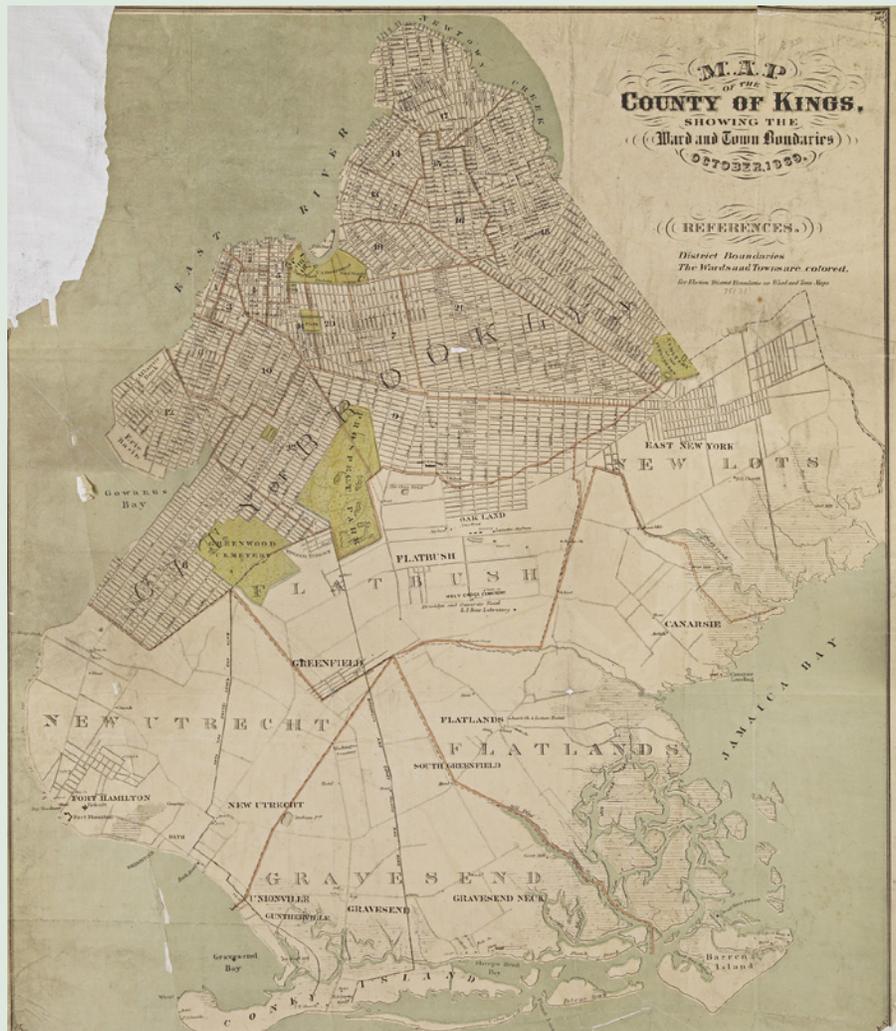


Figure 4. “Map of the county of Kings showing the ward and town boundaries.” 1869. Brooklyn Historical Society Map Collection.

communicating to users about archival collections. It also provides a platform for the library to post finding aids and collection descriptions online without needing the infrastructure required of EAD (encoded archival description) or an ILS (integrated library system). Emma has the added benefit of being indexed by major search engines like Google so it is easy for users to find.

In terms of the map collection, we have posted a collection description on Emma, as well as inventories of the entire map collection. This is beneficial in several ways: first, because not all of the maps are currently cataloged, the inventories provide some level of access to our uncataloged maps. The inventories are not as rich in terms of description as an item-level catalog record but they provide at least a base line level of access. In the inventories, we include basic bibliographic information at the item level, such as title, date, call number, and subject. The subjects are taken from an internally created local vocabulary, which has also been posted to Emma so that patrons can search the inventories more effectively. I also use the Emma description as an opportunity to communicate about the subject headings that I use in item-level cataloging. This is very important because I can list the most commonly used subject terms from LCSH (Library of Congress Subject Headings) and then refer users to our online catalog BobCat, where item level-records are stored. Since controlled vocabularies like LCSH are notoriously counter-intuitive and users are often unaware of what words the cataloger is using, listing subject terms can help make users' searching more effective. Additionally, I use the Emma description as a means to educate users about map-specific vocabulary, particularly genre terms, which are becoming increasingly important in map cataloging.

In addition to WordPress, BHS uses Facebook and Twitter to communicate about collections. My approach to posting follows my general outreach principles as well as the common adage *less is more*. I am very conscious of the addictive quality of social media, especially the urge to post throughout the day or monitor responses. In short, the opportunity cost of using social media can become too high if it prevents me from finishing other tasks. It is also important to recognize that constant posting can cause information overload and, if my readers become overwhelmed by the frequency of my posts, they are likely to stop reading. While I want to share every exciting discovery about the collection, my posts are more effective if they are staggered. In general, our map-related posts on Facebook and Twitter are used to promote blogging or events. This totals approximately three posts to Facebook and Twitter per month, providing users with updates on the collection without overwhelming them.

The last outreach tool I will discuss is the most traditional: item-level cataloging. As described earlier, our library uses Emma for description at the collection level; however, I also create item-level records for the map collection. Since BHS does not currently have the technological infrastructure or staff to maintain its own ILS, we use BobCat, a cooperative catalog hosted by New York University (NYU). Our library has an annual contract with NYU, allowing us to rent space in the catalog. NYU also exports all of our records to OCLC, making our items available in the international catalog WorldCat. The cooperative catalog allows us the convenience and searching capabilities of an

ILS without having to worry about technical issues. The NYU consortium could serve as a model for other institutions that do not have the ability to host an ILS. If there is a large institution in your area, consider asking if a cooperative is possible.

## OUTCOMES

Although our map outreach initiatives have only been in place for about a year, we have already seen positive results. In terms of measurement, we monitor progress by statistics as well as anecdotal evidence and word of mouth. For statistics, we use Google Analytics to track visits to our blog and website. These statistics have shown that MOTM and map collection posts are very popular, consistently finishing in the top five most visited posts. We also monitor retweets and have found that map tweets are among our most highly retweeted. For example, a tweet about August 2011's MOTM showing a map of Williamsburgh received more than twice the retweets of any of BHS' tweets that summer.

Anecdotal evidence, while not scientific, is also showing that the outreach initiatives are working. MOTM and other map posts have received lots of positive feedback from patrons and members of the community. For example, @teachnypl tweeted "@nyplmaps may get jealous but we couldn't resist the @brooklynhistory series Map of the Month. One can love many maps" and on Facebook, a patron named Elana posted "Drool. LOVE the map feature." This is just a small sampling of feedback we have seen on Facebook and Twitter. Additionally, I have had patrons approach me during open hours with printed out copies of the MOTM, asking to see the map in person. I work at the reference desk two to four times per month and I have definitely seen an increase in map requests from patrons, both on-site and remotely. One of the primary goals of map outreach was to make patrons aware that our collection existed, and anecdotal evidence suggests that this is occurring.

## CONCLUSION

I hope that our success in map outreach at BHS will inspire other institutions to launch similar initiatives. Even in times of financial difficulty with limited numbers of staff, there is much that can be done to promote a collection. This means making difficult decisions in term of time management and requires a commitment to consistent outreach measures. While this is challenging, I believe it is absolutely imperative that our collections are visible and accessible to users. As libraries, we are only relevant if patrons are using our resources, and they cannot do so unless they are provided with discovery tools. "Un-hiding" doesn't happen overnight, but it is possible with creativity and perseverance.

## Graphic Styles and the Appearance Palette in Illustrator CS5

Kevin McManigal | [alpineMc@gmail.com](mailto:alpineMc@gmail.com)

### INTRODUCTION (by Alex Tait)

In this issue of *Cartographic Perspectives*, I am happy to hand over the mantle of practical cartographer to NACIS member Kevin McManigal. Adobe Illustrator is a favored tool for many cartographers, and Kevin has provided a detailed review of methods for applying styles to artwork and modifying them quickly and easily.

If you are not using Illustrator's *Graphic Styles* and *Appearance* palettes on a regular basis, you will be after reading this! These tools make quick work of tasks that can be laborious, and time-saving tips like Kevin's allow cartographers to spend more time thinking about design and less time fussing with software.

I would like to extend an invitation to NACIS members and *Cartographic Perspectives* readers to contribute to the Practical Cartographer's Corner. If you have any tips, tricks or techniques that focus on the "how to" in mapping that you would like to share, please send me an email at [alex@internationalmapping.com](mailto:alex@internationalmapping.com).

- Alex

### STEP-BY-STEP GUIDE

Graphic Styles are powerful tools that allow cartographers to quickly style raw data exported from a GIS or other source. In a production workflow, where each map has a related theme or all maps for a project need to have a consistent look, styles function as a continuity template that ensures symmetry throughout the project. They also form a solid basis for alteration and experimentation in one-off maps.

The added functionality of the Appearance palette in CS5 makes it easy to stack strokes and fills or to change color and line weight from one convenient set of menus. This facilitates quick creation and alteration of Graphic Styles, leaving the cartographer more time to design aesthetically pleasing maps.

The following tutorial explains, step by step, how to set up Graphic Styles within Illustrator CS5, and offers notes about their use.

**1. OPEN THE GRAPHIC STYLES AND APPEARANCE PALETTES:**

Menu Bar > Window > Graphic Styles  
 Menu Bar > Window > Appearance

**2. DRAW A LINE OR POLYGON ON THE ARTBOARD:**

- a. Add multiple strokes and fills using the icons at the bottom of the Appearance palette or the drop-down menu in the upper right corner of the palette.
- b. From within the Appearance palette, access the Stroke palette by clicking the blue highlighted word "Stroke." The full palette will appear, allowing control of the stroke styling parameters.
- c. The color swatches are available by clicking the color drop-down menu to the right of the word "Stroke." (To access the color sliders instead, use Shift-Click.)
- d. The transparency of each stroke or fill also can be adjusted under the blue highlighted word "Opacity." The "Opacity" link at the bottom of the stack is for the transparency of the entire object.

Once the object has been styled to the appropriate look for the map, it can be saved as a New Graphic Style for use on other vector objects.

**3. CREATE NEW GRAPHIC STYLE (WITH THE OBJECT SELECTED):**

Graphic Style palette dropdown menu > New Graphic Style  
 Graphic Style options > Name Style > OK

Alternatively, drag the selected object into the Graphic Style palette, and then double-click on it to provide a name.

**4. TO USE A GRAPHIC STYLE:**

Simply select an object or group of objects on the artboard and click on the desired style in the Graphic Style palette. All selected objects will adopt the stroke and fill settings of that style.

Other Options:

- 1. **Break Link to Graphic Style** (with the object selected):

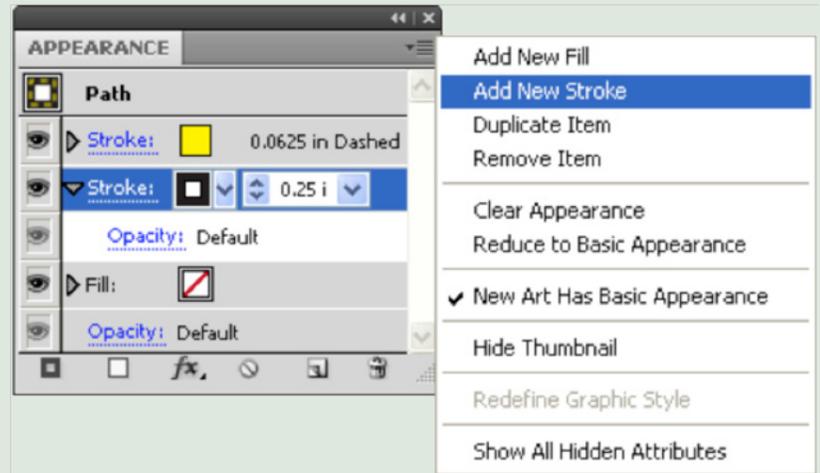


Figure 1. Appearance palette.

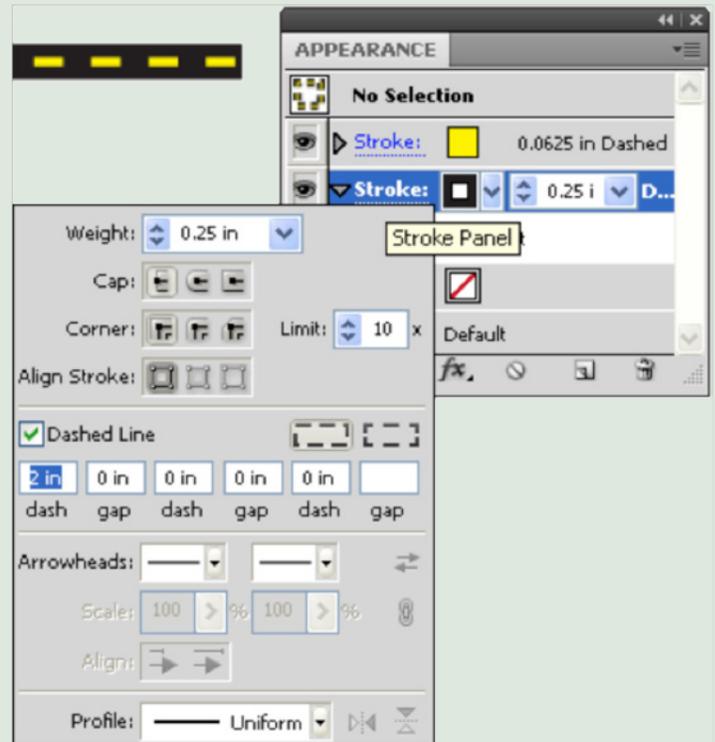


Figure 2. Appearance established (Steps 2a–2d).

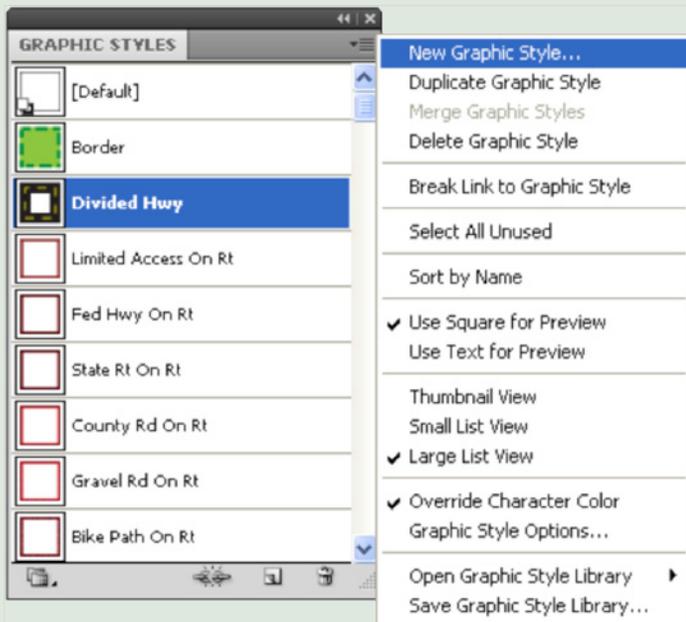


Figure 3. Graphic Styles palette (Step 3).

Graphic Style palette dropdown menu > Break Link to Graphic Style

- Useful when you want to apply a different style to an object.

**2. Redefine Graphic Style** (with the object selected):

- Change the object in the Appearance palette.
- Appearance palette dropdown menu > Redefine Graphic Style

- Useful when an existing style needs a modification.

**3. Change Appearance** (with the object selected):

- Appearance palette dropdown menu > Clear Appearance (no stroke and no fill)

- Useful when clearing a layer of all styles applied over the vector objects at the top level.

- Appearance palette dropdown menu > Reduce to Basic Appearance (one stroke and one fill)

- Useful when starting a completely new style.

**USAGE NOTES:**

Graphic Styles allow global changes; that is, all objects with the style applied will reflect any change made in the Appearance palette and then redefined. This can be very powerful. For example, if hundreds of line segments styled as streets need to be modified, one segment with the “streets” Graphic Style applied can be selected and modified in the Appearance palette. The change will then be reflected throughout the map once the Redefine Graphic Style function is applied.

Graphic Styles should be applied to objects, not to the top level layers that contain them. To apply a style to all the objects in a layer, lock all others layers and drag a selection box over the artboard. Then apply the style from the palette. Problems arise when an entire layer is selected by clicking on the small circle in the Layers palette, with subsequent application of a style. This style on the top level layer is like a blanket that will cover any changes made to objects within that layer. Use Clear Appearance to reset a layer that has an unwanted Graphic Style applied.

A word of warning; cartographers who use the same Graphic Styles to begin each map tend to always produce maps that look the same. Therefore, constantly create new styles, modify existing ones, and combine various styles from different projects. The benefit of styles is that you can recreate the look of a map quickly, and then move beyond the original without having to spend countless hours adjusting settings.

Happy Mapping!

To watch a video of this tutorial, see the Map Practical blog:

<http://mappractical.blogspot.com/2011/09/graphic-styles-in-illustrator.html>

*Kevin McManigal is a professional cartographer and lecturer in the Geography department at The University of Montana.*





that mapps will eventually supplant paper maps. Even if one does not agree with that hypothesis, the fact that a cartographer can take a print map, and distribute it globally for free via mobile networks, translates to far more potential customers. Including a Quick Response (QR) code on the print map that links to a downloadable mapp will likely encourage people to pay for a paper map to put in their glove compartment, even if a company only makes print maps for a particular region or locale. The purpose of this tutorial is to demonstrate that transitioning map products from print to mobile is not necessarily an arduous process. In fact, it can be done within 15 minutes. Take your cartographic masterpiece created in ArcGIS or Illustrator and distribute it to millions of people around the globe!

Following the steps below, you will recreate an interactive mapp that originally began as an ArcMap MXD file, was exported as an Adobe Illustrator file, and is now a mapp on the Android Market. Your end product will have simple pinch-to-zoom and pan capabilities. Once you have mastered publishing to the Android Market, you can seek additional tutorials, perhaps including other *On the Horizon* pieces, to add more interactivity to your mapps. You can also take your old FreeHand or CorelDraw masterpiece and refashion it into a mapp using Adobe Illustrator so it remains marketable in the future.

## REQUIREMENTS AND OPTIONS

Below are the requirements and optional peripheries needed to create mapps using Adobe Flash Professional CS5.5. If you have an Android 2.2 or higher device, you can download and view the end product of this tutorial from the Google Android Market. Visit [market.android.com](http://market.android.com) from any computer and search for “Muehlenhaus Mapp Tutorial.” Download it to any and all of your Android devices right from the Web.

### Requirements:

- A PC or Mac computer that is capable of running Adobe Flash CS 5.5
- An Internet connection
- Flash CS 5.5 (a free 30-day trial can be downloaded from [www.adobe.com](http://www.adobe.com))
- A Gmail account (also available for free)
- The zip file is available at [www.muehlenhaus.com/tutorials/mapp.zip](http://www.muehlenhaus.com/tutorials/mapp.zip)  
Download and unzip it to a place you can easily access.

### Options:

- An Android device running Android 2.2 (Froyo) or higher with a USB2 cable
- \$25 to register as an Android Developer

## IMPORTING AN AI MAP INTO FLASH CS 5.5

As already mentioned, many professional cartographers and designers use Adobe Illustrator to create or stylize their final products. If you have never

used Adobe Illustrator, but are comfortable with ESRI ArcMap, you can still easily turn your paper maps into mobile mapps. Simply open your GIS map in ArcMap, go to File > Export, and under File Type, select AI (i.e., Adobe Illustrator). You will not need to install Adobe Illustrator, because you will directly import the AI file into Adobe Flash. For your convenience, I have posted the Adobe Illustrator file used in this tutorial (it is named map.ai and can be found at [www.muehlenhaus.com/tutorials/mapp.zip](http://www.muehlenhaus.com/tutorials/mapp.zip)).

## SETTING UP FLASH FOR ANDROID DEVELOPMENT

The first thing you will see when you open Flash CS 5.5 is the splash screen. Do not close this. In the left-hand column under Create from Template, select AIR for Android. (If you were to create a mapp for Apple's iOS, you would select iPhone OS from the Create New column.) You will be provided some template options to choose from. All of the template options are 800 x 480 pixel stages. One is just a blank stage; the others offer some built in functionality—a swipe gallery, an accelerometer, and an options menu. In this tutorial, you will select the third one on the list, Options Menu. This template has a built-in menu that pops up when someone presses the menu button on their Android device. This pop-up has a built in Exit button, to which you can add more options, too, if you so desire. All of the templates may prove useful for your mapping needs, and I recommend experimenting with them. However, this tutorial will simply concentrate on bringing our static map into Flash CS 5.5, giving it pinch-to-zoom capabilities, and publishing it to the Android Market. After selecting the Options Menu Android template, you should immediately go to File > Save. Save the file as any name you like, but make sure you save it within the extracted folder created from *mapp.zip*.

## SETTING UP THE STAGE IN FLASH

In most cases, you will want to change the stage (Flash's artboard). In the case of this tutorial, our map is meant to be displayed in landscape mode and it must have a white background, so the first thing we will want to do is set the stage to landscape and change the background color. Without selecting anything, open the Properties dialog (typically found along the right-side of the Flash program window).

Under the Properties tab in the Properties dialog, you will see several options, including Size and Stage. Reverse the numbers found by size by typing 800 into the box containing 480 and 480 into the box containing 800. Finally, select the color icon adjacent to Stage. Select the "Background color:" White.

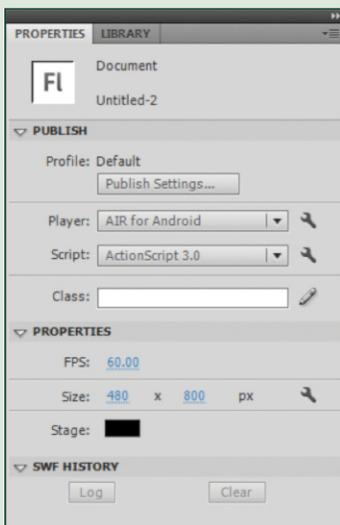


Figure 1. PROPERTIES panel.

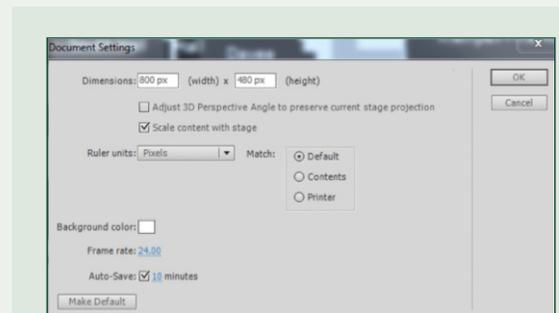


Figure 2. Setting the size dimensions.

## **DELETING THE DEFAULT BACKGROUND**

The stage will realign itself correctly, but you will still have a black background with a fading grid on it. We will delete this grid and black background now. Go to the Layers panel and find the layer called Background. Click on the layer where it says Background. Underneath this you will see a Trash Can icon. Click it. A dialog window may pop up. Select Yes. The background will disappear.

## **REPOSITIONING AND ALIGNING THE OPTIONS MENU**

Another problem with realigning the stage is that our Options box with the Exit button is now not aligned to the stage. Fortunately, this is easy to fix. If there is a padlock icon next to the Options layer, unlock it by clicking on the icon. Then use the Selection tool to select the Options box on the stage. Move the box to line up with the lower left corner of the stage. Once it is lined up with the stage, you can resize it. First, double-click on the box. The box was a symbol. By double-clicking, you are now working inside of the Options symbol. If you look at the timeline/layers panel again, you will see two layers. The bottom layer is the gray box. Select the gray box without selecting the Exit button by double-clicking anywhere over the gray box. Once it is selected, press Q on the keyboard. Resizing handles will appear. Grab the handle on the right-side and drag it to the right edge of the stage. Lock Layer 1 by clicking on the padlock symbol in the Timeline panel. If it is locked, unlock Layer 2. Choose the Selection tool and drag a box around the Exit button and text. Move to the desired location over the gray box, usually in the center. When you are done realigning the Options box, double-click anywhere outside of it to get back to the main stage.

## **IMPORTING THE ILLUSTRATOR MAP INTO FLASH**

Now that the stage is set, we can import our Adobe Illustrator file into Flash. Go to the Timeline panel. Lock all of the layers by clicking on the padlock symbol above all of the layers. If the Options layer is not the top layer, click on it and drag it above the other layers. (We need our Exit button to appear on top of all other layers.) Then highlight the second to top layer (the Instructions layer in this example) by clicking on its title. Beneath the titles and to the left of the Trash Can icon is an insert New Layer icon. Click it. A new layer will be created. Double-click on its title to rename it whatever you want—in this case, I labeled it “map.”

With the new layer highlighted, go to File and select “Import to Stage.” Some seconds will pass as Flash prepares to import. A dialog will appear asking you to choose a file to import. (Note: you can import a variety of file types beyond an Illustrator file, and it is recommended you take a look to see what other formats you may be able to import in the future.) Find the mapp.ai file in the files you downloaded with this tutorial. Select it and after some time you will see a dialog similar to that in Figure 3.

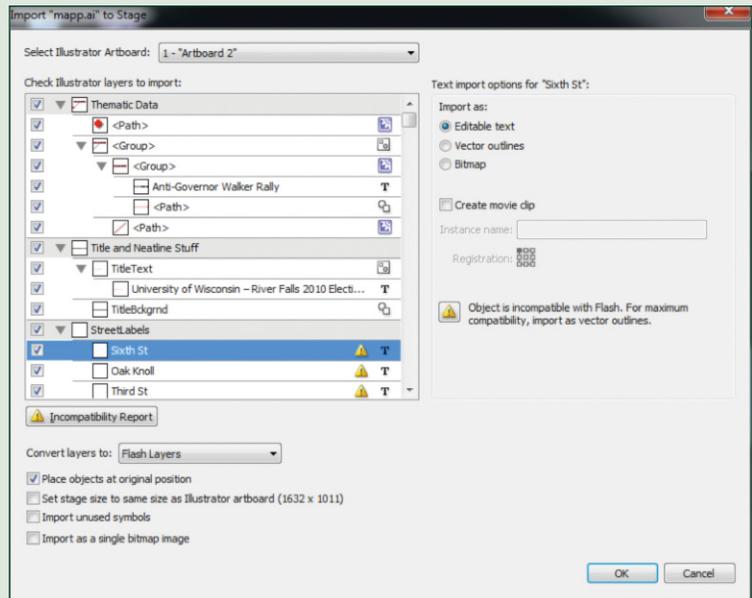


Figure 3. Import to Stage options.

Minimize all of the layers to a single row each by clicking on the arrows to the left of the layer titles. Then hold down the shift key and select all of the layers together. To the right you will see a “Create Movie Clip” box. Check it. Underneath the layers you will see a rectangular button with a warning symbol and the words “Incompatibility Report” (see Figure 3, number 2). Click this. Many times AI files contain text that is not compatible in Flash. There are several different techniques you can use to import text and make it work, but in the case of this exercise, we will default to what Adobe thinks is best. Check the box next to “Apply recommended import settings” and hit Close. Beneath

where you just selected you will see text that says “Convert layers to:”—select “Single Flash Layer.” Make sure that the “Place objects at original position” dialog is selected. Select “OK.” Your final dialog screen should look similar to Figure 4.

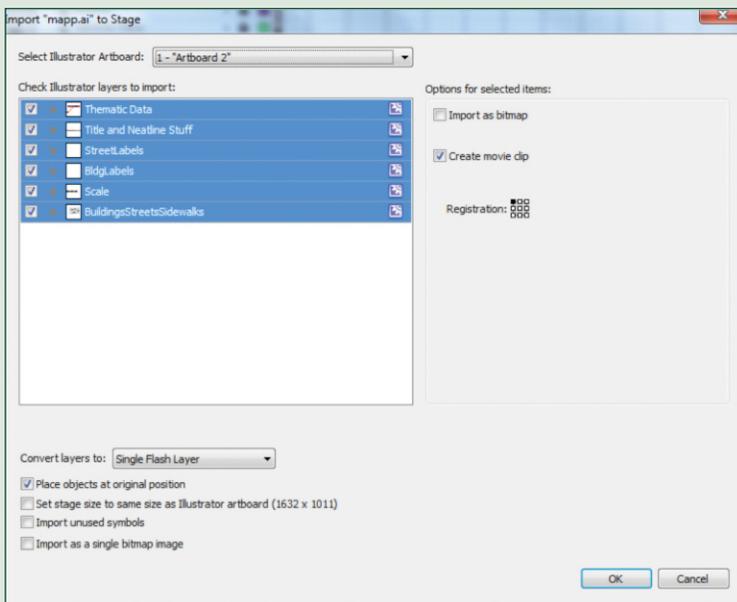


Figure 4. Final import options for mapp.ai

### CHECKING AND FIXING MAP IMPORTATION GLITCHES

Several things will stand out upon the map’s importation. First, it doesn’t fit the stage. Second, each layer of the map is surrounded by its own selection box. Third, some of the text may be disheveled—even though we took Adobe’s recommendations for importation. The first and second glitches are easy to remedy, and will be resolved in the next several paragraphs.

The third glitch can be more problematic. With a complicated map, you may want to undo the Import and go through the process again, double-checking each incompatibility error to see if a better solution (i.e., something other than the default) presents itself. Another option is to delete the bad text in Flash and retype it with the Flash text authoring tool. In the case of this map, I recommend exercising your cartographic right to generalization—just delete any extraneous textboxes!

Once you have imported the AI file, all of the map layers should be on a single Flash layer that was renamed “maps.ai.” In order to add pinch-to-zoom functionality, you need to make all of the mapp components a single MovieClip (or symbol) with a centered registration. (If you are not entirely sure what this means, do not worry. Just follow the forthcoming directions.) Select everything in the mapps.ai layer by clicking the box with a dot in it on the layer under the number 1 (i.e., frame #1) in the timeline. Once all of our map components are highlighted with blue boxes go to Modify > Convert to Symbol, or simply press F8. Select MovieClip and give it a Name of “mapp\_mc.” Where it says Registration, be sure to click the middle box. Then press OK. All of the separate selection boxes should meld into one.

### **RESIZING THE MAP TO FIT THE MOBILE DEVICE**

Resizing your map is easy. Select the map on the stage. Go to Properties. If you do not, you may need to expand the Properties window a little bit by dragging the bottom edge down. Under Properties you will see the width and height of your map—make sure it is selected, otherwise you will not see it. Since we know that the stage is 800 x 480 pixels, we can make our map similarly sized by just typing in these values. Make sure that the lock symbol to the left of the width and height values is set to “Lock width and height values together.” This way your map will not become distorted when you type in new values. Type 800 for the width. Then, using the Selection tool, drag the map to the upper left-hand corner of the stage. It should fit almost perfectly.

### **ADDING CODE HINTS FOR MULTITOUCH PINCH-TO-ZOOM AND PANNING**

The great thing about the Flash platform is that you do not have to be a programmer to create interactivity. Knowing some ActionScript will help, but fortunately, Flash provides simple “code snippets” that all users of Flash can simply insert into their documents to add some interactivity. Of primary interest to most mapp makers is making it possible to pinch-and-zoom or pan on any given mobile device. At this point, your Illustrator document is sufficiently imported into Flash and is ready to be made into a mapp. If you do not want to add pinch-to-zoom or panning to your map, you may skip the rest of this section. If you would like to make your map a little interactive, follow the directions below.

## ADDING PINCH-TO-ZOOM CAPABILITIES

Select your “mapp\_mc” MovieClip symbol on the stage. (Once selected, it should be highlighted with blue around it.) In the Properties panel, type “mapp” into the “<Instance Name>” text box. Go to Window > Code Snippets. You will see the Code Snippets dialog; select Mobile Gesture Events > Pinch to Zoom Event by double clicking on it. The Actions dialog will open up (Figure 5). You will see code has been written for you. There are some simple instructions accompanying the code. If you do not understand the code at all, do not worry; it will work. In order to put pinch-to-zoom on your own maps in the future, you merely need to make all of your map layers into a single MovieClip—as we did with this example above—put the registration point in the center, select your map, and choose “Pinch to Zoom Event.”

```
/* Pinch to Zoom Event
Pinching the stage will zoom in on the selected object.

Instructions:
1. The symbol's registration and transformation points should be at the center.
2. The symbol should be the background of your application and sized to match the stage.
*/

Multitouch.inputMode = MultitouchInputMode.GESTURE;

stage.addEventListener(TransformGestureEvent.GESTURE_ZOOM, fl_ZoomHandler_3);

function fl_ZoomHandler_3(event:TransformGestureEvent):void
{
    mapp.scaleX *= event.scaleX;
    mapp.scaleY *= event.scaleY;
}
```

Figure 5. Automatically generated code for the Pinch to Zoom Event in the Actions window.

## ADDING PANNING CAPABILITIES

You often will want to include a panning option when your map is zoomed in, as it goes over the edge of the mobile devices screen,. Unfortunately, panning in Flash is still relatively clunky. It requires two fingers, which many people find unintuitive. Unintuitive or not, it is useful. Adding Panning is as easy as Pinch-to-Zoom.

Select your “mapp\_mc” MovieClip on the stage. Open the Code Snippets dialog. Go to and double-click Mobile Gesture Events > Pan Event. Code will be added as it was for Pinch-to-Zoom. You will now be able to pan using two fingers adjacent to one another.

## SETTING UP ADOBE AIR TO PUBLISH TO THE ANDROID PLATFORM

Your map is now a mapp. Yet, we still need to do a few things in Flash to get it ready for the Android Market. Flash uses Adobe AIR to export the Flash file as an APK file (Android App). AIR needs some data and information from you before exporting. The first thing you will do is hit SAVE. Sometimes

Flash freezes when exporting using AIR. Once you have saved your file, deselect everything by clicking off-stage somewhere with the Selection tool. Then click on Properties. You should click the Wrench icon next to where it says “Player: Air for Android.”

There is a lot of information that needs to be filled out. There are four tabbed menus (Figure 6). Start with the General tab. You should decide what you want your output file to be called—your actual app file. It must end with “.apk.” Then, you should give your mapp a name that will be visible in the Android Market. Finally, you should give your mapp an i.d. All AIR apps start with “air,” but you can add your own naming convention afterwards. You also must give your mapp a version number. (Importantly, when you make changes to your mapp in the future and want to upload the new mapp to Android Market, the mapp must have a higher version number than the one previously uploaded. This way everyone with your mapp installed will get a message from the Market that an update is available for download.) For this map, because it is best viewed in Landscape mode, you should select “Landscape” under Aspect Ratio. I prefer that my mapp takes up the full screen, so I typically select that as well.

The Deployment menu requires a little more work. First, you need to create a Developer’s Certificate. Basically, this is a certificate that validates the mapp as being yours. If you do not have one yet, you easily can create one by clicking on the Create button. You simply need to fill in the required information, create a password, and, once it is created, type your password into the box below. Make sure that the certificate is good for at least 25 years, as Android requires this for apps to work. Select “Remember Password for This Session” if you do not want to type the password in every time you test your mapp. Select “Google Android Market” as your AIR runtime. Also, if you have the Android Software Development Kit (SDK) installed, you can plug in an Android device (e.g., I use the Nexus One) and when you hit publish, the mapp will be installed and brought right up on your phone for actual device testing. If you do not know what the Android SDK is, or if you do not have an Android device, simply leave the “After Publishing” options deselected.

The Icons tab is one of the most important in many ways. This is where you decide what icon you would like to show up in the Android Market when people search for your app. It is also the icon that will show up in user’s app drawers or as their app shortcut. The icon must be one of three sizes (36 x 36, 48 x 48, or 72 x 72 pixels). You may need to use Photoshop or another graphics software editor to make this. You cannot create an app without an icon. I have one ready with my business’s logo (included in mapp.zip) on it at all times, particularly when I am testing a mapp, so I can just plug the icon in and move on to testing without too much hassle. Save a logo somewhere, browse to it, and select it.

The Permissions tab menu is easier than the others to fill out, but these settings should not be taken lightly. It is here that you can decide what aspects of a user’s phone you want to access and potentially control. If you make a map and want people to be able to take a picture and have the picture be embedded on your map at the exact location they took it, you will need to check the “Camera and Access\_Fine\_Location” boxes. One thing to remember: people using smartphones are increasingly wary of malicious software. Users will see what

your app is requesting permission to access before installing your mapp. If your mapp is merely an atlas of census data and your users see that you want to access their exact location, take pictures with their camera, record audio, and write to their storage space, hopefully they will not balk at installing your product. Select only what you need for the mapp to function properly. I almost always include a link inside of my mapps, so checking Internet access is a must here. (Note: if you, too, want to include a link to a webpage, look under Code Snippets and it will show you how.) Most users expect apps to have Internet access and will not be wary of installing your mapp.

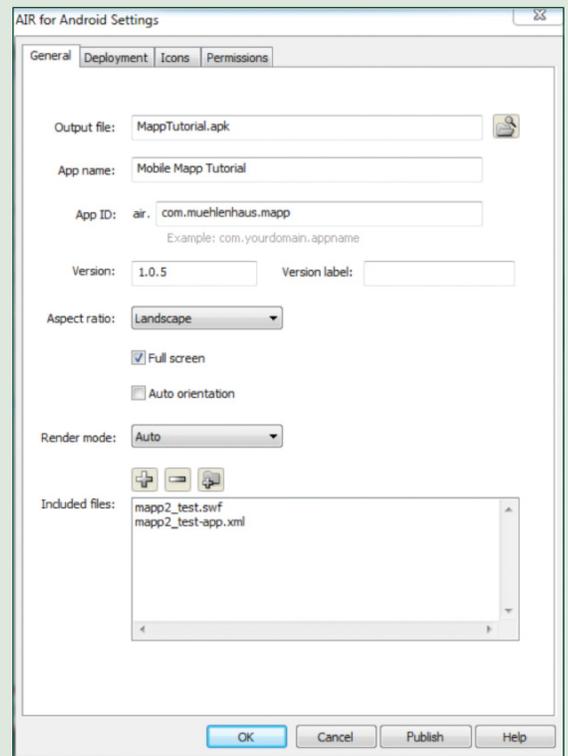


Figure 6. AIR for Android settings. All four tabs contain options that must be filled out.

## CREATING YOUR MAPP FILE

Once you have taken care of the prerequisites found under each tabbed menu, you are ready to publish. I typically hit OK, and save my file before continuing so that, if Flash crashes when publishing, I don't have to refill all of the information. When you are ready, click on Publish as found in the AIR for Android Settings dialog. This will produce both a SWF file and also an APK file that can be uploaded to the Android Market. (If you do not necessarily need an APK file yet, as you are still going to make some changes to your mapp, you can simply hit Ctrl-Enter to see what your mapp would like on a mobile device. Note, however, that you will still need to select Publish at some point before you can upload an app to the Android Market.)

It may take some time, but eventually a new window should open with the Adobe AIR icon and the name of your mapp. You will see your mapp as though it were on a device. If you want to test the Exit button, go to Device > Menu. (This mimics hitting the Menu button on an Android device.) The Exit button appears. If you click on Exit, the window closes. This represents that the mapp would close on the phone—i.e., your mapp is working!

The creation of your mapp is done. You are now ready to upload it for the world to use!

## SETTING UP AN ANDROID MARKET DEVELOPER'S ACCOUNT

Before you can post your mapp for the world to see—or, if you are an entrepreneur, purchase—you must set up an Android Market Developer account. There are now many Android markets, but Google's is the first stop for most shoppers and developers. Others you may want to register to develop for include Amazon's App Market and Barnes & Noble's NOOK Market. The ideal thing about Google's Android Market is that there is no review or censorship process as there is with nearly all other markets—most notoriously Apple's iTunes—so you can see your results very quickly. Also, Google's Android Market is remarkably cheap to register for compared with most other markets. Apple and Amazon charge \$100 a year to be a mobile developer. Google charges a one-time fee of \$25.

Becoming an Android developer is remarkably easy. Have a credit card readily available (or a Google Checkout account) and go to [market.android.com/publish](http://market.android.com/publish). Log in if you have a Google Account. If you do not, create one right there and then log in. You will see a very simple screen asking you for \$25. Hit continue. You will be asked for company information, credit card information, an address, and other such information. Fill in the form and finish the transaction, and you are ready to upload your mapp to the Android Market.

## PUBLISHING YOUR MAPP TO THE MARKET

Once you have set up your account, it is largely a straightforward process to get it online. However, there are a few things you need to do before sending off your mapp. Once you log into the publisher site, you should see a screen similar to that in Figure 7, though with no apps listed. Select "Upload Application." You will see an Upload New APK dialog. Browse to where you saved your Flash file and you should see an APK file by the same name in the folder. Select it and hit upload.

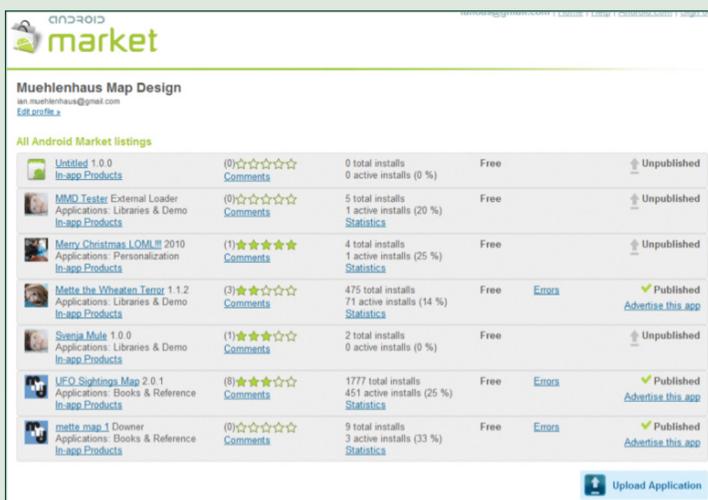


Figure 7. Android Market publishing screen.

The Android Market is beginning to require a minimum amount of information about your apps before you can upload them (see Figure 8). The requirements include at least two screenshots that mobile users can view before deciding whether or not to download, and a high resolution application icon—this is the icon that will be used at various places in the Android market for advertising your app. These images must be made to the sizes specified by Google, and again, you may need to edit and crop your images in a graphics application. You can provide a link to a promotional video, feature graphic, and a promotional graphic; these are not required, however.

Fill in the rest of the information as you see fit. On this page you can also determine in which countries you would like your mapp to appear on the Android Market. You also can decide whether you want to charge a fee for your app. (Note: if you do, you will have to set up a financial account with Google. That is not difficult, but requires some more forms.) You also must give your app a rating, so users know whether it is suitable for children. Finally, there is the option of selecting copy protection. You can decide whether your map is valuable enough to warrant the larger file size it entails.

Near the top of the screen you will see two tabs; the one you are on says “Product Details.” Next to it is one that says “APK Files”; the second tab is where you upload your actual mapp to the servers if you did not do so earlier. If you already uploaded it, you still need to activate your app on the market. Click the APK Files tab. You should see your APK file with the icon file you selected

The screenshot shows a web form titled "Listing details" for an Android Market listing. The form is in English and includes the following fields and options:

- Language:** English (en) (with an "add language" link and a note that the star sign indicates the default language).
- Title (English):** "From Print to Mobile mAp" (26 characters, 30 max).
- Description (English):** "This mapp was created using nothing more than Flash CSS.5 and an ESRI ArcGIS map exported as an Adobe Illustrator file. To learn how to take your GIS and map projects and make them mobile mapps, please read 'Cartographic Perspectives' available on the North American Cartographic and Information Society Website (www.nacis.org). There a tutorial using this mapp is available in an issue from 2011." (580 characters, 4000 max).
- Recent Changes (English):** "The only change made to this mapp since writing the tutorial is... I added a link to the NACIS Website. Click on the middle part of the map to have your browser take you there." (178 characters, 500 max). Includes a "Learn More" link.
- Promo Text (English):** (0 characters, 80 max).
- Application Type:** Applications (dropdown menu).
- Category:** Education (dropdown menu).

Figure 8. Required details for listing in the Android Market

in Flash. To the right there will be several options: Activate or Delete. Click on Activate. Congratulations! You have just created and distributed your first mapp.

Your mapp will be live to the world and downloadable within an hour, but normally well before then. You can create and upload as many mapps or apps as you want. You are now an Android Developer!

## WHAT ABOUT DEVELOPING FOR THE IPHONE AND IPAD?

The methods laid out in this tutorial also can be used to create mapps for Apple's iOS devices and other companies' smartphone technologies. In order to create a mapp for these devices, you simply need to register as an iTunes developer. The fee, as of this publication, is \$100 a year. When you open Flash, instead of selecting an AIR for Android template, select AIR for iOS. The rest of the process in Flash will be remarkably similar. However, Apple must approve any app you create; the review process may take some time, whereas with the Android market your app is typically downloadable within minutes of posting. Also, Apple is known to decline apps without providing any real feedback as to why. For example, the Opera Web Browser was only accepted by Apple when given a Mature (17+) rating.

## STUDENT ATLAS OF OREGON: A CLASSROOM ATLAS FOR ELEMENTARY AND MIDDLE SCHOOLS



By Teresa L. Bulman and Gwenda H. Rice.

Cartography by Center for Spatial Analysis and Research at Portland State University  
(Chief Cartographer: David Banis)

Oregon Geographic Alliance,

2009. 48 pages, 47 maps, 8 1/2 X 11 inches. Available free online at <http://studentatlasoforegon.pdx.edu/>

Softcover ISBN 978-1-60643-848-0

**Review by:** Victoria Packard

### Description:

The *Student Atlas of Oregon: A Classroom Atlas for Elementary and Middle Schools* is 48 pages long and includes 47 maps. It is available in a soft or hard cover and is 8 1/2 X 11 inches, making it easy for students to carry and use.

The maps are general reference and thematic. This review will focus primarily on the thematic maps, among which are examples of dot density, choropleth, isopleth, graduated circle, and color patch maps.

The *Student Atlas of Oregon* is subtitled as *A Classroom Atlas for Elementary and Middle Schools*, but it is a good basic atlas for other age groups as well.

### Analysis:

Any discussion of the large amount of information available in this atlas will involve a consideration of how this atlas is compiled, and the various sections it contains. The following is a brief description of these sections.

The “General Reference Map” section displays the larger cities of Oregon, and the roads and highways connecting them together. “What is a Map?” provides a brief explanation of the differences between a picture, aerial photo, and a regular map the student may have used in the past.

“Types of Maps” shows the differences between a general reference map that provides the location of cities, towns, roads, and thematic maps, which provides a variety of information by themes. These themes deal with the distribution of people within a geographic region, by means of dot density, choropleth, isopleth, graduated circle, and color patch maps.

“How Geographers Use Maps” explains, with written and visual images, how maps can be used to learn about places, locations, agriculture, environment, population, weather, and many more topics.

“How Cartographers Use Symbols” and “Latitude and Longitude Lines” explain the use of cartographic symbols. The description of latitude and longitude is well done. There is enough description to understand map symbols and coordinates, but not so much as to overwhelm the student with information they will not use at this level.

The sections “Making a Globe Become a Map” and “Map Distortions” do a very good job explaining a map projection, and distortions that can occur, without going into extreme detail. There is discussion about the three basic types of maps and how they distort distance, direction, area, shape, or scale. Students will be able to know what distortion will occur with each map type, and how to choose the best map projection for their project.

“Map Scale” and “Using Scale Bars” are both very informative. Map scale is a concept that can be confusing to younger students. The illustration showing the distance of 20 miles on maps from small scale to large scale is a good visual example, and the explanation of the three ways to represent scale is also well done. The assignment to measure and read distances using a map, paper, and pencil is a good practical application for students.

“Physical Regions of the Pacific Northwest” is a good example of how mountains, plateaus, basins, and valleys do not follow the boundaries of states. For example, the Cascade Range crosses the states of Oregon and Washington, while the Wallowa Mountains flow through the states of Washington, Oregon, and Idaho.

“Ecoregions” provides a visual delineation from cool mountain ranges to hot lower basins. Oregon is a good example of multiple ecoregions within a state.

The “Topography” and “Elevation Cross Sections” chapters display the elevation range in feet, making it more understandable visually. The cross sections of elevation in different colors is a good representation of sea to mountain levels. Crossing the map from border to border north to south and east to west will help students realize the symbiotic relationship between topography, and the environment, and how each can affect other changes such as crops, wildlife, and forests.

Oregon sits on three tectonic plates, and it is very interesting to see, in “Pacific Northwest Plate Tectonics,” where they are and in which direction they move in relation to the coast. The listing of located volcanoes

along with historic data on eruptions puts the correlation of plate movement and volcanic eruption in perspective.

Because the “Natural Hazards” map is on the page adjoining the earthquake map, it is easy to see the correlation between plate tectonics, volcanoes, and the number and magnitude of earthquakes in the state of Oregon.

The three maps “Average Temperature for January,” “Average Temperature for July,” and “Average Annual Precipitation” enable students to see which locations are the coldest in January, the hottest in July, and which receive the most rain. This allows students to make comparisons between agricultural, population, and environmental questions. The next map, “Climographs,” displays the annual precipitation and temperature for the larger cities in Oregon in graph format.

The “Vegetation Zones” maps display 10 zones with descriptions of the trees, shrubs, plants, and grasses found in each area. The forest map displays the distribution of 10 different trees in Oregon. Using this map with the previous vegetation map, students are able to understand that there are not many trees in an area that is labeled the Big Sagebrush zone and why the Sitka spruce, which is not affected by salt, grows along the coast.

“Timber Harvest Over Time” display maps from 1925, 1960, 1980, and 2004. They show, in thousands of board-feet, how much was harvested per square mile, and in which areas.

The “Forest Fire Risk” map displays the high, medium, and low risk zones for forest fires. In the “Historic Fires” map there is a listing for historic fires from 1848 to 2002. The list includes data on how many acres were consumed and the geographic location of the fires.

In the “Land Ownership” map, there are three smaller maps displaying Oregon land ownership by private, state, and federal land. There is also a chart showing the percentages of land ownership. The chart is a very good visual aid showing that state and federal land claims 54.6% of the land in Oregon.

The “Wildlife Distribution” map is very interesting. There are eight smaller maps showing the habitat ranges of such animals as black bear, rattlesnake, spotted owl, bald eagle, American beaver, pronghorn, elk, and red-legged frog. Included with the maps are identification keys for animal tracks.

The map in the “Pacific Coast Salmon” section displays the historic and current salmon ranges along with major dams. Different color overlays show historic and present day salmon ranges. This section explains how trees, boulders, leaves, and the water movement all work to help provide food and protection for the salmon and their young.

The “Rivers and Lakes” map displays the location,

direction, and size of various rivers and lakes in Oregon.

The “Pacific Northwest Watersheds” is a good display of watersheds, separated by colors. There is a small display about the large Columbia River watershed: the area it encompasses, and the states and countries it touches.

The “Dams of the Pacific Northwest” page includes a photograph of the Grand Coulee Dam. The legend displays the purpose of each dam, whether hydroelectric, irrigation, or flood control. The names of the rivers along with the dam location and type provides important information.

“Oregon Dams” is a good explanation of the dam systems in Oregon, with a display indicating the size of the dam by the size of the marker. The legend explains that one acre-foot equals 325.851 gallons. The inclusion of mountain ranges helps to explain dam placement.

The “Renewable Energy Potential” section is well done. There are definitions of solar, geothermal and wind energy. Within each of the energy types there are small legends showing potentials by kilowatt/meters. It is very easy to see that along the coast is the best for energy production from wind and that solar energy potential is highest in the east and southeast of Oregon.

The “Lewis and Clark Expedition of 1804–1806” and the following map of the “Oregon Trail” are two good resources for geography and history classes. The boundaries of the Indiana Territory and the Louisiana Purchase are well defined in relation to where Oregon would eventually be. The use of different colors and inclusion of dates for the Clark, Lewis, and Lewis & Clark expeditions are well separated.

All of the Oregon Trail is displayed on this map. The location of forts and geologic formations, such as Chimney Rock, makes the map interesting and less a listing of dry facts. The inclusion of a photograph of wagon wheel ruts is a nice touch.

The “Native American 1780 Population” displays the number and names of the Native American tribes. This is very interesting for genealogy, history, political science, and current affairs.

The “Population” map shows the distribution of people throughout the state, with one dot equaling 500 people. It is very easy to see that the greatest concentration of people is in the western section of Oregon.

The “Ancestry and Race in Oregon” maps have a bar chart for ancestry and a pie chart for race distribution. The ancestry chart displays the ancestral heritage of the parents and grandparents of an Oregonian student. The race chart uses U.S. Census data to display the ethnicity of the state.

The “Population Pyramids of Three Counties” displays gender and age with bar charts. These counties are

Multnomah in the north, Malheur in the southeast, and Curry County in the southwest.

“Farm and Ranch Lands” provides a graphic breakdown across the state and includes the outline of counties.

The two “Major Crops” maps display the distribution of wheat fields and of greenhouses and nurseries. There is a breakdown by bushels and pounds for the wheat and number of nurseries by dot.

The “Farm Products” page has separate maps displaying such products as onions, potatoes milk cows, and beef cows, with one dot equal to so many of the product. The “Fruit” maps have separate displays of grapes, apples, cherries, and pears with each dot equal to so much fruit on each map.

The “Transportation” map displays major transportation infrastructure, such as railroads, highways, and airports, with specific symbols showing train stations, types of railroads (e.g. freight or passenger or both), interstates and highways, and major airports versus smaller or private airports.

The “Ports” section displays two maps. One covers the “Columbia/Snake River System Ports” with each port marked, and the other listing the top 10 ports from Washington to Oregon to California and how many ports are within each state.

The last map shows the “Counties and County Seats.” It displays the counties in Oregon, the county seats, and their location within the county.

#### **Weakness:**

The atlas is a good resource to use with a standard text, but if it will be used as a single teaching tool it will need more practical applications.

The “Topography” map would be more pertinent with names of mountain ranges and cities, and could be cross referenced with “Elevation Cross Sections” on the next page.

If the “Wildlife Distribution” map included another map overlaying of all the habitats, students could see how different habitats overlap.

The “Rivers & Lakes” map should include the mountain ranges to show how mountains affect water flow and lake creation. The “Pacific Northwest Watersheds” section needs a definition of the concept of a watershed.

The “Population Pyramids of Three Counties” shows the breakdown of three counties by age and gender using percentages, but fails to explain why these three counties were chosen. Are they representative of the state?

“Farms and Ranch Lands” is a good display of the farms and ranches in the state, but including the names of the counties would have been helpful.

#### **Appraisal:**

This atlas is a wonderful start for students to learn geography. Many of us sat through geography classes where we colored the states and marked the capitals. The thematic approach is much more educational, and the information is presented in a way students will retain longer and be able to apply to other classes such as history or current affairs.

The use of detailed written text with visual examples is very well done. It encompasses the learning style of two types of learners.

Used in higher education, this atlas will enable students learning GIS or remote sensing to understand the various themes and levels of information, and provides examples of how to overlay information within the programs.

#### **CENSUS ATLAS OF THE UNITED STATES: CENSUS 2000 SPECIAL REPORTS**

By Trudy A. Suchan, Marc J. Perry, James D. Fitzsimmons, Anika E. Juhn, Alexander M. Tait, Cynthia A. Brewer.

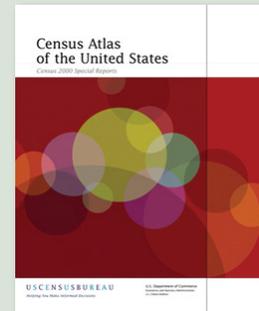
Washington, DC: Government Printing Office, 2007. 302 pages, maps, figures, notes, map and figure index. \$173.50, hardcover.

ISBN: 978-1-58-769010-5

Entire text available online at: <http://www.census.gov/population/www/cen2000/censusatlas/>

**Review by:** Russell S. Kirby, University of South Florida

Every once in a while, a volume is published on such a seemingly ubiquitous subject that it gives one pause to discover how unusual its publication really is. Unfortunately, in the field of the geography of North America, this is the norm rather than the exception. How many comprehensive texts on the regional geography of the continent, or of the United States, have been published in the past thirty years? A handful come to mind, including *Across This Land* by John C. Hudson (2002), *Regional Geography of the United States and Canada* by Tom L. McKnight (2003), *Regional Geography of Anglo-America* by White, Foscoe, and McKnight (1985), *North America: A Geography of the United States and Canada* by John H. Paterson (multiple editions, most recent, 9<sup>th</sup> edition, 1994); none of them are best-sellers, although perhaps all are familiar to readers of this journal.



Even so, it came as a surprise to discover that the most recent atlas published by the U.S. Bureau of the Census, *The Statistical Atlas of the United States*, was based on the 1890 census, making the recent publication of the *Census Atlas of the United States: Census 2000 Special Reports* something of a landmark achievement. Indeed, the only federal government publication worthy of mention in comparison is *The National Atlas of the United States*, published in 1970. That volume contained numerous maps based on census data, but covered a variety of other topics as well.

The *Census Atlas of the United States* represents a truly ambitious undertaking for those who undertook its creation and production. Within its covers, a broad array of demographic, social, cultural and economic topics are presented, often in considerable depth; included are detailed maps at the state, county, and metropolitan area level, and occasionally, temporal comparisons with prior census years 10, 20, 30, 50, or 100 years before. Due to the nature of the 2000 census of population and housing, the primary statistical resource for this atlas, the subject matter is constrained to reflect the questions for which information was collected on census returns. Successive chapters focus on the distribution of population (including urban and rural population patterns, population density, change over time, center of population, and year of maximum population, along with more detailed presentations); race and Hispanic origin (including percent distributions, prevalent race or ethnicity, race/ethnic distributions of children, and patterns of multiple race designation); age and sex (including sex ratio, median age, dependency ratio, and distributions of children and elderly by race/ethnicity); living arrangements (including patterns of married and divorced people, one-person households, patterns of families and households with children by adult status, grandparents responsible for their own children, and same-sex unmarried partner households); place of birth and US citizenship (showing patterns by nation of origin, sex ratio, age distribution, percent US citizen and naturalized citizens who were foreign born by year of entry into the U.S.); migration (including change over time, patterns by race/ethnicity and age, and percent residing in state of birth); language (focusing on language spoken at home and English speaking ability); ancestry (based on specific Census questions and potentially different from place of birth or race/ethnicity); education (including percent of persons 25 or older who completed various levels of education, increase in high school completion from 1950 to 2000, and private school enrollment); work (including commuting patterns, labor force participation, and types of occupation); military service (including veterans, active-duty military population, and veterans in poverty); income and poverty (including median household income, median earnings, and poverty patterns by age, gender, and household type); and housing (including

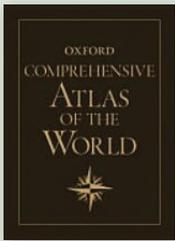
homeownership, value of owner-occupied housing, prevalent period when most housing was built, median monthly rent, minority ownership, percent mobile homes, type of household heating fuel, households without telephone service, households without plumbing, and crowded housing). The atlas includes detailed base maps and related materials, as well as a guide to how to read each type of map.

Most of the maps are choropleth, although other mapping techniques are used. Once the reader has become accustomed to the conventions applied to the maps for each topic, most maps are easy to read, as they use effective schemes for gradation of color across categories. One notable exception is the map of prevalent ancestry (p. 141), which uses 16 different colors to classify counties, several of which are rather difficult to differentiate. Maps showing quantitative variation in mapped variables are especially easy to read, with the US overall percent value for the variable of interest forming a class break, and comparisons are readily made even across sequential maps from one decade to the next. Each chapter begins with a brief introduction to provide context, and often includes data graphics to show patterns of demographic change over time.

As with any project of this magnitude, the authors had to make decisions as to what to include, and generally this reviewer is pleased with the choices made. The book would have been strengthened, however, with a discussion of the limitations of census data, including potential bias from under-enumeration; response rates; which questions were asked only on the long form given to 1 in 6 households; and references to resources where readers might obtain additional insights into the processes underlying the spatial patterns portrayed throughout the atlas. Casual readers of the atlas may think that these maps constitute spatial analysis of social and economic aspects of American society. A few of the maps presented do rise to the level of spatial analysis, but most merely classify a single, often refined, variable by state, county, or smaller areas of metropolitan regions. For many readers, what is presented is more than adequate, but those wishing to obtain a deeper understanding of the phenomenon of interest will have to look elsewhere.

All told, the authors and the numerous individuals whose acknowledgements occupy an entire page in the text have done an outstanding job in providing what I, at least, regard as an essential public service to the citizens of the United States. The *Census Atlas of the United States* belongs on the reference shelf of every public and academic library in the US, and the website at which the atlas content may be accessed should become much more widely known. Moreover, let us hope that in the future, we have at most ten years to wait for the publication of the next edition, and that the publication of this atlas helps to depoliticize the debate over funding the Census

each decade by concretely demonstrating its vitally important role to the American economy, society, and culture.



### OXFORD COMPREHENSIVE ATLAS OF THE WORLD

Oxford, UK: Oxford University Press, 2008.  
584 pages. \$250.00, hardcover.

ISBN: 978-0195374797

**Review by:** Fritz C. Kessler,  
Frostburg State University

In a time of “this and that” web deliverables, it is refreshing to be able to hold something tangible in your hands and leaf through 584 pages of heavy weight glossy paper. Personally, I would get very little satisfaction trying to pore over this atlas on my 18.5 inch flat panel screen, and I suspect many of you would too. Richly bound in black leather wrap, complete with three brilliant red ribbon markers and gold gilded page edges, it also makes quite a stunning visual impression. Yes, it is pleasurable to see and hold the likes of the *Oxford Comprehensive Atlas of the World*—all 13.6 pounds of it. This massive atlas, measuring 15.6 x 11.9 x 2.1 inches, seems to hark back to an earlier time when world atlases in book form were lavish productions that represented a stylistic approach to presenting Earth in all its geographic complexities.

The world journey begins just inside the front and back covers with helpful index maps. Inside the front cover is a double-page spread map of the world titled *Key to World Map Pages* employing a cylindrical projection (most likely the Miller). A medium dark tan fill is used to separate the landmasses from the light cyan ocean fill. Land-water contrast is further emphasized by a medium brown coastline vignette. Boxes of various sizes appear on the world map outlining the extent of the maps within the atlas. A color-coded number attached to each box points the user to the page where the map can be viewed. Red, blue, or green numbers indicate, respectively, the three different scale classes used throughout the atlas: greater than 1:2,900,000, between 1:3,000,000 to 1:7,000,000, and less than 1:7,100,000. Selected world cities and various islands are also shown on the world map along with the page numbers for their reference map. Inside the front cover, one finds explanations of symbols and type for both the city and world maps. Finally, the color tints associated with elevations and bathymetry are clearly shown. Inside the back cover is a double page spread of two maps titled “Key to North America Map Pages” and “Key to Europe Map Pages. The same color-coded box system and city/island designation found on the front end paper is also used in the back. An azimuthal projection is used for the North America map while a cylindrical projection

is the base for the Europe map. Along the bottom of both cover pages, a convenient alphabetized index of countries, islands, states/provinces, and cities indicate the page number(s) for each location listed.

After the foreword is a one-page “User Guide.” Topics discussed in this guide include Map Sequence, Map Presentation, Map Symbols, Map Scales, Measuring Distances, Map Projections, Latitude and Longitude, and Name Forms. This guide serves the reader in two ways. First, it explains various cartographic concepts in which the user may not be fully versed. Second, the guide explains the logic governing the decision making process that the publisher went through in laying out this atlas. For instance, the guide states that the atlas includes reference maps that were compiled “in accordance with the highest standards of international cartography to provide an accurate and detailed representation of the Earth” (p. 3). That being stated, the guide proceeds to inform the reader that the maps are presented in a “classic arrangement adopted by most cartographers since the 16<sup>th</sup> century” (p. 3). That is, maps of Europe are presented first followed by maps of Asia, Africa, Australia and Oceania, then North and South America. Furthermore, under Map Sequence, a reference map is shown with a bright red line that starts in Iceland and meanders throughout Earth’s landmasses terminating at the Falkland Islands that illustrates the sequence in which the maps are presented in the atlas.

Following the “User Guide,” “Contents” covers four pages, artistically presented over the backdrop of global maps. Sections include “World Statistics,” “Images of Earth,” “World Geography,” “World Cities,” and “Oceans.” The three remaining pages list the world and regional maps with the additional information of the principal scale at which each map was compiled. The scale information provides specifics not included in the front cover map index.

The *Atlas of the World* (hereafter, the *Atlas*) begins with “World Statistics.” The tabular Countries and Cities data, printed on a backdrop of an urban landscape, includes land area (kilometers<sup>2</sup> and miles<sup>2</sup>), population totals, and annual income (in USD equivalent) for individual countries, and population totals for principal cities. The Tabular Climate data, printed on a backdrop of hurricane cloud imagery, presents average monthly temperature (degrees Celsius) and rainfall (millimeters) for approximately 90 world cities. The remaining pages in this section show eight shaded relief maps of elevation and bathymetry cast on large orthographic projections, illustrating the world in various hemispheric views. These maps are intended to locate various Earth physical and human extremities (for example, highest mountain, longest river, most populous city, and greatest economic wealth). Each map includes tables presenting the same extremes; listing, for example, the 10 least populous countries. In addition to pinpointing the location of a

selected extremity, flag(s) of the country(ies) of reference are also shown.

“Images of Earth” includes satellite imagery of fourteen world cities and one delta region. Contrasting images of Greenland’s Helheim Glacier and the Arctic ice sheet are also provided. All the imagery is presented in natural color, and associated with each image is a short textual description of the scene highlighting important features or attributes of the area. The satellite images were provided by NAP Group, but little other information about the imagery specifics is given. According to the NAP Group website ([www.napgroup.com](http://www.napgroup.com)), they are only processors and distributors of satellite imagery, and the site lists numerous government and private sources from which they acquire satellite data.

A detailed visual exhibition of physical and human geography comes next in “World Geography.” Each of the 27 included topics is given a two-page spread incorporating a multitude of informational methods. The astronomical topics (Universe, Stars and Constellations, Solar System, Moon, and Earth) employ satellite images, star charts, planetary data, NASA mission information, and graphics. More earthly and traditional atlas topics follow: Surface Geology, Landforms, Oceans, Atmosphere and Weather, Climate, Water and Vegetation, Population, Languages and Religion, Food Production, Minerals, Energy, Trade and Wealth, and Standards of Living. These present data on such topics as continental drift, ocean currents, monsoons, and annual sediment yield, using artistic renditions, climographs, digital elevation models, and choropleth maps. The atlas also includes contemporary topics such as Climate Change and Global Warming, Biodiversity, International Organizations, Conflict, Globalization, Health, and Travel and Tourism that report on issues such as carbon dioxide emissions, totals of endemic species, numbers of refugees, and descriptions of organizations through text, pie charts, photographs, bar graphs, and flow maps.

The primary cartographic component of the *Atlas* begins with maps of 88 world cities. The maps are arranged alphabetically with one to four maps per page. The city maps take on a familiar design using pastel hues that show roads, rail lines, urban areas, woodlands, points of interests, airports, and individual important buildings. There are plenty of labels identifying the various features mapped. Each city map is drawn at a different scale, but is accompanied by individual scale bars (in both miles and kilometers). A map inset positions each city within its country or state.

Although all five oceans are included in “Oceans,” the Atlantic and Pacific Oceans are each given a two-page spread. A sequential blue color scheme represents bathymetry, while a spectral color scheme illustrates topography. Basins, plains, rises, and ridges are labeled along with trenches and fracture zones.

Continental, regional, and country maps comprise the meat of the *Atlas*. The maps take on a traditional format in terms of their geographic organization (in order, the divisions are World, Europe, Asia, Africa, Oceania, North America, and South America). Each geographic area is presented in the same template. A natural satellite image cast on an orthographic projection (in the tradition of Richard Edes Harrison) introduces each section. There follows a physical and political map of each continent/region, and then maps of the individual countries/regions. In the World division, each physical map is matched with an elevation/bathymetric cross-section along 40° N. Each political map is accompanied by eight smaller world maps, with oblique azimuthal equidistant projections, showing distances from the center. In the remaining divisions, each physical map shows major rivers, waterbodies, and landforms, while country boundaries, capital cities, major cities, and major rivers are shown on the political map. Both types of maps show topography and bathymetry. The ensuing individual country/region maps include shaded relief, bathymetry, rivers, water bodies, cities, airports, and a graticule. A scale bar, representative fraction, inset map, page references to adjoining maps, and a color legend for the topography and bathymetry are included with each map.

A two-page “Geographical Glossary” follows the cartographic presentation. The glossary presents a listing of non-English geographical terms along with the country of origin and English translation (for example, Hon Vietnamese island). The *Atlas* concludes with the lengthy “Index to World Maps.” This index, which is set using what appears to be approximately 6-point type and divided into six columns per page, spans pages 435 to 584 (almost one-fifth of the book; which is to be expected given the scope of this atlas). Each entry provides latitude and longitude, page number, and map grid location.

While leafing through the atlas, one finds many impressive touches. Certainly, the larger satellite images captivate one’s attention, drawing the viewer in to carefully study the landscape complexity and the details contained within the richly hued patterns. “World Geography” presents detailed information on a diversified subject matter in a way that mimics the presentation found in human or physical geography textbooks. Page after page of colored graphics, diagrams, artistic renderings, colorful maps, concise but informative textual descriptions (and, where appropriate, pictures) draw your attention to this section for a better look. Included in this section is a plethora of multivariate pie charts and bar graphs that buttress the information content of each topic. Numerous tables reporting informative data populate each topical section. While I did see one example of a cartogram showing world population and a handful of flow maps, it is the choropleth map that dominates the thematic symbolization presentation of data with their saturated

hues. In many cases, four or five choropleth maps accompany each section's two-page spread. Most maps use the Winkel Tripel modified azimuthal projection. However, there are other projections employed throughout this section, most of which unfortunately are unnamed. The ones that I was able to visually identify include the Mercator, Miller, Plate Carrée, Eckert IV, and interrupted Mollweide. In short, this visual complexity helps to accentuate the diversity of topics and themes to which Earth's inhabitants have to manage. The "World Map" section presents a complete inventory of the world at scales large enough to be useful to the reader. Individual section map scales range from approximately 1:770,000 to 1:26,000,000, a breadth of range that solves a number of problems experienced by other atlases. With many smaller atlases, the map scale must be compromised, calling into question the utility of the maps. Another benefit from the large format of this atlas is the number of labels appearing on the individual maps. Wise use of different type sizes and styles creates a clear visual hierarchy. Possibly one of the greater design accomplishments of this atlas has to be the way in which a double-page spread is visually matched at the gutter. In some lesser-quality atlases where a double page-spread is found, much of the information that crosses the gutter is lost. Not so with this atlas, as there is just enough shifting of the map or image as to make all of the information visually available.

The main points of contention I take with the atlas concern the often poor overall map design, which makes reading the labels difficult (especially for older eyes) and creates an overly dismal feel to the maps. First, poor choices were made with the color values used for the shaded relief on the individual country/region maps. On most of these maps the relief is simply too dark. The relief shades progress from light green to pale yellow to an orange-brown hue, ending in a saturated purple. The dark brown and purple of the highest elevations causes the greatest difficulty when reading the labels (e.g., Southwest Asia, pp. 266–267). The inclusion of a light halo around each letter does little to alleviate the difficulty in reading the labels. Using a screened shaded relief in order to create a lighter progression of hues would have increased the visual contrast and promoted label readability. A similar problem exists with the individual United States state maps. The state in focus uses the same hue progression as the country/region maps but the surrounding states are shaded in a grayish brown. The overall effect gives the maps an unnecessarily gloomy feel. The problem is especially prevalent in maps of states with low relief (e.g., Ohio, p. 374). The somber shaded relief coupled with the choice of red to represent the roads and county boundaries (which are difficult to distinguish), creates maps that are depressing to view.

Second, the symbolization often interferes with text readability. Again, on the individual United States state maps, a thin diagonal-line fill is used to represent

administrative boundaries such as national forests. This diagonal-line fill is most troublesome on the western states like Arizona (p. 360) where the dark brown color sequence used for the higher elevations creates poor visual contrast. Yet on the country and regional maps, the administrative areas are outlined without any interior diagonal-line fill (e.g., Southern British Columbia, p. 328), an approach that makes the areas laborious to find. Changing the outline colors so that they do not fall within the shaded relief color scheme would ease the situation, although, as already mentioned, lightening the overall shaded relief sequence would diminish the conflict.

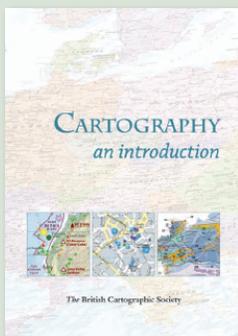
Third, in the World Geography section, there are several instances where flow maps are aptly used, but the choice of map projection is wholly inappropriate. For example, the World Migration flow map (p. 70) inappropriately casts the data on an interrupted Mollweide projection. This approach creates conceptual difficulties for the naïve map reader in two ways; first, the flow lines arc beyond the projection's boundary, and second, the flow lines jump across the interruptions. A non-interrupted projection could have kept the flow lines completely within the map, lessening confusion and thus aiding the map reader in interpreting the flow lines. The World Air Travel and Tourist Destinations flow maps (pp. 90–91) use a different interrupted projection, and as a result share a similar problem, albeit to a lesser extent, as the flow lines do not extend beyond the projection's boundaries to the degree as seen on page 70. Despite these difficulties, the air travel and tourist destination maps successfully force the user to view the world from a non-traditional perspective.

There are a few petty criticisms I found with the *Atlas*. In the "User Guide," the Map Sequence line should have started in Greenland instead of Iceland (p. 3) as this is the order in which geographical topics are presented. In "World Statistics," the shaded relief color sequence for the maps do not follow the Elevation and Depth Tint key found inside the front cover, and no substitute key is offered (pp. 12–19). In "Images of Earth," the satellite images of the Helheim Glacier, Greenland, are temporally reversed from what the caption indicates (p. 36).

Within "World Geography," there is an issue of consistency in the map presentation. For instance, the application of map borders is inconsistent. Most maps are displayed within a border (e.g., p. 72) while a few maps appear to be floating on the page without borders (e.g., p. 71). In a similar fashion, the inclusion of the graticule is not consistent. Some maps show the Prime Meridian and the equator using easily identifiable lines cast in a cyan hue (p. 74) while on other maps both or only one of the lines is barely visible (p. 87). Antarctica's presence on many maps is unpredictable. It appears as if Antarctica is included in the Winkel Tripel (p. 59) but is

absent on other map projections (p. 63). The positioning of some maps inside their border in this section is unbalanced. Some map borders are tight along the west-east extent, but spacious along the north-south extent (p. 78). For other maps, this juxtaposition is reversed with the map border tight against the north-south coastline with extra space between the west-east coastline (p. 78).

In summary, this atlas will serve map libraries and other institutional settings best where there is a range of user curiosity about the nature of Earth's geographic phenomena. An individual, however, would have to give considerable thought as to whether or not to purchase this atlas. Aside from its cost, one has to reconcile the fact that most of the data that is presented in this atlas is available via the web. Its size and weight practically eliminates portability. Conversely, while you may be able to find the *data* on the web, you are not going to find it assembled together in such an artful, creative, and visually impressive way. Yes, there are issues with the map design. But, with a massive research and compilation undertaking such as this, perfection is largely fleeting. The bottom line is: if you are someone who needs the most recent and timely statistic, craves the ability to query and click, and salivates at the latest techno-whiz-bang web app for your geographic pleasure, then this atlas is obviously not for you. If, on the other hand, you cherish the laborious construction involved in compiling a world atlas, luxuriate in the lavish feel of glossy paper between your thumb and forefinger, enjoy casually leafing through large format pages, and marvel at the wonderment that unfolds before your eyes, then this atlas should be on your short list.



## **CARTOGRAPHY: AN INTRODUCTION**

By Giles Darkes and Mary Spence.

London: The British Cartographic Society, 2008. 64 pages, maps, figures. £4.99 (about US \$7.99), softcover.

ISBN: 978-0904482232

**Review by:** Trudy Suchan

The British Cartographic Society published this little book because they were "... convinced that with a little knowledge of cartography a map's message can be communicated much better" (Foreword, p. 5). How little is the book? The maps and illustrations are postage-stamp sized. Does it impart a little knowledge? Much more than that. All of the basics are here—scale, projections, generalization, symbolization, classification, color, text, legends, and marginalia. The authors encapsulate the evolution of cartography in three pages, including space for six illustrations. They emphasize the importance of knowing

the audience of and purpose for a map, and they introduce concepts of data quality and map quality.

The book is written for the lay mapmaker. The text is punctuated vigorously with exclamation marks and speaks directly, even casually, to the reader: "Maps which don't work are often unclear, imprecise and inefficient! ...But don't worry, we hope some of the ideas and issues in cartography explained in this booklet will help you to design a better map" (p. 9). If the explanations seem too long winded, we are assured that "The impatient or harried can immediately refer to [the chapter] Better Mapping in 5, 15 and 50 Minutes" (p. 60).

In its appeal to the lay audience, the book employs visual design gambits from other media: the running page footer is reminiscent of a TV news screen crawl, while the "did you know...?" balloons and useful tip boxes would be pop-up text in an online guide. Typically, unfamiliar terms and acronyms should be defined at first use, but the GIS acronym is used at the top of page 8, expanded to "Geographical Information Systems (GIS)" at bottom of page 8, and is at last defined on page 21. Similarly, cartograms are referred to on page 8, defined on page 15, and finally illustrated on page 33. I would guess that these rules were waived in the name of non-technical, breezy writing, but it is perhaps a little too breezy for an introduction.

One strength of the book is the variety of maps shown. There are snippets of antique maps, political maps from contemporary world atlases, navigation charts, geological maps, Ordnance Survey maps, a subway map, a walking map, and imagery; all are miniaturized nicely. In addition, the second author enriched the book with numerous contributed illustrations; most notably, a 4 x 8 cm cartogram of population for the world.

Organizing the technical and conceptual body of topics in such a short volume must have been a challenge. The authors developed five sections: "An Introduction to Cartography," "Some Map Basics, Issues in Producing Good Maps," "Designing Better Maps," and the two-page "Tips for Improving Your Maps." Separating basic precepts from design forced some artificial breaks in the flow of information about certain topics, for example, color, symbolization, and GIS technology. But even that separation is not clean; conceptual content (know your audience, what makes for good map design, integrity in data representation) is found in the midst of technical topics. Still, in 64 pages, it's easy enough to find all that the book has to offer on a given topic.

In summation, the maps and illustrations are notable, and the book content is up-to-date and satisfyingly complete. The price is so reasonable that I would buy several; one to keep and one to lend, but over-40 readers should factor in the cost of a magnifier.



When I was growing up in my hometown of Sydney, Australia, we moved house to a suburb far, far away from my school. Instead of a familiar short bus ride, I was suddenly confronted with a train journey of some distance. Making that initially daunting journey much easier was Sydney's CityRail network diagram, which reassuringly presented the complex and lengthy routes as simplified colored lines, with the stations I needed to know about clearly indicated. Over the next few years, I got to know that diagram very well, as I used it to plan journeys all over Sydney for school, college, and employment.

As time went by and I pursued a career in graphic design, I learned of the origins of this style of network diagram—the famous London Underground Tube map—and found out just how many imitations of it there are around the world. While in London in 1997, I purchased the excellent book *Mr. Beck's Diagram*, a full history of the development of the Tube Map, and my love affair with the transit diagram began. I personally believe that the Underground Map is one of the greatest pieces of informational graphic design ever, even with all the changes that it has undergone over the years.

These days, with the transit diagram an almost ubiquitous design form, it can be difficult to realize exactly how revolutionary this visual approach was in the 1930s: thick, brightly-colored, starkly angled route lines with geography reduced to the barest elements. The diagram emphasized connections and station



Figure 1. US Interstate diagram



Figure 2. TGV diagram (detail): Île-de-France

sequencing over geographical reality, and helped make visual sense of a vast and chaotic transportation network. Originally only grudgingly released by the London Underground as an experimental pamphlet in 1933, Londoners quickly embraced the Tube Map as their own, and it now stands as an instantly recognizable symbol of their city.

Over the years, I tried my hand at a few transit diagrams myself: redesigning the diagrams of Sydney and my new hometown of Portland, Oregon, but with only limited success. Then, in late 2009, I came across a series of interesting diagrams on the Internet by various authors, all of which showed the US Interstate highway system in diagrammatic form.

Many commenters were calling these “subway-style” maps, but I felt that none of them really captured the

essence of the best transit diagrams: none used different colors for different “lines,” or clearly differentiated “transfer stations,” for example. Taking the London Tube map as my inspiration, I set about designing my own version (Figure 1), using Google Maps and Wikipedia entries as my main sources of information. The first version took me about 80 hours of work in Adobe Illustrator and met with great success, both critically and as posters that I offered for sale. The diagram was also featured in the excellent book *Mapping America: Exploring the Continent*, foreworded by Fritz Kessler and Frank Jacobs. I revised the poster at the beginning of 2011 to correct some inaccuracies and technical errors that I discovered in the first version.

After the enormous success of this first diagram, I started thinking about other networks that I could represent the same way. Part of me definitely enjoyed the slightly subversive nature of the Interstate Diagram: taking a system that is normally depicted with the absolute geographic accuracy of a road map, and showing it instead in the simplified rectilinear form of a transit diagram. It turns our perceptions around; what if this was a transit network instead of roads? Doesn't America look small when it's presented at the apparent scale of a large city, as most transit diagrams represent?



Figure 3. US Interstate diagram (detail)

Most of my work since carries on this theme: *transit network diagrams of things that aren't*. Almost as successful as my Interstate Diagram is my diagram of the Amtrak passenger train network (Figure 4)—reducing an extensive America-wide system down to a simplified diagram. Every Amtrak train route is denoted by a different colored line, and (unlike Amtrak's own geographically accurate map) every station is shown. For me, the interesting things that can be seen from this diagram are the incredible dominance of the Northeast Corridor (routes from Boston to Washington, DC) in terms of service, and the major hub of Chicago's Union Station, where



Figure 4. Amtrak diagram (detail)

trains from across the country meet at one place, every one of them ending their journey there. Expect to change trains at Chicago!

Finally, I revisited the theme of highways as transit diagram with my European International E-Road diagram (Figure 5). Similar to the US Interstate system, the E-Road network criss-crosses Europe and even extends into Asia and parts of the Middle East. Most European nations are signatories to the United Nations resolution that defines the network, but not all of them signpost it. This network actually proved to be far more complex than the Interstate diagram, and it took me two separate attempts to finally nail the design, which I definitely consider one of my best pieces.

*Cameron Booth is a graphic designer with 20 years of experience. These transit maps are his idea of fun after a day of work. You can find more information about these diagrams and more on his blog at: [www.cambooth.net](http://www.cambooth.net)*



Figure 5. European E-Road diagram (detail)



## INTERVIEW

**Tim:** Thanks so much for taking the time to share your experiences with *Cartographic Perspective* readers. Would you mind introducing yourself and giving a thumbnail sketch of your background?

**Patrick:** Growing up in Canada to Swiss parents, I think I was always studying the differences between North America and Europe. Even at the age of 7 or 8, I was a news junkie: watching the news and flipping through our Swiss and Canadian news magazines, observing the design differences. Fast-forward to my university years, and my internships as a technical writer grew to that of a technical illustrator, and I started doing freelance instructional design and illustration for Hewlett-Packard. Instead of mimicking the painstaking detail of typical technical illustrations, I wanted to simplify them. I think Shakespeare said, “Brevity is the soul of wit.” So I took that, and the rules and principles of technical writing theory, audience analysis, and use-case analysis, and applied it to pictures.

I tried to take away the extraneous details. Instead of drawing the detailed computer motherboard, I drew the actions required to repair a very simplified representation of that motherboard. At the same time, I would try to make that representation topographical, showing how that object that belongs in a certain space relative to other objects in their spaces. This was 1993 or so.

**Tim:** Were you designing for the web at that time?

**Patrick:** Some of the companies I worked for were creating publications and putting them online, but not in the way we see now. Things were very static then. It fascinates me that cartography, at that point, was also very much static. The concept of a dynamic map was absolutely lost to us. It was not even predicted to be something of the future. It didn't register on our radar.

**Tim:** What first attracted you to cartography?

**Patrick:** Early on, cartography was open season for me, because, like technical or user manuals, you can judiciously use design and communication to teach people to do something on that landscape. Or, you can choose to give people a sense of what's in that landscape, and let them direct themselves what to do.

It's amazed me that once cartography became dynamic, once maps became something that were embedded in your browser, or in your little mobile device, all of these original rules of user-oriented design



Figure 1. Patrick Hofmann

and communication were now much more naturally being applied. We finally witness the outcomes of brevity and taking away clutter. We see designers making things that are fundamentally elegant and precise, establishing those conceptual rivers of space and flow so that people can actually navigate a map efficiently. The opportunities are incredible. The maps that you see today are just scratching the surface in terms of the depth of information that can be offered, not to mention the amount of information that we should adequately and appropriately take away.

**Tim:** **What's next if we are just scratching the surface?**

Patrick: That excites me, but it's hard to answer. Where I work, we can't physically build every single map tile of every single square meter of planet earth. So, you take a convention or library of conventions, and you say, "OK, given all of these cartographic conventions, how does Madison, Wisconsin look? How does London, England look? Can people navigate from A to B here? Can they search for landmarks or particular categorical searches? Can they find stuff? Are we appropriately adding things to the map when it's reasonable, and are we appropriately taking things away when it's unreasonable? Oddly enough, those questions haven't changed since 1993: I ask them whether I'm designing a technical illustration or an icon for a map.

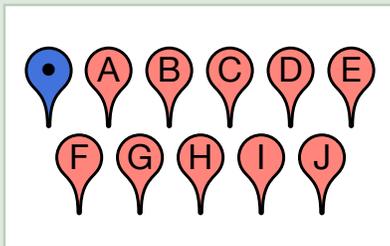


Figure 2. Basic Google markers

**Tim:** **Speaking of conventions, could you speak to how you have developed a single set of icons for mapping the entire world? Were some conventions global and others local? Why?**

Patrick: It basically began as an exercise to make a single universal set of icons; however, we were aware of the risk of some icons being confusing in some contexts. Will 80% of those icons be appropriate and recognizable for 80% of our users 80% of the time? At the beginning of the design process, I was sure that a single universal set would achieve that. I was thinking that we would have to make some localized icons at some point; after all, you want to minimize the number of icons that have to be "learned," and, of course, the number of icons that could be misinterpreted as to offend.

**Tim:** **So, some icons must require more sensitive design than others?**

Patrick: Sure—the places of worship icon is a good example of this. Not every single religion on the planet kneels or prays in the same way. Kneeling is not ipso facto, the thing that often defines what worshipping is. So I felt I had to come up with something unique for a universal icon.

So I thought of motifs that exist across religions, with a particular goal: to find the safest ones. Architectural elements came to mind. Architectural styles have changed, and the building styles of places of

worship have changed somewhat dramatically over the centuries, but they still have an obvious canonical association. So, I collapsed all of the architectural styles that I could find for the top 12 or 13 religions on the planet. The result was something that looks vaguely, but not exclusively, like a church... or a mosque... or a synagogue... or a temple. The averaging of everything created a very obvious symbol, because it paid homage to turrets, or minarets, or steeples. I thought it was quite successful as a single icon.



Figure 3. A sampling from Google icon library

**Tim:** Sure—but are there times when you might want to use a more specific icon?

Patrick: Definitely—and we use these as well. We distinguish between Shinto temples and Christian churches—it gives users a more informative view of the neighborhoods of Tokyo, for example. I designed icons for different types of Buddhism because they vary so much symbolically and really offer an informative texture of the makeup of an area. The result is a map that really educates people. As soon as you see a bunch of “wheel” icons over suburban Bangalore, India, it’s amazing to say, oh, those are all Dharmist Buddhist temples.

That said, we haven’t localized all our categories iconically. I haven’t localized all our restaurants, for example. This place is known for chicken wings. That one for pizza. That one for pasta. That one for soup. It might get too busy.

**Tim:** But then you run the risk of getting comical rather than canonical, right?

Patrick: Yes. That's exactly it—the balance between learnability and usability; canonical versus comical. The pizza slice, for example, looks very odd at by 12x12 pixels on a map. The chicken wing—or just the silhouette chicken—has never made it to Google Maps for a reason. These ideas just don't speak as well as the fork and knife. They might provide an amount of information, but I'm not sure they wouldn't add more busy-ness to the map rather than richness. Another issue would be the great number of restaurants that serve more than one type of cuisine. Whereas places of worship tend to be designated to a particular sect of a religion, restaurants can be a big can of worms.

**Tim: Speaking of restaurant icons, have you seen the user-generated Google Map icons on the Map Icons Collection hosted at <http://code.google.com/p/google-maps-icons/>?**

Patrick: Yes, indeed.

**Tim: What do you think of the icon of a man wearing a sombrero to indicate the location of Mexican restaurant?**

Patrick: I think they've done a really admirable job of creating one big family of icons. Although it's perhaps stereotypical, what's good about the sombrero icon is that it's not literal, but rather symbolic. A taco or burrito at such a small size is too literal and not unique enough. I like it when icons aren't so literal.

**Tim: It's associative.**

Patrick: Yeah, it's just a sombrero.

**Tim: Any tips on how to make an icon better?**

Patrick: In addition to refraining from literal representations, try to make it work as a single object, as a single silhouette. It's often better to bank on the learnability of a simple symbol rather than the immediate intuition of a complicated symbol (which often is done with an overly literal icon).

**Tim: I'm curious to hear what your thoughts are on icons for things that are emotionally charged. In academic cartography the tendency may be to avoid using sensitive icons and instead use a generic point. If it has to be graphically represented, you use something very generic. But I'm wondering what your thoughts are. Would you use an icon for the location of an abduction or rape, of example?**

Patrick: That's the thing—should we really be that specific? Do we need an icon for “rape”? How often are my users going to read a map that's

going to pinpoint these areas? And by pinpointing these areas, will we need to graphically make the distinction between abduction, child abduction, rape, torture, etc.?

With such crime maps or data-influenced maps, there is often going to be a supporting descriptive legend or some other component to which we are going to apply more information. Users will have other ways to get the finer details: the time at which the offence occurred, for example. Because these icons exist on the map to pinpoint location, they don't need to be overthought. There is no problem with using a dot on a map.

**Tim:** **Sure. Do you ever find yourself falling back on simple dots when you're stuck on a design?**

Patrick: Yes. Early in 2011, we were struck by floods in Queensland, Australia and earthquakes in Christchurch, New Zealand, and yet more earthquakes and a disastrous tsunami in Japan. In helping create the disaster maps for these events, I tried hard not to be too literal on everything. I didn't want to end up with a map that was trying to express so much that you couldn't see the forest for the trees.

With the example of Japan, it was really, really important to try and distinguish tsunami-affected areas from radiation-affected and earthquake-ravaged areas. But I wasn't going to go far beyond that. So create a category that talks about the climatic and cataclysmic impact of those three things. But again, don't create radically complex icons that represent the different levels of severity of radiation. It's good to use the same radiation icon and put a number next to it, or to change the size of the icon, but not create a different series of uniquely different radiation icons.

What I did for the earthquakes (and even other disasters) was similar. I created epicenters that looked like targets. The idea of the target is a very impactful one. It's one that we are familiar with from our formative years, from the age of three or four. We use it as a target, like pinning a tail on a donkey, when we're playing video games, and things like that. So the target is to me one of the most simple, and iconic, and easily recognizable things.

**Tim:** **I am always impressed, whether in Madison, Wisconsin or New York, New York, by how much information is on Google Maps. The addition of 3D buildings is impressive in Google Maps for mobile...**

Patrick: Did you find it helpful?

**Tim:** **I did use it once to determine the name of a building while looking across Manhattan at a unique roof. My memory failed me, but**

**Google Maps had the answer. So in that way, the 3D was helpful. But as a default reference, it may be distracting.**

Patrick: That's one of the biggest challenges for any mapmaker: finding the happy balance between attention and distraction. When a label appears versus not appearing is actually a very important one as well. Because we have so many other information types, neighborhood names, suburb names, street labels, street names, and these landmark icons to deal with.

So my engineering colleagues judiciously and constantly tweak these priority formulas, trying to see how we best show the right information at the right time. And on Android and on Google Maps in WebGL, you'll notice the difference—the labels actually appear quite dynamically. The map is no longer static at any zoom level.

**Tim: Do you ever get oddball feedback on your icons?**

Patrick: No, to be honest, I'm always expecting a ton, always expecting a deluge of feedback, especially on the religious icons, especially on just naturally misused icons. For example, stadiums in Canada that have been identified as baseball stadiums when they're actually hockey arenas.

But that's because the data classifications of certain buildings and areas may be poor, and we're continuously trying to fix that.

I think the effort to achieve absolute currency and absolute accuracy is a challenging one, because the city, the land, the earth, is always changing. Places plotted by publishers of maps change right after the maps are published. A new map is history a moment ago. As mapmakers, are we in a design industry, a design into science, where we have opportunity to make mistakes and be forgiven for them?

**Tim: Sometimes you're blamed though, right? I feel like this is also an era where users are too trusting. Could they follow your map and make mistakes?**

Patrick: That was the interesting point of our crisis maps during the earthquakes and floods, by the way—knowing that these state and governmental organizations were relying on our maps to send emergency vehicles out to various locations. They wanted the maps published as quickly as possible. The rapid timing was astonishing.

But again, we do provide that information with the very clear caveat that it is updated every so often and it is important to contact your authorities if you plan on driving through such a catastrophe. During an emergency, people need to know that—yes, we want to help people, but we don't want to inadvertently misguide them.

**Tim:** One last question—what is your favorite part of your job?

**Patrick:** That's a real tough one. I have to say, I enjoy the icon design. Map design is fun, but it's significantly more massive in terms of its information breadth and depth, conventions, stakeholders, engineers, testing and so on.

I think my favorite part in one word is the “variety.” My job isn't just icon design. It isn't just cartographic design. It involves just pure user experience design. Like, how are people going to use the map to find more information about a place? What brings them to it? What takes them out of it? How are they going to make comments about that place? How are they going to share that place? My job touches on so many different design disciplines and information disciplines. For me, that's the best part of it all.

**Tim:** Great. Well, thank you again, Patrick! We look forward to seeing what's next for you and Google Maps.

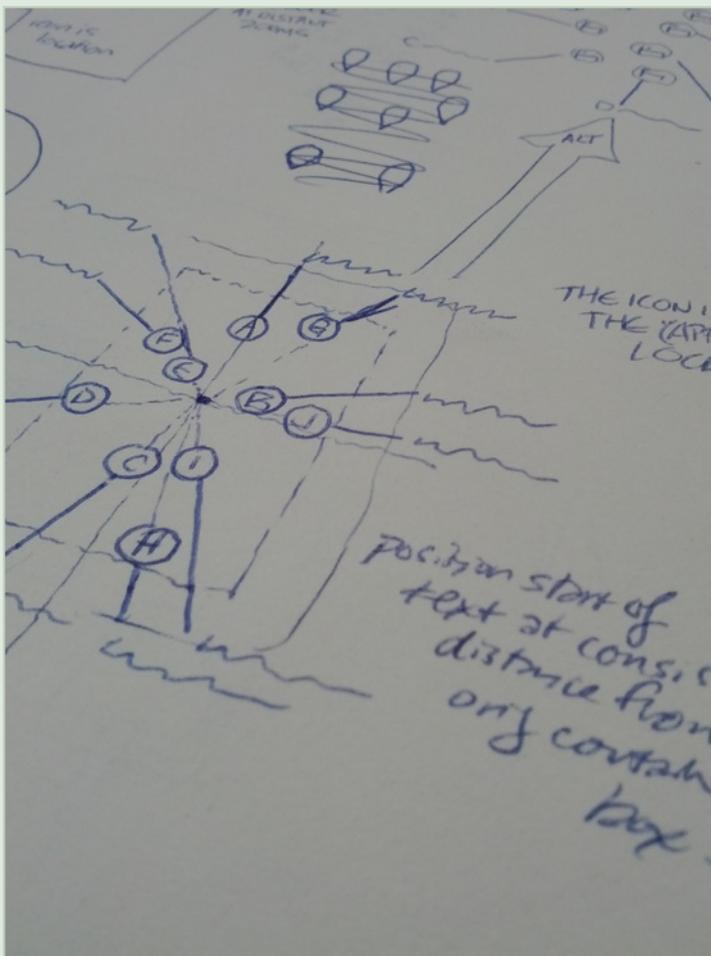


Figure 4. Sketches



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Name of author(s). Year. *Title in Italics*. City of Publication: Publisher Name.

MacEachren, A. M. 1995. *How Maps Work*. New York: Guilford Press.

A. H. Robinson, J. L. Morrison, P. C. Muehrcke, A. J. Kimerling, and S. C. Guptill. 1995. *Elements of Cartography, 6<sup>th</sup> Edition*. New York: John Wiley & Sons.

**Articles in Periodicals:** Author's or authors' names as in *Books*, above. Year. "Title of Article." *Title of Periodical*, volume number, page numbers [follow punctuation and spacing shown in the following example].

Peterson, M. 2008. "Choropleth Google Maps." *Cartographic Perspectives* 60:80–83.

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Bassett, T. J. 1998. "Indigenous Mapmaking in Intertropical Africa." *The History of Cartography. Vol. 2, Book 3: Cartography in the Traditional African, American, Arctic, Australian, and Pacific Societies*, edited by David Woodward and G. Malcolm Lewis, [page #]. Chicago and London: University of Chicago Press.

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Cartography Associates. 2009. "David Rumsey Donates 150,000 Maps to Stanford University." David Rumsey Map Collection. Accessed January 3, 2011. <http://www.davidrumsey.com/blog/2009/8/29/david-rumsey-donates-150-000-maps-to-stanford>.

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