MAPPING TEXT

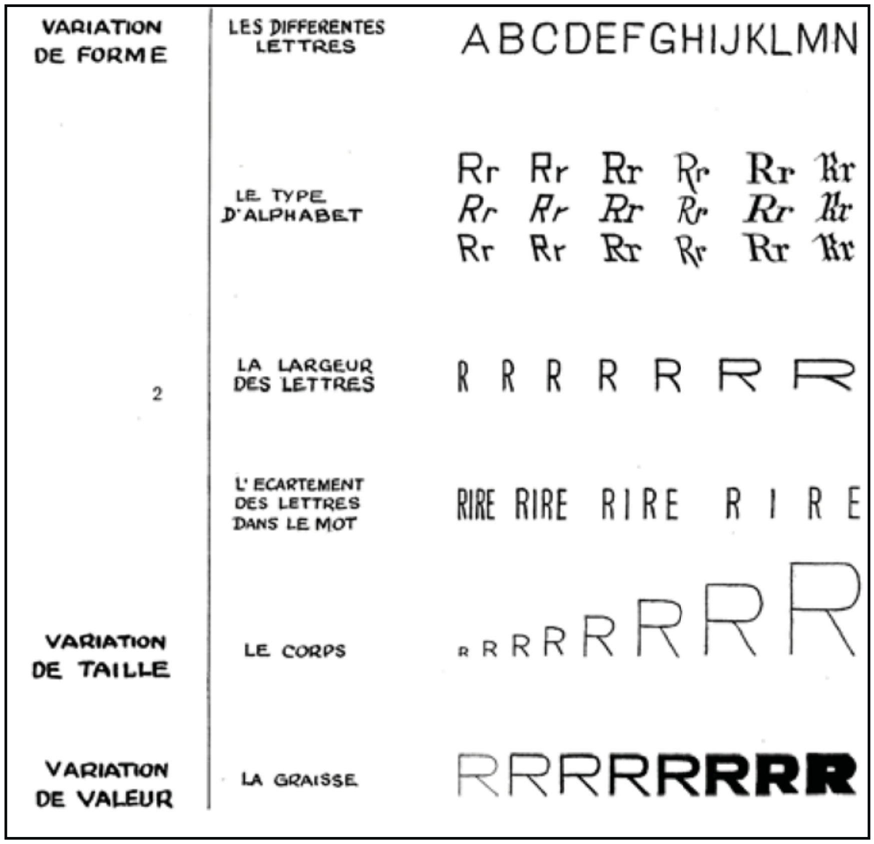
by André Skupin

"The best-drawn map may have its appearance ruined by the poor skill or bad taste displayed in the lettering."
- J. B. Johnson (1885)[1]

What is a map? And what is a *good* map? Either question can be surprisingly difficult to answer, but in making the attempt one eventually must confront the role of one frequently overlooked element: written text appearing in maps. This has traditionally been referred to as "map lettering" or these days more commonly as "map labeling." An otherwise perhaps map-like graphic artifact that is completely void of lettering – like a raw aerial photograph – could hardly be called a map. In making that judgment, consider what constitutes the overriding characteristic of maps in terms of how they function. It is abstraction!

Maps do not aim to faithfully represent the reality of geographic space or of other spaces for that matter, and they dare not try, since, from a technical perspective, it would simply be impossible to even capture all of spatial reality, in all its intricate detail. Instead, maps – good ones at least – are a carefully-calibrated orchestration of what the map-maker considers relevant and important in consideration of the purposes laid out by whoever pays the bill. Maps lie and cheat, they add and subtract, they expand and contract, they transform and disfigure. Toward that end, one typically begins by conceptualizing reality as populated by points, lines, and areas, followed by the attachment of descriptive attributes to such entities, and finally their expression as graphic symbols. In doing so, map-makers can follow well over a century of cartographic science, including Jacques Bertin's influential *Semiology of Graphics*.[2] The point-line-area model is compelling indeed, as it retains some connection to geometries that can actually be observed on the ground or from the air. Switching back and forth between Google's Map and Satellite views nicely illustrates that.

The story is quite different for text. The text written on a map is not physically imprinted on the landscape; it is much further removed from what it depicts, through multiple levels of abstraction. Eliminate those texts and it becomes harder to even call what you are looking at



(Figure 1). *Semiotic variables of form, size, and value, as applied to text (Bertin 1998, p. 415).*

a map. In fact, maps without text deserve a special name; from "blank map" to the more expressive German term "stumme Karte" (mute map), they serve almost exclusively didactic purposes. It is not surprising then that cartographers have long characterized writing in maps as anything from "an integral part of the map"[3] to "a necessary evil,"[4] but necessary nonetheless.

When placing labels inside a map, decisions have to be made regarding three key issues: ***text content***, ***text design***, and ***text placement***. Text content refers to choosing which objects are to be expressed in text form, followed by a definition of the actual string of characters to be used. Text design involves making choices among such text variables as font type, spacing, size and color (Figure 1). The semiotic principles publicized by Bertin clearly apply here as well, specifically his prescriptions for expressing data variables through visual variation: for example, that the visual variable *size* is best used to denote quantitative differences, while *hue* is better suited to express qualitative attributes.

If ***quantitative*** differences are to be expressed via text – such as the names of cities distinguished according to their population – then manipulating font *size* is the most effective method. Changes in *color value* (like the difference between a light, medium, or dark red font color) are to a certain extent useful as well, but require fairly large font size and a limited number of variations in order to be easily recognizable. *Saturation* and *texture density* can meanwhile safely be ignored as possible variables when using realistic font sizes.

RESEARCHERS HAVE...RANKED LOCATION/ POSITION ABOVE ALL OTHER VISUAL VARIABLES

Qualitative differences among map entities can be expressed as well, most notably through variations in font *shape* and *color hue*. The former is exemplified by the use of multiple font types in a single map, such as Arial and Times. One typically has to be cautious though when mixing fonts from different font families with each other, such as serif and sans serif fonts, as this can easily disturb the overall aesthetic of the map.

Interestingly, text affords special means for expressing binary differences. Sometimes these differences can be purely qualitative, such as when they're used to distinguish between land features and water features. This is one case where a distinction of roman and italic font styles is both useful and subtle. At other times, certain features are meant to be explicitly set apart from others, such as when the names of capital cities are capitalized – which seems fitting enough – or expressed in bold text, while other cities are not. This typically binary use of boldness might be more a reflection of what has been actually available in the text design portions of common software packages, as compared to the possibilities pointed to by Bertin (Figure 1).

So far, this paper has managed to ignore the semiotic variable that is by far the most powerful in a perceptual and cognitive sense: location. Humans have evolved to be very good at spotting patterns based on location. Accordingly, location is featured prominently within Gestalt psychology, where it drives such organizing principles as proximity, symmetry, connectedness, or closure. Researchers have also consistently ranked location/position above all other visual variables, when it comes to the ability to convey patterns inherent in the data. For example, note how easy it is to detect linear relationships, clustering, and outliers from a simple scatter plot.

The problem with using it *actively* as a manipulable semiotic variable in geographic mapping is that location itself – and such related concepts as proximity, connectivity, or flow – tends to be the very *subject* that we are trying to understand via maps. If spatial patterns are what we are studying, then we will want to be cautious about introducing our own patterns *just* for purposes of visualization. Location is in fact something to which cartographers extend a great reverence. When preprocessing our chosen point, line, or area geometries and then attaching symbols to them, cartographers tend to be quite conscientious about preserving locational information as much as the map's scale, purpose, density and distribution of geographic objects allow. The very concepts of point, line, and area are a reflection of the attempt to generate a computable representation that is aligned with a cognitively meaningful categorization of real-world entities.

Here, though, is the problem: while we can adapt our conceptualization of entities to fit a particular situation – such as cities being represented alternatively as points or areas–the fundamental nature of text itself is dictated to us and unchanged, no matter whether it is attached

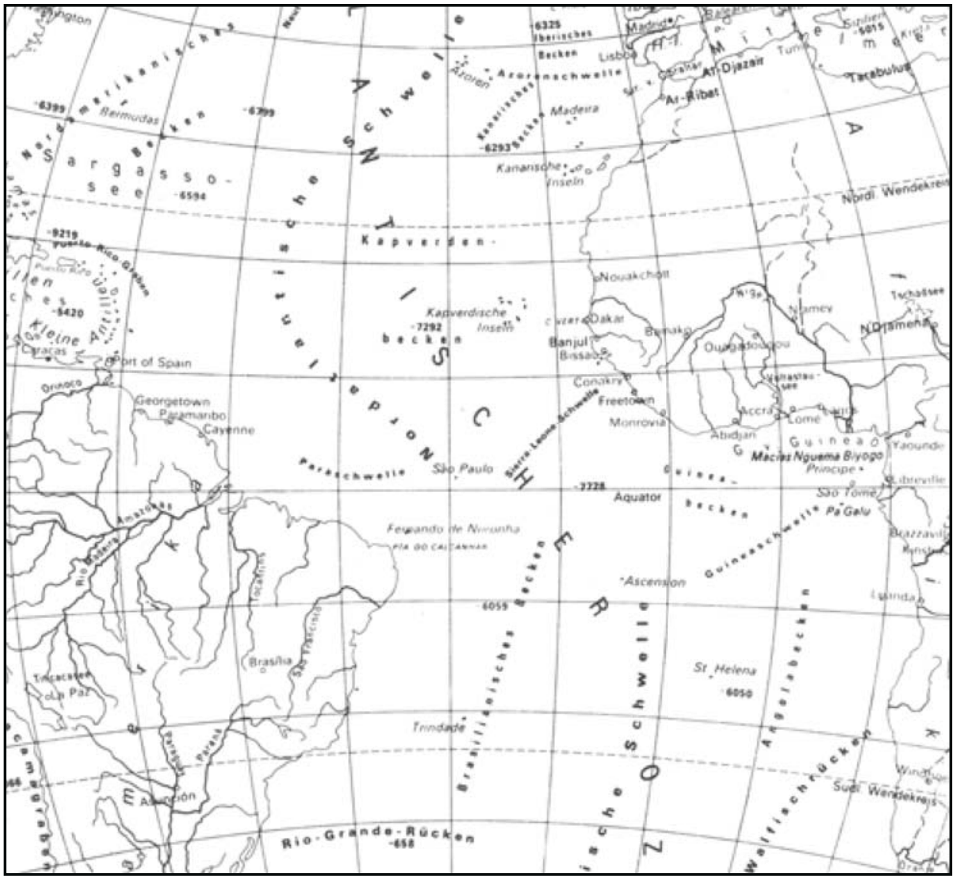
THE LABELING OF THE ATLANTIC... SWINGS HANDSOMELY ACROSS THE FULL HEIGHT OF THE MAP

to a point, line, or area object. Text is always linear in terms of its original representation, with its length being just a direct function of the number of characters (or syllables or whatever other building blocks a written language is composed of). That length itself has no inherent meaning (e.g., *Chile* versus *Argentina*). In terms of its visual appearance, a given text element will always occupy an elongated area, whose height depends on font size. The difficult question in label placement is where to place this text area such that it maintains clear association with its respective map object and avoids conflict with other map content, including other text areas.[5] Label placement for area objects is relatively simple, since they are conceptually well-matched with the respective two-dimensional text areas, as long as area objects are large enough and not shaped too irregularly. Line labeling is likewise fairly straightforward, given the linear nature of text. However, placement of labels for point objects is inherently far more complicated, since point objects are conceptualized as being zero-dimensional, with no height or width, and even their symbols have a very small footprint on the map. By comparison, text labels for points are quite large and cannot be located at the same spot occupied by the objects (and symbols) they are referencing. Conflicts with other symbols and labels are thus inevitable, and solving this is a difficult combinatorial problem that has received significant attention from the cartographic and computer science community. All this doesn't even address the fact that in real-world applications, the label position has to be coordinated not only within a single map layer (e.g., the label expressing the name of a country should be clearly associated with the respective area symbol for the country, typically inside of it), but across multiple layers (e.g., country names should not interfere with other symbols and labels for cities, highways, and rivers).

Quality map label placement has simultaneously been an issue of such difficulty *and* importance that it has come to rely on a small number of niche software solutions, such as ESRI Maplex, MapText Label-EZ, and MAPublisher LabelPro. These typically provide a staggering list of labeling controls for both individual feature classes (e.g., roads) as well as coordination across multiple classes (e.g., assigning priority to road labels vis-à-vis other classes).

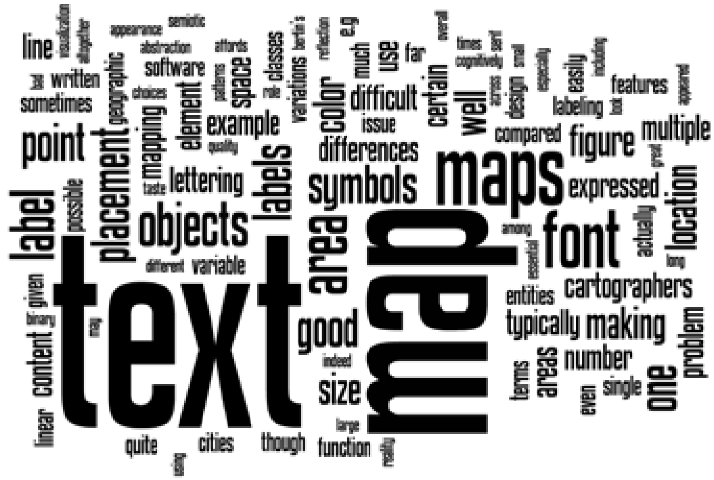
With label placement being such a well-known problem, it sometimes leads to a certain myopia and lack of imagination when it comes to the full potential of using text within maps. For example, label text can sometimes altogether replace an object's symbol, especially for linear objects and elongated area objects. This can lead to remarkable solutions that are both space-efficient and visually elegant. For example, notice in Figure 2 how the labeling of the Atlantic Ocean (*Atlantischer Ozean*, with only the central portion shown here) swings handsomely across the full height of the map from the North Atlantic to the South Atlantic, while overlapping – but not overprinting – labels for various other oceanic features.

In contrast to serving as the *identifier of an object*, a label could instead be used to convey the essential *character of a region*. In that scenario, labels can be an alternative to traditional methods for symbolizing area attributes (Figure 3). This can be quite efficient, even altogether eliminating the need for a map legend.



(Figure 2, above) *Portion of a map of the Atlantic Ocean with extensive labeling of geographic features.*[6]

(Figure 3, below) *Use of text as indicator of geographic distribution of grain production in Austria. Weizen=wheat, Roggen=rye, Hafer=oats, Gerste=barley, Mais=corn.*[7]



(Figure 4, above). *Two Wordle visualizations of the content of this paper. Note the use of the semiotic variables size, orientation, and location, with the latter two only serving a space-filling function.*

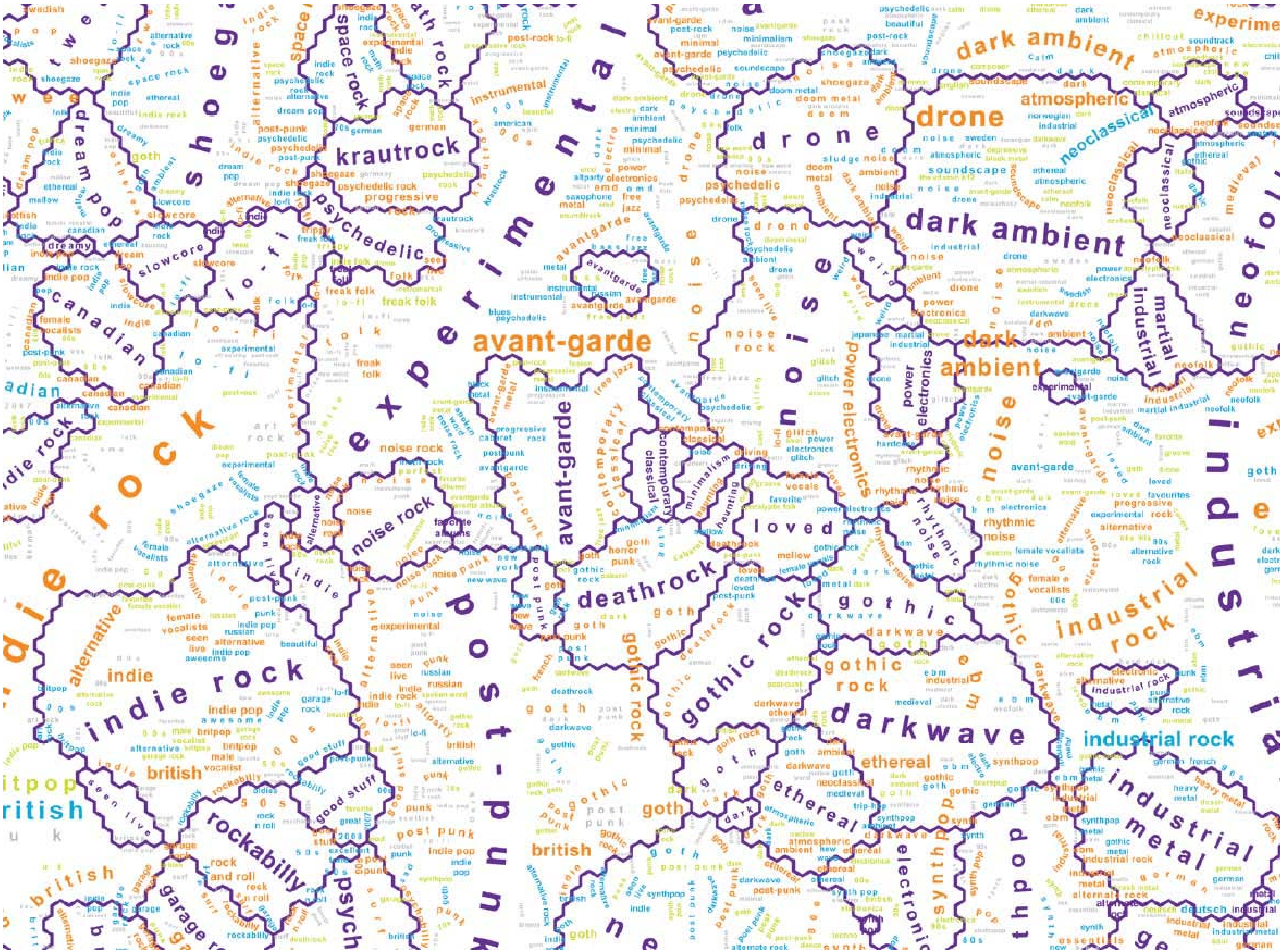
(Figure 5, right page, to be viewed at 90 degrees counter-clockwise). *Use of dedicated GIS software for automatic placement of several thousand labels in a visualization based on the music folksonomy of last.fm (courtesy of Biberstine, Börner, Duhon, Hardy, and Skupin).*

Today, true advances in the use of text in mapping depend on a simultaneous consideration of the look and possible function of text, informed by the role of *space* in cognition and visualization. This can lead to improved use of text in cartographic maps, and also to interesting new mappings derived *from* text data. Unfortunately, we find plenty of examples where the role of space as organizing principle and the power of location as semiotic variable are ignored or abused. Keep in mind that, to the human observer faced with a display, distance matters, connectivity matters, clustering matters, and even gaps matter, as they all are involved in giving meaning to space.

Wordles (http://www.wordle.net) are a particularly compelling example for text mapping going astray. Like some other popular techniques, notably treemaps, Wordles are driven by a single-minded fetish for *filling* space, at the cost of using space in a cognitively defendable manner. To illustrate this, the text of the current article was turned into two different Wordle visualizations (Figure 4). Note how the semiotic variable ***size*** is correctly and consistently used in both outputs. Meanwhile, the variables ***location*** and ***orientation*** have not been imbued with any meaning at all, apart from being manipulated in random fashion in the interest of filling the display space.

For a very different approach to text mapping, consider the visualization derived from the last.fm music folksonomy seen in Figure 5. Here, more than one million user-tagged items were mapped in two dimensions according to the similarity of tag texts. The resulting model is represented in five layers, beginning with the top-dominant term in each map region, followed by the second-most dominant term, and so forth. This is an example for a mapping of text that takes the power of space seriously – including use of a supercomputer to project extremely high-dimensional text data into two dimensions – and connects with traditions passed down by generations of cartographers,[5] via a labeling solution computed for almost 40,000 area objects using Maplex software.

Finally, it is worth mentioning that text is one of the most revealing elements of visualization, laying bare much of the historical, social, and technological context of its creation. This is illustrated in Figure 6 for a portion of Southern Africa, as depicted in multiple editions of *Goode's School/World Atlas* between 1932 and 2009. Notice how stable the depiction of the physical environment is, with visible changes mostly due to technological advances (e.g., from 1932 to 1960 and 2005 to 2009). It is only the lettering that reveals the colonial and post-colonial changes occurring in


indie rock
experimental
avant-garde
noise
drone
dark ambient
shoegaze
dream pop
psychedelic
krautrock
lo-fi
canadian
deathrock
gothic rock
darkwave
ethereal
industrial
industrial rock
industrial metal
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neoclassical
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neofolk
post-punk
rockabilly
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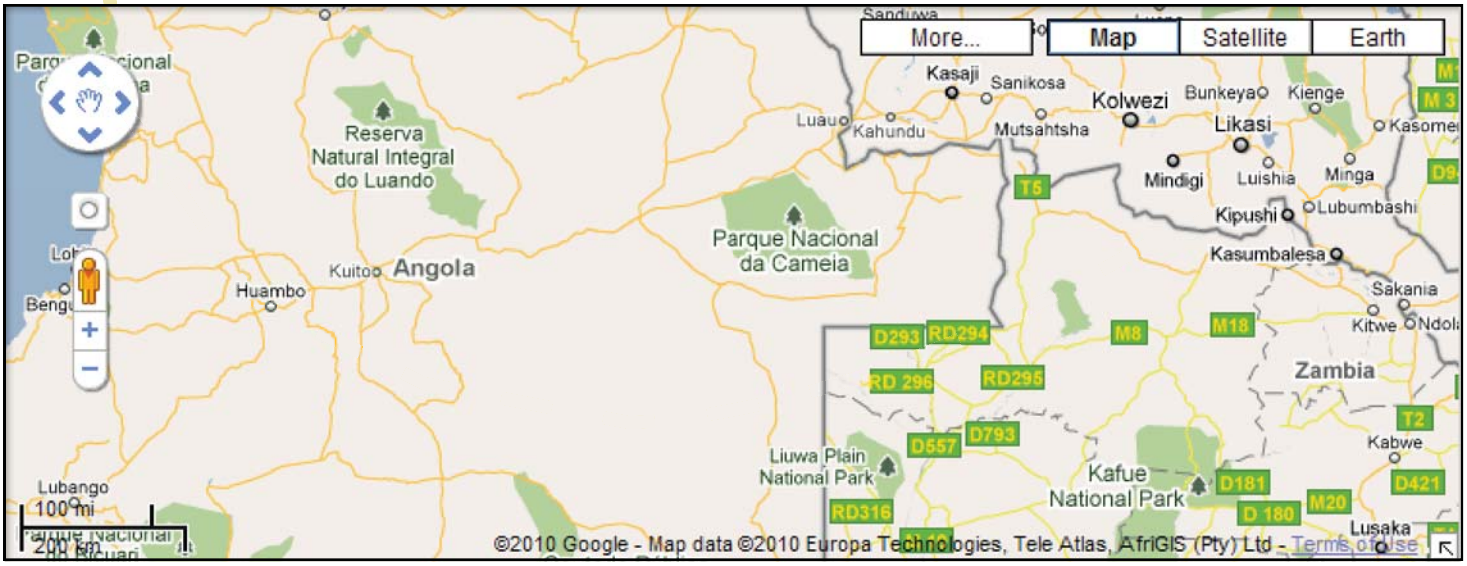
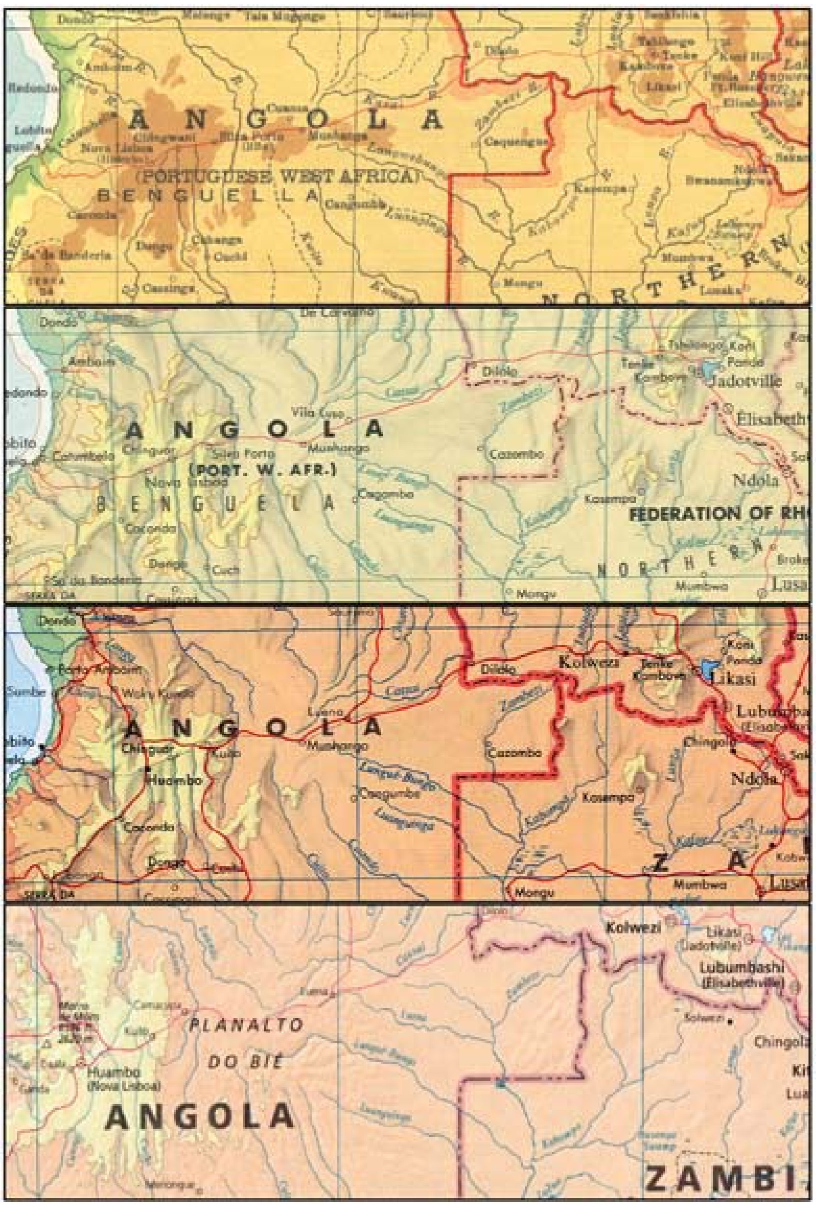
britpop
noise rock
power electronics
loved
space rock





1932

1960

2005

2009

(Figure 6, left). *Depiction of a portion of Southern Africa during the evolution of one atlas product. Shown are Goode's School Atlas' 4th ed. (1932), 11th ed. (1960), 21st ed. (2005), and 22nd ed. (2009). Scale 1:16mio, except 2009: 1:12mio.[8] Images courtesy of Rand McNally & Company.*

(Figure 7, above). *Depiction of a portion of Southern Africa in Google Maps.*

this geographic region. For example, in 1925 the Portuguese colonial powers changed the name of the Angolan settlement of Huambo to Nova Lisboa. The 1932 edition reflects this change by using Nova Lisboa as primary label and Huambo as secondary label. By 1960, 35 years after the name change, Nova Lisboa appears as the sole label. Newly independent Angola renamed the town back to Huambo and this is correctly reflected in the 2005 atlas edition. Then, in the 2009 edition, something odd happens, with Nova Lisboa reappearing as secondary label. This, however, has nothing to do with any actual changes on the ground. Instead, one has to know that 2009 marks the first edition of the atlas to be largely produced using GIS (geographic information systems) software and digital geographic databases. Changes include a larger map scale; though, contrary to intuition, there are overall *less* settlements depicted in this geographic region. Another change is the use of a digital gazetteer that apparently includes Nova Lisboa as a secondary name for Huambo, and also indicates Jadotville as a secondary name for Likasi. There are no reasons to ascribe any sinister motives to these name interchanges, as even the U.S. Board on Geographic Names (BGN) does in fact list Nova Lisboa as a "variant" of Huambo. However, the fact remains that in this atlas product some colonial place names give a repeat performance several decades after their on-the-ground and on-the-map disappearance. The main question here is not whether these colonial names should reappear – since it might be useful to include such historical context – but whether this was based on thoughtful deliberation on a case-by-case basis, weighing the geographic facts as it were, or whether label content was blindly fed from a digital database.

Uncritical reliance of map creators on the wisdom of digital geographic databases is a worrying trend that is only made worse when heterogeneous data sources are blindly mashed up. Google Maps provides fine examples for the dangers of the latter approach. Note the heterogeneity of labels in Google Maps' depiction of the same region in southern Africa (Figure 7). According to this map, Angola is virtually void of any settlements and only Zambia uses a numerical system of road naming.

Sure, Google Maps is interactive, comes with an API (application programming interface), and – here comes the all-powerful argument – it is free to use. However, cartography is about much more than putting data on a map that one happens to have available, and it is also certainly about more than creating something that is *good enough*.

A map is supposed to be an organic whole, a carefully orchestrated arrangement of geographic data, blending cartographic tradition with the creative imagination of the mapmaker. The result is a product that can be very useful *and* that can impart lasting esthetic value. Choosing the content, design, and placement of text is a crucial element of that process, whether one is creating a printed map or a highly interactive visualization system. Wordles, despite their shortcomings, have demonstrated the genuine excitement that purposeful semiotic manipulation of text can generate. Let's build on that, as we design artifacts that incorporate text in a manner that prevents grumpy cartographers from having to decry "the poor skill or bad taste displayed in the lettering."

ENDNOTES

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