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MAP TYPOLOGIES: 20TH CENTURY USAGE REVISITED

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ABSTRACT

The ways in which maps were categorized evolved in interesting ways in the 20th century. A major typology was the reference/thematic dichotomy. The term thematic map came into use in mid-century, although the distinction between reference maps and the maps eventually labeled thematic had been made decades earlier. The question of whether it was the maps, their manner of use, or the mental processes employed was a matter of some discussion. Within these two divisions, subcategories had labels. Thematic were divided into subcategories such as choropleth, dasymetric, isarithmic, and dot maps, categories that were conceived of in varying ways. Some were relabeled, not always with terms that were lasting. Distinctions blurred between others. By the end of the century, geographic information systems that took a procedural approach to constructing maps were devoid of some of the traditional category labels, though the literature of the maps themselves was not. There was also criticism of terms like reference and thematic as meaningless labels, with maps conceived of as social constructs creating reality rather than representing it. Some typologies have probably outlived their usefulness. Others are developing and are likely to be useful temporarily as well.

(This paper is inspired by, and is an expansion of, a short piece on map typologies written for the 20th Century Volume of History of Cartography, founding editors David Woodward and Brian Harley.)

Typologies consist of categories of phenomena that share common characteristics. Map typologies are based on various criteria including content, data measurement, physical or conceptual form of the distributions mapped, and the form of the symbols on the map. Ideal typologies include all instances of a phenomenon (they are exhaustive) and categories that are mutually exclusive (no individual example belongs in more than one category). Maps, however, are notoriously difficult to categorize and we find some maps straddling categories in a typology or fitting no category. Yet, typologies have facilitated communication about maps and it is difficult to imagine teaching a class, conversing with a fellow cartographer or map reader, or writing about maps without using terms for categories of them. On the other hand, typologies also channel thinking, and looking their definitions and the uses of typology vocabulary can potentially clarify our intellectual history and perhaps even facilitate clearer thinking in the present or future.

Cartographers in the 20th century most commonly dichotomized maps into “reference” and “thematic.” Reference maps, often called “general reference,” include, most universally, such maps as topographic, place-name wall maps, and general atlas maps. Their description may include terms and phrases such as multi-purpose, showing a variety of phenomena, and showing locations of specific features. Thematic maps are exemplified by population, resource, and crop maps and have been described with phrases such as special-purpose, showing a distribution, or showing form. The term “thematic” was not coined until the 1950s (Creutzburg 1953, Fabrikant 2003), even though they had undergone considerable development in the 19th and early 20th century and had roots well before that (Robinson 1982). Descriptions of both categories presented problems, given that some distributional information is present to some degree in all maps and likewise with locational information. The user of an atlas map may see patterns of mountains or of major cities; the user of a population map may be observing which political units border one another. Interestingly enough, the nature of the difference between the two categories, and the problem of what information is obtained from which maps, was a thread in the Nature of Maps (Robinson and Petchenik 1976), and the authors argue that the differences are cognitive rather than inherent in the maps themselves.

A further problem is that some maps defy classification in the reference/thematic dichotomy. Navigation maps, for example, have a very special purpose, yet they show the locations of a variety of features. And inventory maps show exact locations of all instances of a phenomenon. The quintessential overlay maps associated with geographical information systems showing, say, the suitable places for locating a land fill, seem to be a class of their own; there is a theme involved, suitability, yet the map is showing very specific locations. Definitions of general reference and thematic that left gaps and led to overlap of specific uses set the stage for development of task classifications, i.e., the categorization of what users do with maps. One task typology might begin with perception and move on to the more cognitive processes of identification of symbols, location of specific items, recognition of distributional qualities such as trends or general areas

of common values, and hypothesizing about or recognizing relationships suggested by or portrayed in the map (Board 1984, Olson, 1976). Such task categories, however, do not remove the inherent categorizability of maps, or at least our seeming need to do so in the 20th century, and our need for words like reference and thematic. I would argue, at the risk of yet another flawed set of definitions, that if we accept that definitions describe a core of items and that there will be some instances in gray areas, we can make a viable distinction. Reference maps are those that show specific location of a variety of features but are selective of instances of a feature shown. Common usage of the map is to find the location of specific features relative to other specific features. Thematic maps include virtually all instances of selected phenomena but the individual instances are agglomerated. Common usage of the map is to see pattern or structure.

There are interesting variations in vocabulary and definitions for these major categories of maps. Keates (1989 p204) preferred to call thematic maps "special-subject maps." He argued that "thematic" sometimes included "special-purpose" maps that accommodate user needs (presumably such as tactile maps, which accommodate users with visual impairments). His preferred term focused specifically on content. This is a different approach than writers such as Muehrcke (1978 p80) who explicitly defined them as "special-purpose" (perhaps including those based on user needs and perhaps not) and defining reference maps as those serving "primarily a geographical dictionary function".

Kraak and Ormeling (1996 p44) divide maps into two major categories but choose topographic and thematic, with topographic supplyng "a general image of the earth's surface: roads, rivers, buildings, often the nature of the vegetation, the relief and the names of the various mapped objects" whereas thematic "represent the distribution of one particular phenomenon." They add, "A thematic map would…emerge if one aspect of the topographic map (such as motorways or windmills) is highlighted, so that the other categories of data on the map are perceived as ground."

There are further breakdowns of these major categories, and the names of subcategories are especially widely used in thematic mapping. We commonly encounter terms for groups of maps including dot, graduated symbol, flow, choropleth, dasymetric, cartogram, and isarithmic (isometric and isopleth). The descriptions of these groups of maps involve data types (commonly classified into ratio, interval, ordinal, and nominal, but later in the century more commonly into just two categories: qualitative and quantitative), the form of the phenomenon as conceived by the mapmaker or as inherent in the collected data (stepped, smooth, combination), and symbol form (points, lines, areas, and on rare occasions volume [physical models] or apparent volume [stereomaps]). Many sub-categories exist within the general category of thematic maps and each new innovative depiction potentially introduces another. Sometimes definitions or general practices have led to proliferation of categories and a case in point is the choropleth map, which many have argued should show data that are standardized by area—population density, for example, rather than population counts. Yet there are numerous instances when counts are more relevant; crime rates in urban areas would be highly distorted by low populations in business districts, and assigning children to schools requires numbers, not densities. Also, a tax rate is actually tied to an areal unit and cannot be standardized to a density or similar concept. Maps such as those of tax rates were once referred to as "areal extent" rather than choropleth, but that use of the term has largely disappeared. We may see a map of "the areal extent of an oil field" or "of the corn belt," but the term is not used to categorize maps on which values actually change at boundaries of data collection units.

Using computers to produce maps has led to some distinctive conceptual changes that have affected map typologies. Terms were proposed by Howard Fisher, the originator of the first general mapping program, SYMAP, and they appear in the book that was published much later (Fisher 1982). He based his definitions on the forms of the maps, and in effect on the computer algorithm that would produce it, with no reference to the nature of the data (densities, raw; qualitative, quantitative). Any map showing values by shading in areal units was a "conformant map." Any map depicting a surface using lines of equal value was called a "contour map," a term that most previous writers applied only to maps of land elevation, even though the origins of the word and its general use to mean "curvature" would suggest Fisher's more universal application to isoline maps. He also used "spot," "band," and "field" to label what is more generally called point, line, and area symbols. Although his terms did not come into universal use, the reference to form was in line with changing usage of more traditional terms; "choropleth," for example, has (in usage if not in formal definition) more or less come to mean any map showing data by enumeration units.

Another example of change, in point of view though not in vocabulary, was the melding of dot mapping and dasymetric mapping when computers became viable tools for sophisticated dot map production. The methods by which dots had been placed on maps had probably always been essentially similar to

dasymetric methods, but dots represented counts and, furthermore, placement had been "influenced" by knowledge of variations within enumeration units, rather than determined by calculation. Dasymetric data were generally densities or other values that depended on area (sq. mi, sq. km, hectares,…), and, at least in theory, new values were calculated for subparts of enumeration units. When Wendel Beckwith developed a computer program for the Census Bureau to produce dot maps, numbers of dots had to be calculated and it dasymetric methods were explicitly employed (Beckwith 1978).

As geographic information systems developed in the latter half of the 20th century, the use of terms for types of maps was largely abandoned within some of the major software. The user of ESRI products could very easily produce choropleth maps, yet there was no use of the term choropleth within the software. The change in vocabulary usage reflects in part a lack of canon among the wide range of players in the development of such systems, and it is in part a reflection of shortcomings in the vocabulary and classifications themselves, especially the difficulty in placing maps into unique categories. Most of all, however, it reflects a procedural approach to constructing maps and, in that sense, echoes Fisher's efforts. A computer fills an area with color, for example, in essentially the same way whether it is a triangle, circle, political unit, area between two isarithms, or the region with all the characteristics desired for the location of a new shopping center. And it makes no difference to the computer what the data are if asked to categorize, compare to a particular value, or divide one set by another. There is nothing inherently unique about the procedures used in creating a choropleth map; the procedures can be combined with other procedures in various ways to produce other types of maps, even though when talking about using a geographic information system for producing a product, map categorizations are still commonly used. And although procedures have labels (draw lines, fill,…), they are so implicit in a GIS system that most are just assumed upon selection of the data set (adding the U.S. county data set to a map in ArcGIS causes the boundary lines to draw and fill). In fact, the whole conceptualization of geographic information systems is based on layers, not the internal procedures. Kraak and Ormeling (1996) sum up well when they say "In a digital environment the differentiation between topographic maps and thematic maps is less relevant, as both map types consist of a number of layers…" They go on to say that much of the difference between the two types of maps is in the design, with relatively equally-weighted items on topographic maps, whereas graphic emphasis can turn the map into a thematic one.

Interestingly enough, one of a dichotomies mentioned by Henry Gannett in the late 19th century was topographic maps (Gannett 1892, p101). The other category was the small-scale "geographic map." He begins "We read of topographic maps and of geographic maps" and goes on to say they contain the same sorts of features but "The distinctions…are merely those of scale and of the area represented." Further "Mother maps are those [topographic maps] made from original sources of information" whereas other topographic maps are compiled.

Another view of map categorization is expressed by Denis Wood (1992), who emphasizes the realities created by maps (there is no school district boundary on the earth's surface nor many of the other features on maps) and their index function as documents more often creating than reflecting such phenomena of living as ownership, power, where children will go to school, to whom one will pay taxes, and on and on. His indictment of the thematic/reference categorization as he talks about the nature of maps and their function to connect us to "living," the trend away from such categorizations in the technical world of geographical information systems with its layers of information, the end of the Robinson (1953,…1995) text as the unifying force in classrooms, and the problems the thematic/reference typology of maps has been plagued with for decades may be the perfect storm for its demise. It was an influential distinction in the 20th century when some maps were rooted in engineering and surveying, others in fields of study like geography and sociology, and when the production of the maps was in different places. But everyone shares the same layers of data and even the software today.

On the other hand, in the late 20th century map typologies did not disappear. They expanded as animation and interactive mapping became increasingly used. The terms "static," "animated," and "interactive" are categories that overlap with other typologies, as the maps that are changing or with which the user is interacting fit also into other categories. But the newly developed media suggest categories within themselves (Lobben, 2003) that are likely to prove useful—for a while.

The vocabulary of traditional typologies continues in use in classrooms and writing, though gaps and inconsistencies also continue, and some of the distinctions are less and less useful. Meanwhile, new typologies become relevant as cartography develops within a changing technological and intellectual milieu. New categorizations are likely to be useful, if only temporarily (to wit, "computer maps" of the 1970s). Dialogue on typology vocabulary and usage clarifies not just history but current, and potentially future, thinking about maps.

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