The Changing Look of Maps within Geography Journals

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Abstract. Geographers often point to maps as basic expressions of the spatial relationships and patterns they study. Yet, the manual generation of a thematic map represents a considerable investment in time and various technical graphic arts skills are required to produce a presentable copy. Such training became part of many geography programs and, during the last century, they devoted considerable time and resources to studying the making and nature of maps. More recently, computers and software have greatly speeded and simplified map generation and they have made possible high quality graphic production. Geographers now are able to spend more time focusing on the analysis of a spatial problem and less on the generation of the map to express it. Within geography departments, interest in traditional cartography also has declined and new courses in geographic information science and in geovisualization have replaced them. One way to assess the impact of the changes in maps produced by geographers is to examine the maps that were published in past decades to those now being published. In this paper we look at the state of cartography as seen through the types, frequency, and defects in maps published in geographic journals. Results suggest a greater use of technically better maps, a continuation of a number of problems associated with various thematic map types, and the appearance of some new artifacts of mapping software such as graphic scales with divisions that confound interpolation and a lack of an appropriate map projection.

1. INTRODUCTION

Technology, along with the abilities and desires of those who use and make maps, has had a significant impact on what is recorded and how features are graphically presented. Maps proved to be helpful in visualizing spatial relationships among various places so that people could assess resources, routes, distances, and distributions. As such, they provide a record of people's spatial awareness of their world and what and how they chose to represent those things that were important to them.

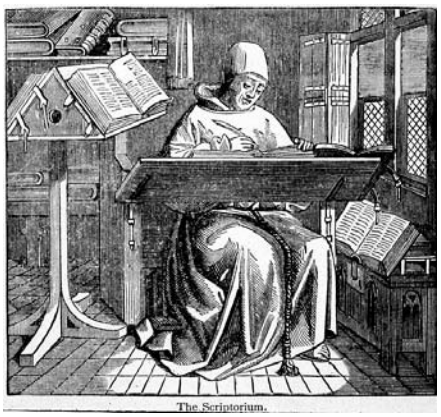

Figure 1. Blades, William: *Pentateuch of Printing with a Chapter on Judges* (1891).

Because of limitations in spatial knowledge and drawing tools, early maps were relatively crude, inaccurate, of limited content, and time consuming to produce. However, these and other problems have been reduced to acceptable levels because of developments such as the printing press, photography, mathematics, aerial platforms, a more educated population, and the need for scientists to know much more about the characteristics of features than just their locations. The end result of these and many other contributions are highly detailed and accurate maps that usefully reflected the nature of the physical world. In addition, thematic maps that presented information about the spatial qualities of highly specific data that might have interest to a limited audience became common. Map symbologies became more varied in appearance and distinct classes of thematic maps such as dot, isoline, graduated symbol, choropleth, flow, and cartogram appeared.

Probably the most profound technological change to date in the production and display of maps is one that began nearly 40 years ago. Maps are no longer necessarily created by experts or technicians, but by software commanded by anyone who can access a computer. Raw data such as stream or traffic flows, weather, or earthquakes that often are updated continuously on computers at remote locations serve as the sources from which maps are quickly created (Figure 2). Maps that once took days or weeks to produce now appear in seconds on a computer screen and once used, are discarded without ever being converted to a printed copy. Those that do reach hard copy form often are generated by people with limited expertise either in the topic of interest or in cartography. The result is the potential for mistakes and errors to creep into the maps either when the software does not follow common cartographic conventions or the author is unaware that there is potential for error.

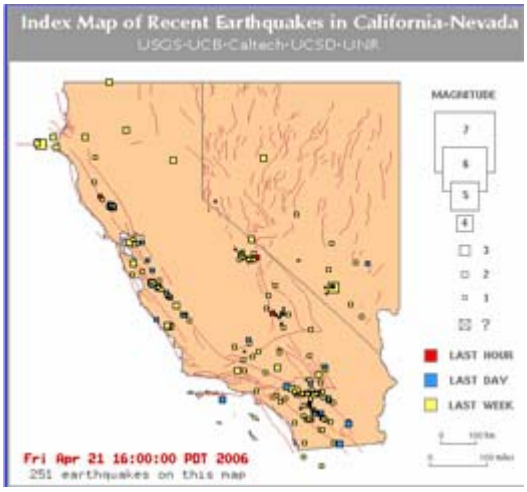

Figure 2.

2. CARTOGRAPHY WITHIN GEOGRAPHY

Because geography has a focus on spatial awareness and analysis, geographers have had a special interest in maps to help them convey their ideas to others. Indeed, they often point to the map as evidence of how they view and analyze the world. During the previous century a number of geographers began to actively study the making and function of maps. Within the United States, Arthur Robinson and George Jenks, in particular, intensified this specialty as they pursued research on map design and communication (Tyner 2005). By the end of the 1970s cartography became a major subfield of geography with one of the larger specialty group memberships within the Association of American Geographers. Most geography departments offered courses on the subject and there were several major textbooks available. John Wolter went so far as to suggest that cartography was on the verge of becoming a separate discipline (Wolter 1975).

However, about that time the transformation from manual to automated mapping began and geography's interest in and commitment to traditional mapping started to change. Eventually, people in need of a map could, like fast food, have one served up quickly via the internet. To some, this was seen as a democratization of the map making process so that anyone with a spatial question could easily create a map. Goodchild observed that this lead to a perception "that in a world where anyone can make a map, who needs a cartographer?" (Goodchild 2000). Denis Wood, in an essay entitled "Cartography Is Dead, Thank God!" more or less reveled in the lack of need for academic cartographic specialists (Wood 2003).

Interest in traditional geographic cartography has declined or "been marginalized" (Goodchild 2000). There is less use of paper maps as people seek to find things on maps through Internet services like *MapQuest* and *Google Earth*. One can get a sense of this by asking students when they last used an atlas other than a road atlas to find information.

Judy Olson noted the decline in interest by looking at the frequency of references to cartography in job descriptions in the *AAG Newsletter* from 1981 – 1997 (Olson 2003). Compared to all listings she notes a steady increase in GIS job offerings, a slight decrease for remote sensing, and a slow decline in cartography offerings (Figure 3). This was made more dramatically evident in a second figure that compared only those three categories (Figure 4).

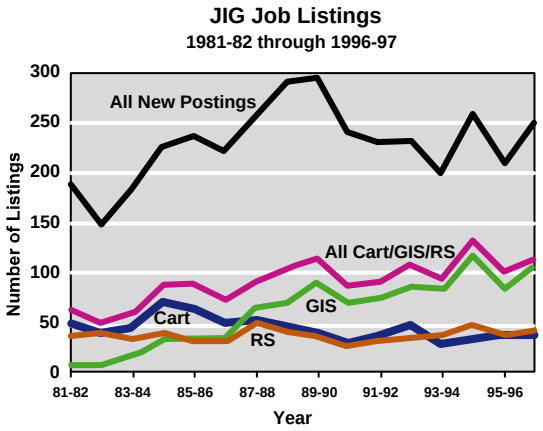

Figure 3. (Redrawn from Olson)

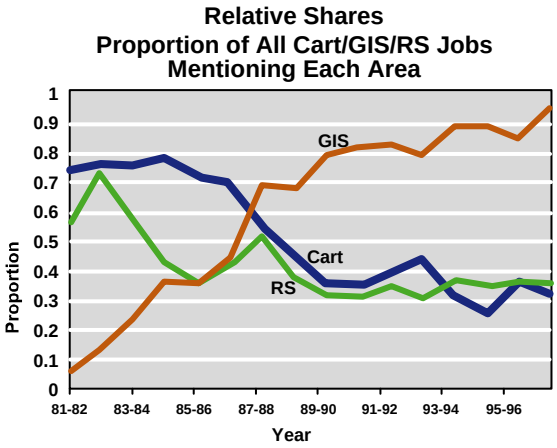

Figure 4. (Redrawn from Olson)

In a comparison of cartography, remote sensing, and GIS courses from 1991 to 2001, Judy Tyner also notes a decline in offerings of cartography courses and a rise in GIS courses (Tyner 2001) (Figure 5).

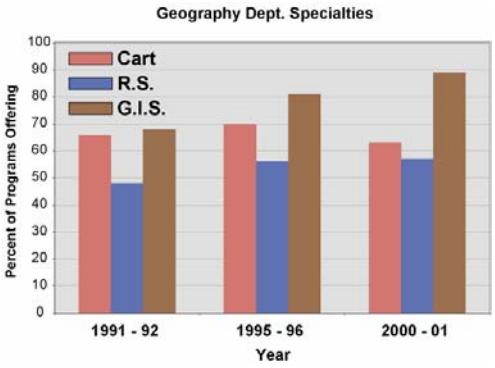

Figure 5.

In a survey of GIS certificate programs, Chris Wayne notes that many lack cartography coursework and few cover thematic mapping, map composition, or design (Wayne 2003).

A philosopher once commented that what is studied in universities is deemed important. And so, what now seems to have emerged within geography is an interest in spatial analysis through what is called geographic information science and in dynamically probing a spatial problem on a computer by displaying tables, maps, and any other information through what is being called geovisualization. What is occurring is not so much an abandonment of cartography for analyzing and presenting spatial relationships, but a shift away from a focus on static maps to new tools and methods in a digital environment. However, the usual end result of geovisualization often continues to be a static map that best summarizes and presents to others a solution to a problem. Thus, there continues to be a need to understand the nature and construction of maps despite less academic attention.

The actual design of maps is increasingly being left to the defaults and options of software and to discussions in a chapter within a GIS text. For example, a number of characteristics in the default page layout generated by Environmental Sciences Research Institute's (ESRI) *ArcMap* program are becoming increasingly evident in a variety of maps appearing in sheet form, journals, and on the Internet.

Since geographers place particular emphasis on their need for and understanding of maps, this paper seeks to note trends in the look of thematic maps that have appeared in several geography journals over the last twenty years. Geographers often use maps in their research and should generally follow recommended practices in map construction. Also, because this period covers the time of transition from manual to digital methods, one would expect changes to be evident in the published maps. For example, because of the cost of quality typography and area fills, early maps should evidence less and more coarse area shading as well as simpler type styles rendered by hand or with lettering guides. The first evidence of computer-generated maps would be those generated on a line printer, then a plotter, and finally those produced by an imagesetter. Throughout these two decades maps were occasionally generated through photographic methods, but these were more costly to produce and were usually not popular with publishers since once screen tints were embedded in the image by the author, any subsequent changes in dimensions could ruin the illustration. Usually a black and white copy suitable for photography by the publisher was preferred to a screened photograph or negative.

Because maps can now be rendered and manipulated more quickly, we would expect to see an increase in the number of maps. However, this assumes that geographers would be generating about the same kinds of publications they did earlier. A recent opinion editorial by Wilbur

Zelinsky suggests that over the last five years 22% of the articles appearing in the *Annals* and 13% of the articles appearing in the *Geographical Review* are non-geographic in character (Zelinsky 2006). While he admits such articles have appeared in the past, he notes that non-spatial types of articles appear to be a more common trend within the last five years.

3. MAPS WITHIN GEOGRAPHICAL JOURNALS

Four geographical journals were selected for evaluation: the *Annals* of the Association of American Geographers, the *Geographical Review*, the *Professional Geographer*, and *Urban Geography*. The most recent issues available ranged from 2004 to mid 2005, a total of six issues for the first three journals and ten for *Urban Geography*. Then the same time frame was selected for 1994 to 1995 and 1984 to 1985. For each journal the page and illustration dimensions were recorded as were the types of articles (regional focus or methodological focus), the area in tables, the types of graphics (maps, graphs, photos, diagrams), the types of maps (locator, distribution, choropleth, dot, isoline, or other), and any notable comments about map content or appearance. Often locator and distribution maps are very similar, but the former was deemed to focus on showing where an area is while the latter often showed the distribution of specific data such as the location of parks within a city.

While it is the intent of this paper to assess the nature and quality of the maps appearing in the articles, space and time did not allow for a detailed map critique. Instead, the paper examines the presence and rendering of basic map elements that several basic texts on cartography suggest ought to be considered for inclusion in any map (Brewer 2005, Dent 1999, Monmonier 1993, Robinson et al. 1995, Slocum et al. 2005, Tyner 1992).

These basic map elements (Fitzsimons 1985) include:

1. Title: It should briefly describe the map topic, what it is, where it is, and when it occurred. In professional journals, titles are usually not incorporated into a figure's design, but provided as a portion of the figure caption. Captions offer authors the additional advantage of being able to make statements to direct the reader's attention to particular aspects of the map's distribution.

2. Legend: It should include topical elements shown on the map. Base information such as cities, roads, rivers, and boundaries need not be included if they are undifferentiated, clear, and self-evident on the map. The word "Legend" need not appear, but a label indicating the units or form of the map data is often helpful. For example: Percent Unemployed.

3. Scale: Usually a graphic scale should be present with even, whole subdivisions. For smaller scale maps, however, such scales become less useful because of variability of scale over the map. Use of a representative fraction is risky since it will become incorrect if the map is enlarged or reduced in scale from the original.

4. Source: This would include a comment about the data source of topical map information; particularly if the map represents quantitative data. In the *Geographical*

Review this often includes a credit to the creator of the map should that be different from the article author.

5. North Arrow or Geographic Grid: This is considered a required element when a map's orientation is not conventional or if the reader might not know that it is. Usually a north arrow is not recommended if the map scale is small enough that north varies in orientation across the map (particularly with conic projections). In general, the authors suggest excluding it if the map is obviously north oriented. A geographic grid or tick marks can be useful for orientating smaller scale maps.

6. Inset Maps: If smaller in scale, these maps are used to provide general location and if larger in scale, they are used to show detailed regions of the main map. A smaller scale inset map is often helpful especially if the area is far from the location of the audience.

7. The Mapped Area: To this we would suggest that a map should provide a "sense of place." This should happen at two levels. At the top, one should have a sense of where the mapped area is in the world (often accomplished with the use of a smaller-scale inset map). At the second level there should be some base information and type to provide places of reference for the portrayed distributions. In many cases the presence of terrain, cities, administrative boundaries, rivers, or major roads strongly associates with a distribution and can better indicate where features are located within the mapped area.

Finally this paper notes the general visual qualities of the maps. In some cases maps had very poor differentiation between land and water (the base level of 'visual hierarchy') and in others symbology was noticeably coarse and cluttered. In general, one would expect map design to be simple and clean since the maps are intended to present spatial concepts as part of a journal article. The topic should be clearly evident and not surrounded by unnecessary embellishment.

4. RESULTS

Figure 6 summarizes the percent of article space devoted to various forms of graphics among the four journals during the last 20 to 30 years. Though the journals devote about ten to twenty percent of their article space to graphics, the types of graphics and the trends of use are varied. In *Urban Geography* and *The Professional Geographer*, tables are the dominant non-text element. Photographs are significant in the *Geographical Review.* In the 2004-2005 sample, this journal also averaged 3.2 photos in 37 articles for a total of 8.8 percent of the article space, double that allocated to maps, and more photography than the other journals. In three of the journals maps are the prominent graphic element and these journals have generally increased the area devoted to maps in the last decade. A surprising exception is the steady decline over the last twenty years in the area devoted to maps within the *Geographical Review.* During that time the area devoted to maps dropped from 10.0 percent of the article area to just over 4.4 percent.

The use of graphs, diagrams, and tables has generally been modest with the exception of *Urban Geography* which has devoted 9.3 percent of its article area to tables. This is several times the amount allocated by the other journals.

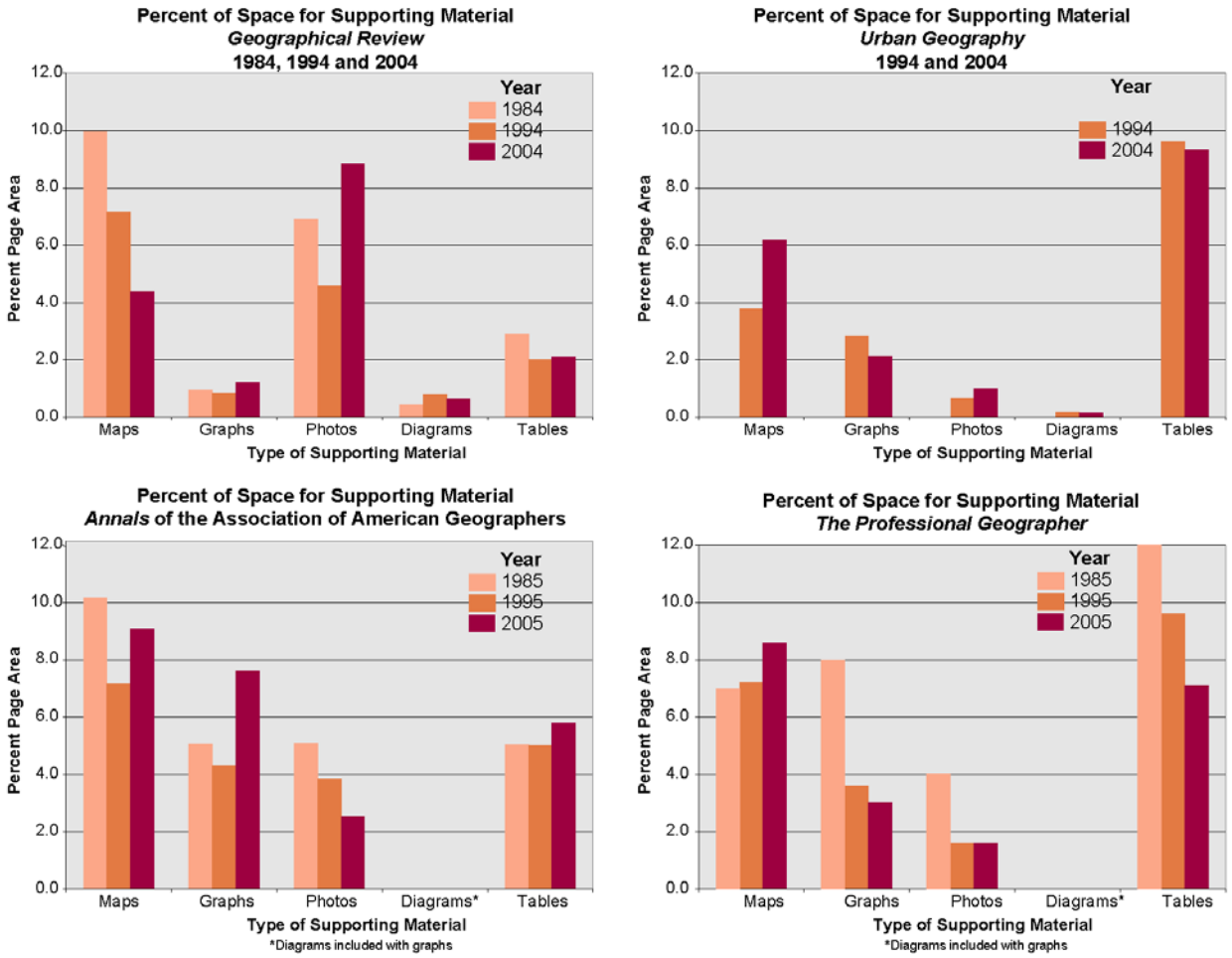

Figure 6. Percent of Article Space Allocated to Tables and Graphics.

Figure 7 indicates the proportion of all maps divided among several common types. In three of the journals locator and distribution maps account for about sixty percent of all maps presented. The exception is in *Urban Geography* where choropleth maps are most predominant. This would seem related to the use of nations and census units in many of the articles. The other forms of thematic maps do not often appear and in most cases account for about five percent of all maps. Overall, between 1994 and 2004 a low proportion of dot, graduated symbol, isoline, and other maps were produced for these journal articles.

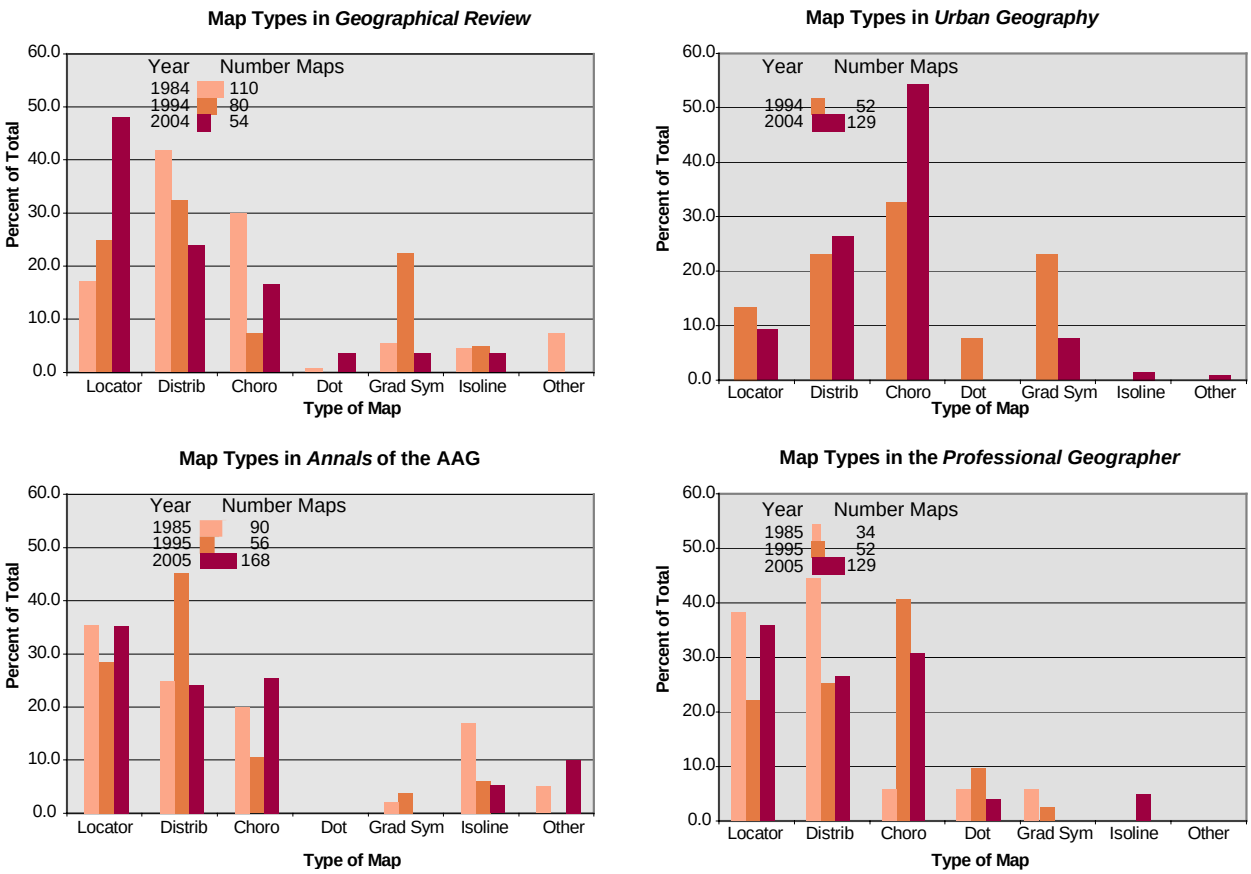

Figure 7. Percent of All Maps of Specific Types.

The maps appearing in the 1984-1985 period were still predominantly hand-drawn. A few were generated through photomechanical methods and contained fine screen tints, but most avoided area fills or used stippling or preprinted, adhesive patterns. In many cases, type was apparently done with *Leroy* or some other mechanical lettering system since the characters exhibited straight strokes with curved ends. Generally graphics were more coarse than today.

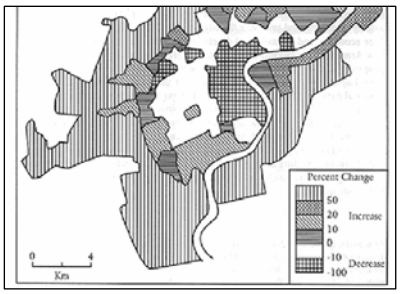

Figure 8.

Figure 8, a section from a population change map in a reduced form, exhibits a number of characteristics of maps of this time. The patterns are rather coarse, there is little to indicate the area is Shanghai, there is only a labeled river to relate to the patterns, and the patterns emphasize a white mid value within the sequence of patterns.

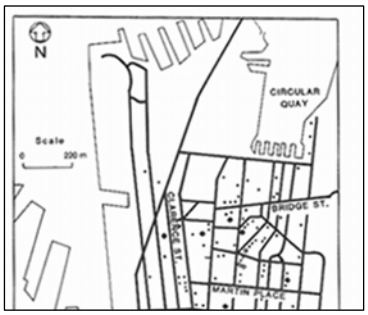

Figure 9.

Figure 9 is part of a reduced section of a map of the harbor in Sydney, Australia. It illustrates the frequent problem of no area tint to separate land area from water. The heavy road network obscures the three different sizes of graduated symbols which are of seven different shapes to indicate foreign ownership of banks. A graphic scale of “220 m.” is included.

Maps in the period from 1994-1995 were increasingly being generated with the aid of computer pen plotters. Though line printer maps could have been produced twenty years earlier as well, none appeared in the journals examined. Maps generated by plotter were typically identified by line pattern area fills, visible straight-line segments on curves, and blocky type composed of even strokes (Figure 10).

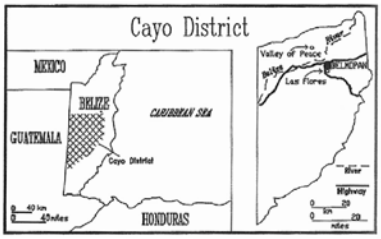

Figure 10.

By 2004-2005 digital software enabled the easy generation of screen tints, high quality type, and fine linework, and it could be modified quickly (Figure 11). The potential now exists to produce high quality maps equivalent to those produced by scribing and photomechanical methods. However, problems still appear. This map was obviously generated on a computer using *ArcGIS* software. The distinctive compass rose is a common default that authors include on maps. Of more concern is the lack of a projection that causes this map to be twenty percent wider than high. This distortion increases with latitude because the values for longitude are treated as equivalent to latitude though a degree of longitude here is less on the ground than a degree of latitude. An undeveloped vernier scale is included to the left of the 0 in the graphic scale.

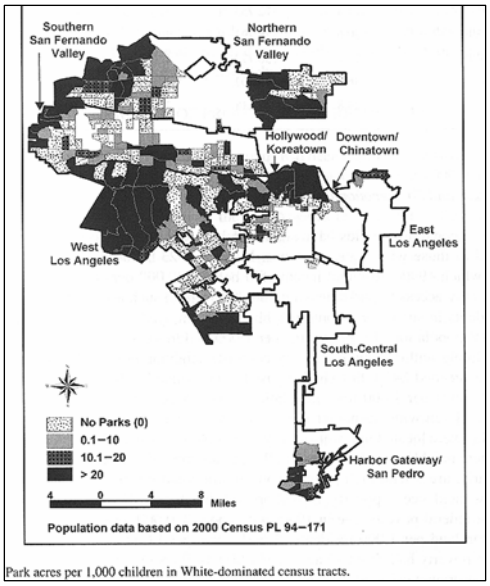

Figure 11.

Presently there are few technical limitations other than lack of color or space that should cause difficulties in generating quality maps for journal publication. The problem is more one of conceiving and executing a design to express spatial relationships within a research topic. Or put another way, "pilot error." Based on a number of years of editing journal maps for *The Professional Geographer* and *Annals* of the Association of American Geographers the authors of this work have noted a number of design issues evident in submitted maps that have evolved over the last ten years as graphics have shifted from a manual to digital format. Some problems have persisted over the decade while others have become less evident or new ones have emerged. These are summarized in Table 1.

Table 1. Summary of Mapping Issues in Geographical Journals

1994-1995	2004-2005
Maps designed for data analysis not presentation.	Map was designed for research not presentation.
Graphics don't support article text.	Graphics don't support article text.
Students often make the graphics	Students still make the graphics
Viewed as separate task from writing.	Viewed as separate task from writing.
Choropleth maps often show raw counts	Choropleth maps still show raw counts
Ineffective use of type	Ineffective use of type
Monotonous, single font	Type should serve as map symbols
Poor figure/ground relationships	Confusing order of visual hierarchy
Very generalized graphics	Too detailed graphics and maps
Visual dominance of graphic scale	Scale divisions confound interpolation
	Metric or 'SI' units may be required

In a number of cases the maps submitted to geographical

journals seem designed for data analysis rather than presentation. This is evidenced by maps that are incomplete and devoid of base data that might be helpful in understanding any association of the mapped data with basic ground features such as rivers, roads, or cities. Similarly many thematic maps have little or no type to identify ground features. In a number of instances places are mentioned in the text, but not shown on the map. Part of this problem may result from the strong focus on the data gathering and writing of the research and less familiarity, experience, and interest in the graphics that accompany it. Authors occasionally turn over map production to students so that they can focus more on the writing of a paper. Certainly students are less familiar with the concepts to be shown and are often inexperienced in map production.

Because many maps were once drawn with the aid of lettering guides, typography of earlier journal maps was often very plain with either an upright or italics variation. However, with many more fonts now available, a number of maps still fail to utilize type variation as a support for feature recognition. That is, larger type can indicate a greater importance or magnitude of a feature and a different style can indicate a different class of feature such as land versus water-related elements.

Because of the difficulty in manually generating area fills, earlier maps often omitted them entirely. Such maps created serious figure/ground problems when complex coastlines were visible. Furthermore, the coastlines competed with other linear features and were sometimes mistaken for them. All line work of the earlier maps was typically generalized and occasionally overly so. In current maps, area fills are no longer difficult to generate digitally, but now many maps are overly detailed due to large-scale databases being utilized in mapping and GIS software. So far such software doesn't automatically adjust presented line detail to the scale. A very recent phenomenon is the inclusion of shaded terrain or satellite imagery in the background of a map. This can so dominate a map that the thematic topic is lost within it.

The decision to include a graphic scale and north arrow has often been problematic, sometimes they are omitted when needed and sometimes included when not needed. In more recent maps both elements have become overly dominant due to default settings within *ArcGIS* and other mapping software. Because graphic scales are generated to fit within an area dragged with a mouse, they often have uneven maximum values and fractional divisions thereby making them less useful.

Overall there has been a marked improvement in the last twenty years in the look of maps appearing in geographical journals. Digital methods have made high-quality graphic symbology and type quickly and inexpensively available and three of the sampled journals have increased the area devoted to maps. However, either through ignorance or lack of care problems and poor design choices continue to appear. Maps do not get the attention to detail as do footnotes and bibliographies. Perhaps this is because people have greater experience with words and are judged more harshly when those standards are not followed. Quite likely these problems will continue given a waning interest in instruction on thematic mapping in geography and the incorporation of instruction to a modest part of a course in GIS increasingly taught by someone with a non-cartographic background. Today, in many geography programs GIS is an obvious techniques choice. But without providing basic principles of presenting mapped data are we in danger of losing our ability to effectively communicate in the 'language of geographers?'

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