

LOOKING BACK AND AHEAD: A HISTORY OF CARTOGRAPHY AT THE CENSUS BUREAU AND WHAT THE FUTURE HOLDS

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ABSTRACT:

At the United States Census Bureau virtually all census data are geographically referenced. As a result providing maps for conducting censuses and surveys and for disseminating the results is one of the major functions of the Census Bureau. This paper will detail the history of cartographic developments at the Census Bureau as well as examine where the Bureau may be heading in the coming years. Beginning in 1854, the Census Bureau began its illustrious career in cartography. Through the 19th, 20th, and into the 21st century, map-making at the Census Bureau has taken on different forms. As technology has evolved so has the cartographic response. From the innovative statistical atlases of the late 1800's to the present, the quality and effectiveness of census cartography has grown. Having a rich national spatial data source in the TIGER file for the 1990, 2000, and 2010 censuses allowed the Census Bureau to leap into new and varied cartographic products to meet specific operational needs. Through time, the concept of a map has changed from a graphic representation of features presented in familiar paper format to maps that exist but are only viewed in a virtual state. More importantly, recent technology offers new opportunities for cartography such as viewing maps on mobile computing devices and increased precision of map data through global positioning systems (GPS) and improved remote sensing capabilities. In the past, even with automated mapping techniques, the final product was a paper map in the hands of the user. One of the challenges for census cartographers concerns a change from a “real” mapping operation to a “virtual” mapping environment. Where will U.S. census cartography be in 2020?

1. INTRODUCTION

Due to the geographic nature of most census data, maps are a critical element in conducting a census or survey and for disseminating the results. Therefore, cartography is one of three principal geographic support functions at the United States Census Bureau. Maps are used both in the field by enumerators to augment data collection, and in printed and electronic publications, as an accompaniment to statistical data tabulations.

This article will highlight significant milestones in cartographic support of decennial census data dissemination beginning in the mid 1800s. Map development, decline, and ascent will be examined leading up to and including the 2010 Census. Finally, predictions will be made about the direction cartography will be headed in the years leading up to and including the 2020 Census.

2. THE IMPORTANCE OF MAPPING TO THE CENSUS

According to Article 1, Section 2 of the Constitution of the United States: "Representation and direct Taxes shall be apportioned among the several States which may be included within this Union, according to their respective Numbers The actual Enumeration shall be made within three Years after the first Meeting of the Congress of the United States, and within every subsequent Term of ten Years, in such Manner as they shall by Law direct." The results of the census are used to apportion millions of dollars in federal funds each year for

programs such as building and improving transportation networks and ensuring communities have adequate health and educational facilities.

Maps are critical to the census taking and data dissemination activities. Maps are created to support the field representatives in collecting the data from the field. Maps are also used to accompany and visualize the vast amounts of statistical data collected from numerous censuses and surveys. Today, without maps as planning, development, and dissemination tools, the job of taking the census would be next to impossible.

3. 19TH CENTURY MAPPING AT THE CENSUS OFFICE

In contrast to the significant dependence we place on maps in the census activities today, there is no record that the first seven decennial censuses utilized maps for enumeration or data dissemination. It wasn't until the mid 1800s that mapmaking began at the Census Office, now known as the U.S. Census Bureau. In 1854 Superintendent James Dunwoody Brownson (J.D.B) DeBow, included the first map published by the Census Office in his *Statistical View of the United States*. This map (Figure 1) divided the United States into four regions based on hydrologic drainage basins (U.S. Census Bureau, 2010).

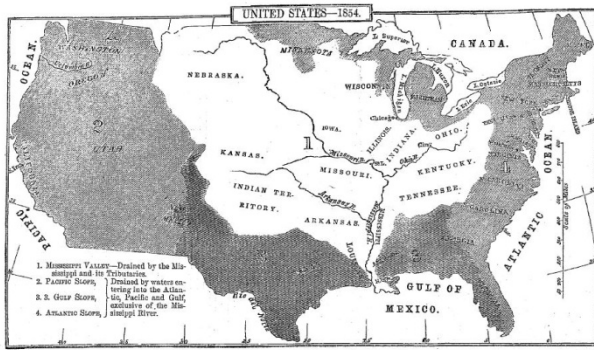


Figure 1. J.D.B. DeBow's 1854 Map of the United States

As the nation moved toward the eighth census in 1860, it was also slipping toward civil war. As a result, however indirect, of impending national turmoil a scarce number of maps were produced from this census. During this time, at least six maps have been credited to Superintendent Joseph C.G. Kennedy. These map are presumed to have been developed to support the 1860 census and are preserved in the National Archives (Friis, 1974).

In 1870, the Census Office first combined maps with its census report (Dahmann, 2001). This activity continues to this day. Cartographic activity at the Census did not truly commence until the publication of the first Statistical Atlas in 1874, under the supervision of Superintendent Francis Amasa Walker. This atlas, drawn entirely by hand, included 38 pages of maps rendered both in color and black and white. Topics ranged from Malarial diseases (Figure 2) to Population over Time (Figure 3) to a Geological Map of the U.S. (Figure 4) (United States Census Office, 1874, 1874b, 1874c)

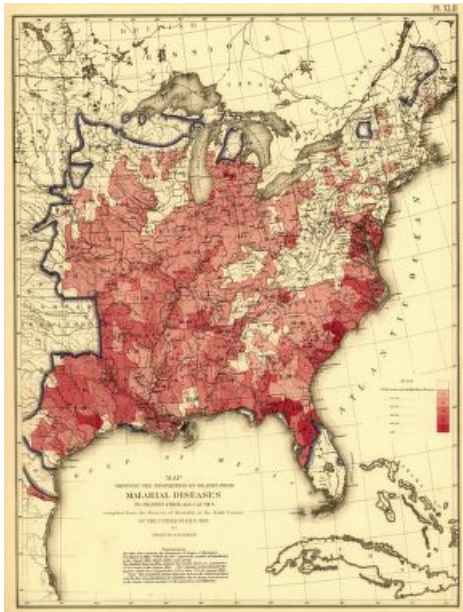


Figure 2. Malarial diseases

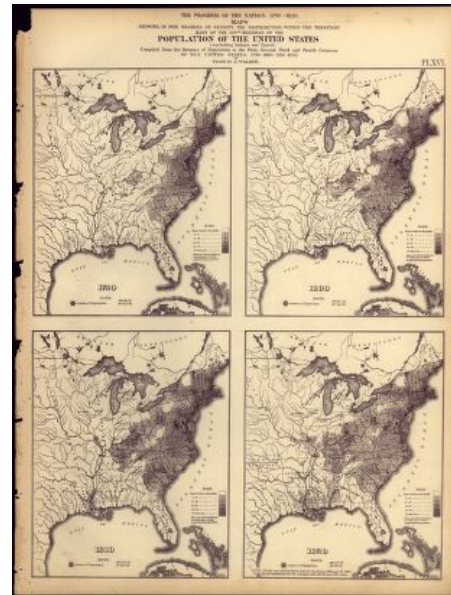


Figure 3. Population of the U.S. (1790, 1800, 1810, 1820)



Figure 4. Geological Map of the U.S.

In 1880, Henry Gannett was appointed as the geographer of the Census. Gannett served in this position for the 1880, 1890, and 1900 censuses. Under Gannett's direction the data produced as a result of the census was accompanied for the first time by maps in the report. And excerpt for the Census report can be seen in Figure 5.

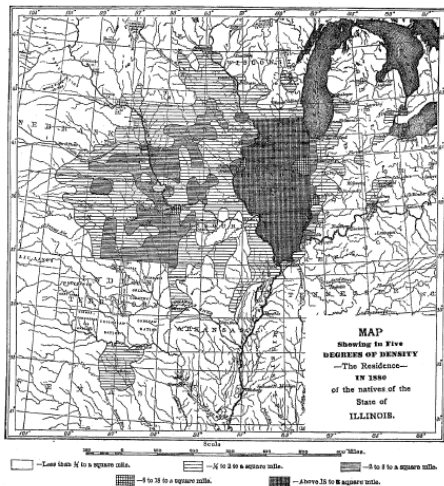


Figure 5. Excerpt from *Statistics of the Population of the United States, 1880*

Henry Gannett was also responsible for the 1880 and 1890 versions of the *Statistical Atlas of the United States*. In the 1880 atlas there were 116 plates containing maps. The 1890 atlas had 57 pages that contained maps illustrating the population characteristics of the nation (Figure 6). However, by the turn of the 20th century the nation once again saw a decline in the maps produced by the Census (Klove, 1967).

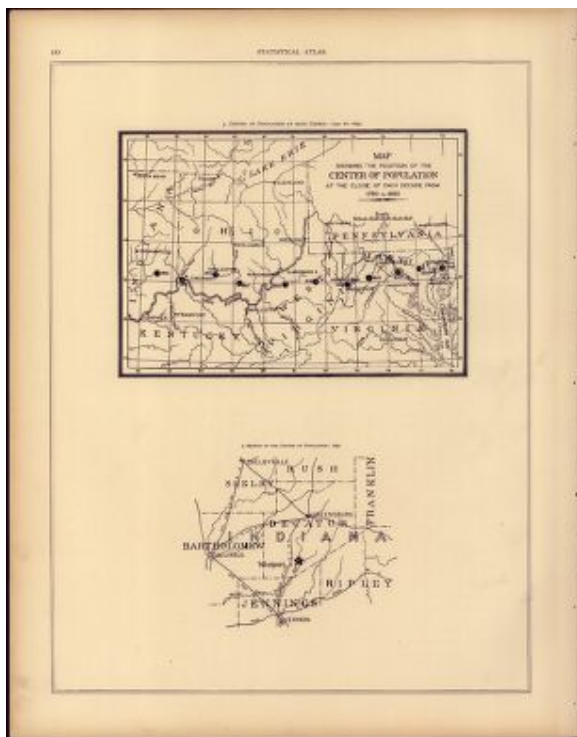


Figure 6. Center of population at each Census: 1790-1890

4. 20TH CENTURY MAPPING AT THE CENSUS OFFICE

With the turn of the 20th Century, the Census Office changed to the Census Bureau and became a permanent office under the Department of Commerce and Labor. Unfortunately at this time, the nation also saw another decline in the U.S. Census cartographic production. While the census reports still continued to provide maps in conjunction with the data released, special maps were on the decline. In 1900 the physical size of the atlas was changed to page size, and by 1910 and 1920 the atlas maps were no longer in color. As a result of a recommendation by the Joint Census Advisory Committee there was no atlas produced for the 1930 census.

In the 1940s interest in statistical cartography at the Census Bureau began an upswing. In 1945 a large color map of population density by minor civil divisions was produced. Figure 7 shows a Regions, Divisions, and States map that quickly became a standard product.

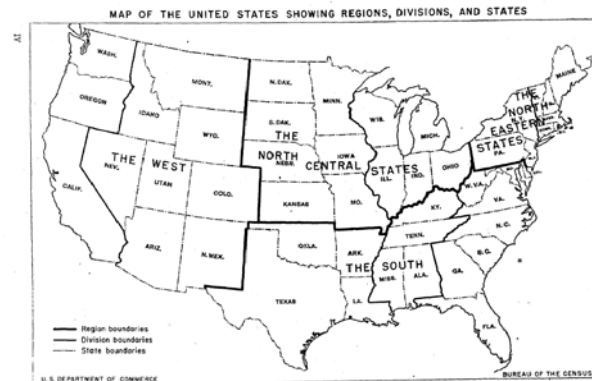


Figure 7. Regions, Divisions, and States map 1940

The 1950s brought numerous black and white maps to accompany statistical data and a color population distribution map (Klove, 1975). An example of these can be found in Figure 8. While these maps could be considered the beginnings of an atlas, a publication was never realized.

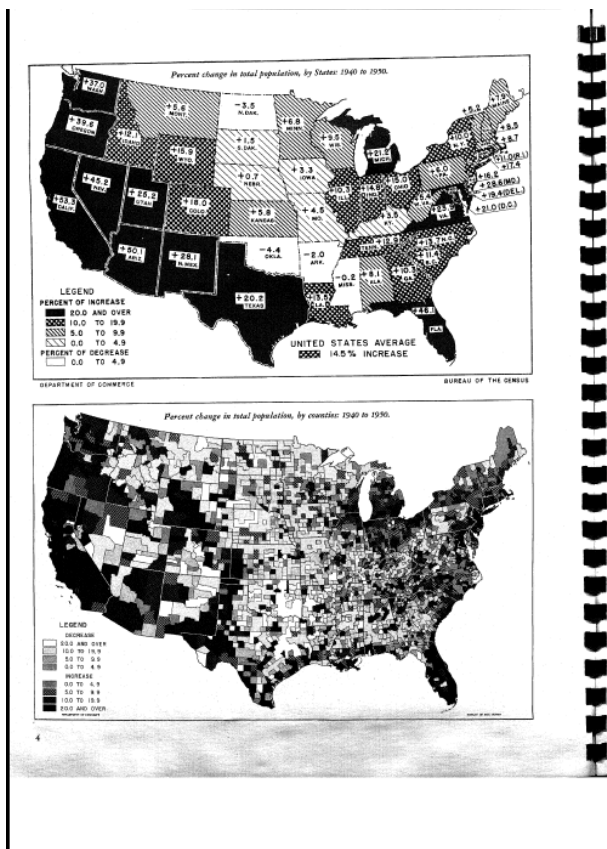


Figure 8. Page excerpt from Portfolio of United States Census Maps-1950

The 1960 Census of population reports continued the tradition of supplying maps to augment the data. Following the 1960 census, color once again became prevalent in maps in the statistical data publication, the *Census of Population*. In the early 1960s the GE-50 (Geography Series 50) maps were developed. These maps were large format (42 by 30 inches) and were printed at a scale of 1:5,000,000 (Figure 9). This series of maps included 62 different maps for the nation (Meyer et al, 1975).

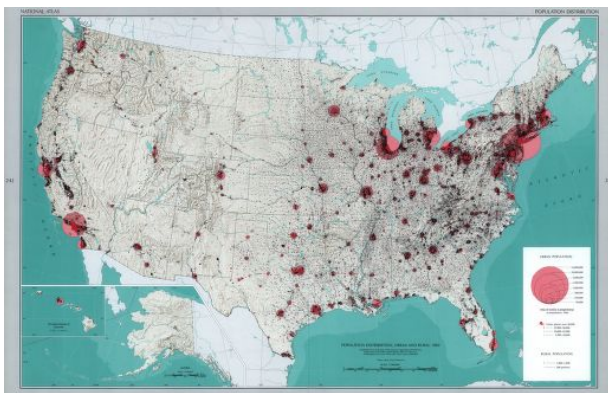


Figure 9. Population Distribution, Urban and Rural: 1960

The next significant era of cartographic development at the Census Bureau began in 1965 when the Census Advisory Committee on Small-Area-Data was established. This group developed a case study called the "Census Use Study" to help in planning for the 1970 census. As a result of this group's work, the GBF-DIME (Geographic Base File-Dual Independent Map Encoding) files were developed (NCGIA, 2010). These files were a significant development in digital geographic data and laid the foundation for choropleth mapping at the Census Bureau in the 20th century.

To support the 1970 census, the Metropolitan Map Series (MMS) was developed using the 1:24,000 scale maps series of the USGS and extensive local assistance. This set of maps was used for the 1970 and 1980 censuses. Each MMS covered the urbanized core of a metropolitan area.

In 1974 the GE-70 series of maps was developed. This series had a smaller sheet size (20 by 30 inches) and was at a scale of 1:7,500,000. This series included the popular dot distribution map of the U.S. The 1970 census also introduced the GE-80 Urban Atlas series (Figure 10) (Meyer et al, 1975).

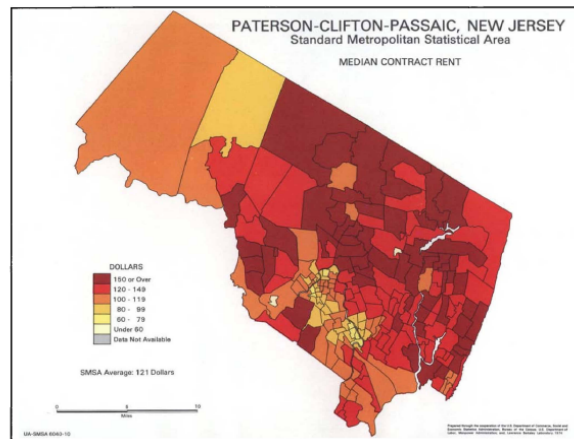


Figure 10. Excerpt from Standard Metropolitan Statistical Area atlas for Paterson-Clifton-Passaic, New Jersey, 1974

As the 20th census approached in 1980, funding cutbacks limited products offered by the Bureau. The GE-80 series Urban Atlas was discontinued at this time. However, as a result of the 1980 census, the bureau produced a number of different map products. These included detailed 1980 Census maps for census blocks and enumeration areas, summary reference maps, and special purpose maps (including the GE-50 and GE-70 series of maps) (Dixon, 1982). In 1980 the Bureau also produced its first large format map based primarily on automated cartographic methods (Birdsong et al, 1982). This Population Distribution map paved the way for the overwhelmingly automated cartographic production in the 21st Century.

In the mid 1980s, the Census Bureau developed the TIGER database. TIGER was designed to meet the geospatial needs for the 1990 and 2000 decennial censuses. Maps were considered one of the three primary products and services from the TIGER system (Marx, 1986). This spatial database spurred a

reinvigoration of mapping at the Bureau. In 1982 a Census Bureau mandate specified that all maps for the 1990 census were to be made in an automated fashion (Broome et al, 1995). The development of the TIGER System combined with exploitation of recent technological advances allowed for the alteration of the cartographic methods and procedures. At this time the Bureau developed a system of cartographic extracts to support mapping. This allowed the cartographer to develop multiple types of maps requiring less computing time (Bishton, 1990).

In the early 1990's, cartographic functions supporting data dissemination activities at the Census Bureau began to shift to commercial GIS and map publishing software. To support data dissemination for the 1990 census tract/block numbering area and block maps were produced. In the mid 1990s follow-up products such as the Congressional District atlas, the County Subdivision series of maps and numerous maps in the Statistical Abstracts were also produced. While the maps were made in an automated fashion, paper was still the delivery form for the maps. Electrostatic plotters were used to plot the computerized map files. However these files were device specific and therefore the use of the computerized files were extremely limited (Trainor, 1990).

5. 21ST CENTURY MAPPING AT THE CENSUS OFFICE

2001 marked another milestone in census cartographic publications. After an 80-year hiatus, a statistical atlas was once again produced at the Census Bureau. *Mapping Census 2000: The Geography of U.S. Diversity* contained 75 maps created from Census 2000 data. The maps in this page size book were based on redistricting data from Census 2000 and covered the topics of population, race and ethnicity (Brewer, 2001). Figure 11 shows an example of an atlas page. Each page was based on a common template (U.S. Census Bureau, 2010c).

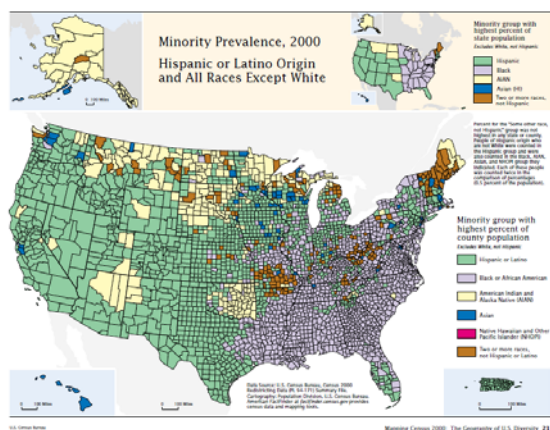


Figure 11. Page excerpt from *Mapping Census 2000: The Geography of the U.S.*

In 2008 the Census Bureau also published another atlas. This atlas, the *Census Atlas of the United States* is the first

comprehensive atlas of population and housing produced by the Census Bureau since the 1920s (U.S. Census Bureau, 2010b). This coffee table sized book gives the user a wide-ranging overview of the United States with approximately 300 pages and almost 800 maps (Figure 12).

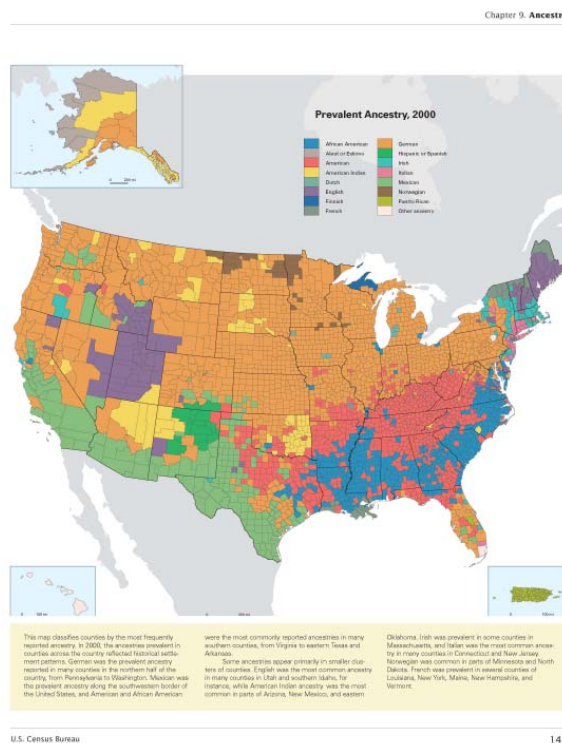


Figure 12. Page excerpt from *Census Atlas of the United States*

As a result of Census 2000 large format reference maps were also produced to support the data distribution. These hundred of thousands of color maps included the Census 2000 Block Maps, Census 2000 Tract Maps, Congressional District Maps (one series of maps for each congress), Metropolitan Area Maps, Census 2000 Public Use Microdata Maps, Urban Area Maps, and general reference maps. Examples of these maps can be found at: http://www.census.gov/geo/www/maps/CP_MapProducts.htm Map products created from Census 2000 were all produced digitally in Adobe's pdf format.

In support of Census 2000, the Census Bureau began replacing paper census reports with an online tool, American FactFinder. This tool, still in existence today, allows the user to create on the fly reference and thematic maps using census data. The web page for American FactFinder is <http://factfinder.census.gov>.

6. THE FUTURE OF MAPPING AT THE CENSUS BUREAU

At the time of this writing, the results of the 2010 Census are being tabulated. Planned map products include many familiar

products that will have enhanced capabilities. The pdf files produced will now be geo-referenced and in many cases layered. This will allow the user to interact with the maps in ways that have not been possible in the past. Maps will be produced to support statistical reports such as the Demographic Profile, Summary File 1 Report, and the Population and Housing Reports. The maps will include the Census Block Maps, the Regions and Divisions map, the Urbanized Area maps, and numerous other page and large format maps.

2010 will also provide a new and enhanced American FactFinder. The new system will offer users more control and choices for creating thematic and reference maps.

With the surge of technological innovation the nation has seen over the last decade, the question of what role maps will play in future censuses and surveys is critical. Moving away from paper based activities and increasing its focus on a more electronic method for data dissemination, means the Bureau must make a shift in its methods for creating and disseminating maps. While the Bureau will continue to provide high quality printed maps, the move toward electronic media is afoot. Cartographic design must concentrate on mobile devices and graphical user interfaces. Map services are being developed to allow users to create their own cartographically sound maps. These services will consist of cartographic templates and will result in publication quality maps. There are also plans for two atlases. One will be a statistical atlas based on the data collected from the 2010 Census much like the one produced for Census 2000. The second will be an electronic geographical atlas highlighting the diverse geographical nature of the United States.

7. CONCLUSION

The U.S. Census Bureau is an innovator in the field of cartography. Without maps, the Census Bureau would not be able to successfully complete its Constitutional mandate to conduct the census every 10 years. Maps provide the geographical backbone for the statistical data the Census Bureau collects and tabulates. Cartographic development at the Census Bureau has led several technological improvements over time. From the late 19th Century through today map production has occurred in fits and starts. Now at the beginning of the 21st Century, the cartographers at the Census Bureau have an opportunity to once again create new, exciting data visualizations. In 1990, Timothy Trainor, now chief of the Geography Division, said, "The future is just beginning for additional cartographic innovation at the Census Bureau..." (1990). This innovation continues today.

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