CHAPTER TEN

Melting-Pot Ideology, Modernist Aesthetics, and the Emergence of Graphical Conventions: The Statistical Atlases of the United States, 1874–1925

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Visual rhetoric in technical, business, and professional communication spans a wide array of forms, ranging from text and screen design, to pictures and illustrations, to the display of quantitative information. These forms constitute a visual language that, like verbal language, rhetors adapt to a specific audience, purpose, and context. In a given rhetorical situation, for example, a document designer can choose a certain type style and size, arrange text on a page, and insert graphical elements to make the page or screen more accessible to readers, to emphasize information, and to create an inviting tone. Similarly, the designer can rhetorically tailor pictures to a given situation by selecting certain information to represent, using an appropriate style, and deploying drawing conventions (textures, color-coding). Likewise, the designer can shape quantitative information by organizing and articulating it within a generic structure (pie chart, bar chart, line graph; see Kostelnick, "Conflicting"; Kostelnick and Roberts 263–308). All of these rhetorical strategies are easier to implement than in the past because of the contemporary technology of design software, laser printers, and computer networking.

Although visual rhetoric always begins with a designer shaping visual language for a specific audience and purpose and culminates with a reader interpreting that language in a specific situation—e.g., interpreting a diagram to set up a VCR in a living room—that specific rhetorical act is embedded in a much larger and more social set of rhetorical circumstances. Visual language develops within discourse communities that enculturate its members in its conventional codes, and those codes embody cultural values and norms, including aesthetics. These social factors are inherently rhetorical because they

profoundly influence how, at a given historical moment, communities use visual language to achieve certain ends.

One such historical moment occurs in 19th-century America with the emergence of data displays to represent statistical information. Beginning with the 1870 census, collections of data displays called "statistical atlases" were created to visualize the progress of the nation. Statistical atlases were published for six consecutive censuses (1870 to 1920), five of them by the U.S. government. Before the atlases, census data were published as uninviting tables, which hindered comparisons and limited the public's access to the information. The U.S. statistical atlases represented an emerging trend, which began earlier in Europe, to display data about nation states; atlases strengthened the national identities of the countries that issued them; the first U.S. atlas (1874) also symbolized the scientific progress of the nation (Monmonier 1, 4). A landmark in information design, the U.S. statistical atlases collectively stand as one of the most public acts of visual rhetoric in the nation's history. They played a pivotal role in the development of conventional forms to represent data, forms that we now largely take for granted. By visualizing a rapidly changing nation transformed by westward expansion and the assimilation of immigrants, the designers of the atlases shaped attitudes about public policy. They enhanced their visual arguments by imbuing their designs with the aesthetic values of the era, initially deploying a decorative Victorian style and then shifting to modernism, which fostered universal forms and aimed to objectify representations of cultural diversity by making them appear economical and perceptually transparent.

In this chapter, then, I will explore how the statistical atlases for the 1870 to 1920 censuses reveal the rhetorical nature of data displays in a larger social context. I will provide historical background that sets the stage for the design of the atlases, then examine how the atlases developed and certified data design conventions by teaching Americans how to interpret a wide variety of graphical forms. I will examine how those forms created visual arguments about the progress of the nation, particularly the assimilation of immigrants, and how they embodied the aesthetic values of the era, initially projecting a Victorian sensibility and later modernism and its ideology of cultural homogeneity.

BACKGROUND FOR DATA DISPLAY OF THE STATISTICAL ATLASES

The graphical display of economic and demographic data was a relatively new phenomenon in the 19th century, having earlier been applied primarily in science, mathematics, and engineering. Publications like the *Philosophical Transactions of the Royal Society* included line graphs as early as the late 17th century to display weather data, and later inventor James Watt used indicator diagrams to measure steam power (Funkhouser 289; Biderman 15). In the late

18th century William Playfair applied graphing techniques to economic data—trade, national debt, revenues—an innovation that greatly expanded their audiences. In the 19th century, techniques for displaying data continued to develop and proliferate, particularly in disciplines such as engineering, medicine, and the natural and social sciences.

Beginning with the 1850 census, the U.S. government started collecting a variety of economic and social data, which formed detailed factual profiles of the nation that organized its citizens into what Daniel Boorstin calls "statistical communities" (165–173). The statistical atlases were designed to make this wealth of census data more accessible to the public, thereby fostering civic participation. According to the U.S. Secretary of the Interior, the first atlas (1874) was intended:

> ... for distribution to public libraries, learned societies, colleges and academies, with a view to promote that higher kind of political education which has hitherto been so greatly neglected in this country, but toward which the attention of the general public, as well as of instructors and students, is now being turned, with the most lively interest. (Walker, Preface 1)

Because many of these readers were unfamiliar with the visual language of data displays, the atlases had immense instructional value, educating citizens not only in the progress of the nation but also in visual literacy.

The atlases completely transformed the design and reception of census data, making them more compelling and comprehensible to the public. The first three atlases (for the 1870, 1880, and 1890 censuses) were published as folios and included a wide array of maps, charts, and graphs, many of them in full color (Walker; Hewes and Gannet; Gannett, *Statistical, Eleventh*). The second set of three atlases (for the 1900, 1910, and 1920 censuses) were published as smaller quarto-sized volumes, the last two rendered chiefly in black and white (Gannett, *Statistical, Twelfth*; Sloane, *Statistical, Thirteenth and Fourteenth*).[1] The primary transformation in statistical display occurred in the three folio atlases, heroic acts of visual rhetoric that were produced during the founding era of statistical graphics (when "statistics" still largely meant data about "states"). The first atlas (for the 1870 census), the folio with the fewest pages, included over 50 plates, many of which contained numerous displays that together comprised a total of 1,200 figures (Walker, Preface 1). The first atlas contained a wide variety of "illustrations," which were classified into two types: "Geographical" and "Geometrical." The former consisted of maps with various systems for coding data, both physical and demographic, and the latter were constructed of "lines and plane figures" (Walker, Preface 1–2). The Geometrical illustrations included an array of configurations, including population distribution charts (males on one side, females on the other), area charts, line graphs, pie charts, percent charts, and several novel displays. Maps

accounted for about 2/3 of the plates, a proportion that shifted in subsequent atlases as other forms were introduced, including rank charts and wind roses (circular charts showing monthly distributions of deaths and diseases).

The graphical displays in the initial 1874 atlas visualized the distribution of people across the country, their religious affiliations, occupations, literacy, mortality rates, and health (including charts for blindness, deafness, idiocy, and insanity). The 1883 atlas, published by Charles Scribner's, included a more comprehensive design of the census data, although it contained a smaller range of display types, mainly maps, line graphs, and horizontal bar charts, the latter of which often appeared in close proximity on the same plate. The 1883 atlas also visualized more economic data—about occupations, agricultural production, manufacturing, finance, and other business activities (Hewes and Gannett). The 1898 atlas contained probably the richest variety of designs, introducing some new forms (e.g., wind roses) as well as displaying variations of existing forms, with increased emphasis on visualizing data about the burgeoning foreign population (Gannett, *Statistical, Eleventh*). The quarto-sized 1903 atlas refined and consolidated existing forms, which were then further winnowed down in the 1914 and 1925 black-and-white editions (Gannett, *Statistical, Twelfth*; Sloane, *Statistical, Thirteenth and Fourteenth*).

Over the half century that the U.S. atlases appeared before the public, they profoundly shaped visual discourse about statistical data. Before the 1874 atlas appeared, graphical display in the United States lagged behind practices in Europe, which developed rapidly during the nineteenth century (see Funkhouser). Some of the U.S. atlases' designers—civil servants, academics, and members of professional organizations, including the American Statistical Association—were undoubtedly familiar with European developments in data display (see Dahmann 2). International statistical congresses that were held in Europe provided a forum for deliberating about graphical methods, but a consensus about conventional practices was not reached (Funkhouser 311–322). Having considerable leeway to visualize census data, the designers of the U.S. atlases both modeled contemporary forms and invented their own, in the process sanctioning a variety of genres, teaching American readers how to interpret them, and building reader expectations.

THE EMERGENCE OF DATA DISPLAY CONVENTIONS

Design is inherently rhetorical because its forms are largely negotiated and shared by groups of users, or visual discourse communities (see Kostelnick and Hassett 24–30). By socially constructing design forms, visual discourse communities create, codify, and perpetuate conventional practices, which engender expectations among its members. Those processes occur with all forms of visual language—from architecture (houses, banks, campus buildings) to consumer products (furniture, cars, stereos) to information design, including typography (left justification, boldface for emphasis), screen design (icons, pull-down menus), pictures (perspective, cross-sectional views), and data displays (pie charts, line graphs). Conventions also vary in their flexibility and in the size of their currencies (the numbers of users who deploy and interpret them), and they evolve differently: Some have a long history (paragraphing, left-to-right lineation), others are relatively new (screen design, hypertext), and others have virtually become extinct (handwriting styles for business). Regardless of their profiles, all conventions share one crucial element—a supporting visual discourse community, which can be large and amorphous (a culture) or small and well defined (a corporation, a discipline; see Kostelnick and Hassett 36–39, 58–66, 83–96).

The atlases played a key role in shaping conventional data display practices, supplying a hinge between the inchoate, experimental forms of the 19th century, which were largely the domain of specialized disciplinary communities, and the emerging conventions of the 20th century, which served a much larger and increasingly multi-ethnic audience of U.S. citizens. The atlases were a laboratory for visually representing census data, encompassing a rich variety of graphical displays, several of which are recreated conceptually in Fig. 10.1. Forms like the data density map (a, b), pie chart (g), bar chart (j), and line graph (k) developed strong conventional status over the past century and today claim enormously large currencies. Other forms like the population distribution chart (c), percent chart (f), rank chart (j), and wind rose (l; also known as a polar chart) still have conventional status, though they claim smaller currencies. The currencies of other forms like the rectilinear area chart (m) and the circle chart (h) were short-lived and have long since evaporated. For example, the circle chart (h) was used in the 1874 atlas to compare the size of the blind population in each state with that of the previous census, with the inner circle displaying the 1860 population, the outer circle the 1870 population, and the shaded area the difference between them—i.e., the thicker the filled area the greater the increase in that state's blind population (Walker, Plate LI).

Other forms were entirely novel: The chart shown in Fig. 10.1d, which appeared in the 1874 atlas (Walker, Plate XXXVa), displays the evolution of the national debt from the founding of the nation through the high-debt bulge of the Civil War. Fig. 10.1n, which appeared in the 1898 atlas (Gannett, *Statistical, Eleventh*, Plate 22), displays the evolution of the U.S. population since the first census (at the top), with native Whites shown in the middle, Blacks on the right, immigrants on the left, and a summary below in the form of a rectilinear area chart. Numerous bi-polar population distribution charts also appeared in the 1874 atlas, showing males on one side and females on the other according to age groups, with the gender having the larger population shaded on its side. The compiler of the 1874 atlas, Francis Walker, considered these charts "to be a novelty in the graphic illustration of Statistics" (Walker, Preface 2; see, for example, Plates XLVII-L). Figure 10.2 shows a small segment of a plate contain-

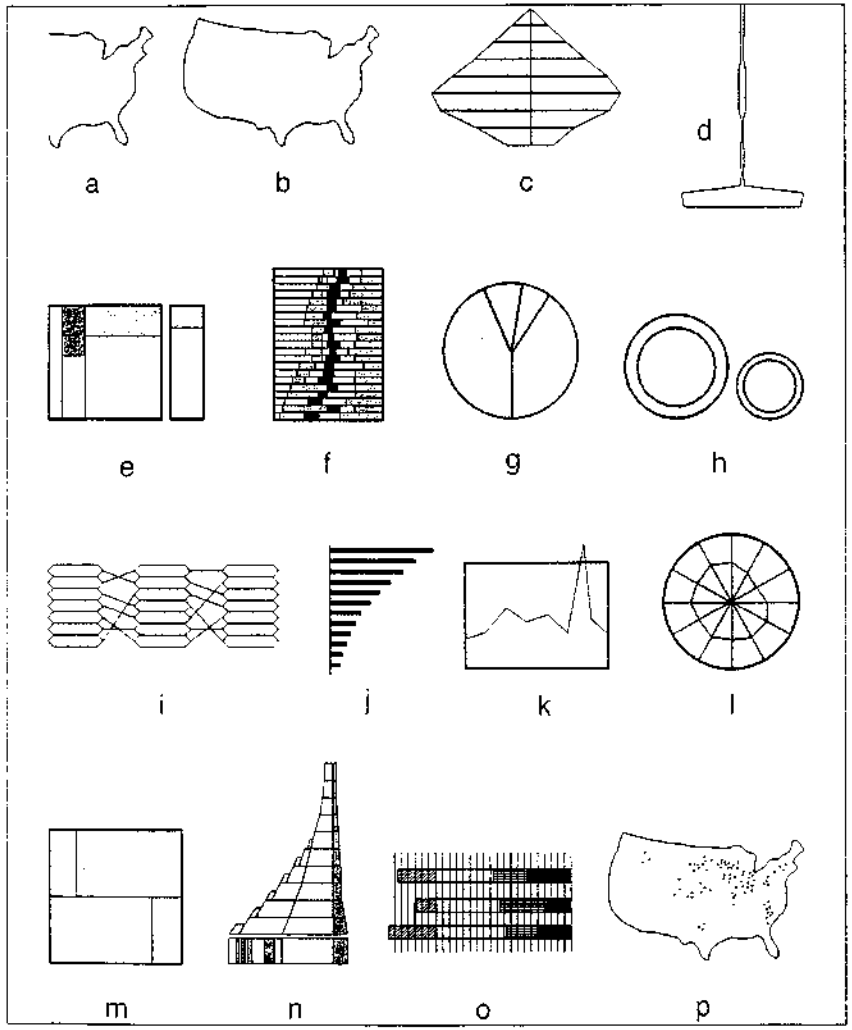

FIG. 10.1. Sampling of Data Design Forms That Appeared in the U.S. Statistical Atlases.

ing numerous such charts, with males outnumbering females in each of them, particularly in western states like Nebraska and Nevada. Bi-polar charts appeared again in 1898 and succeeding atlases to represent population data divisible into two distinct but relatively equal groups. To many early readers of the folio atlases, most of these forms were initially novel and supplied fresh, inviting, and even challenging interpretive experiences: Those readers had little

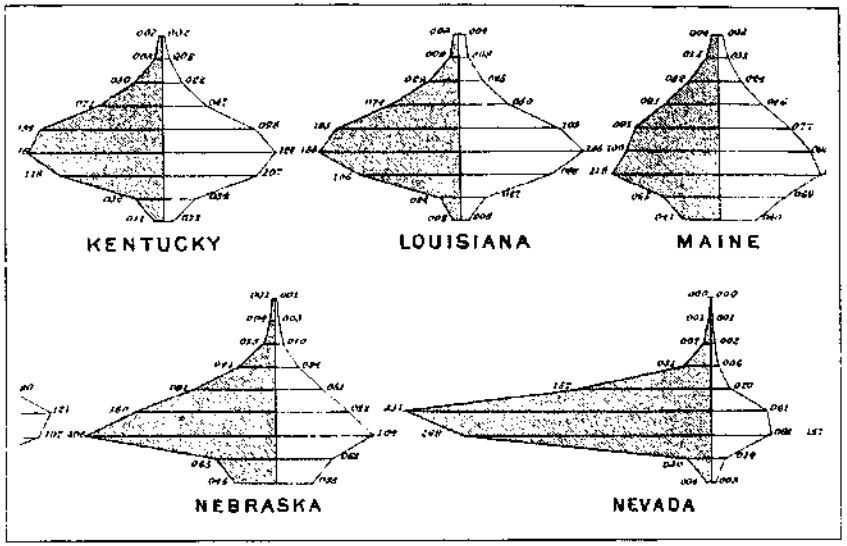

FIG. 10.2. Bi-Polar Charts from the 1874 Statistical Atlas Showing the Distribution by Sex of the Foreign-Born Population of States (Walker, Plate XXXIX).

sense of what was, or would become, conventional: to them, a pie chart may have looked as exotic as the debt or bi-polar chart.

Many graphical displays in the atlases underwent novel adaptations because their conventional boundaries had not yet been established and data display genres themselves still lacked stability. For example, early bar and line graphs with values that exceeded the plot frame were typically adapted to accommodate the data. In the 1883 atlas, the designer of the bar graph in Fig. 10.3 represents two variables (Agricultural Laborers and Farmers and Planters) that vastly exceed the horizontal baseline by snaking their bars back and forth until they accumulate their total values. Dozens of bar graphs in the 1883 atlas use this novel and ingenious technique (see, for example, Hewes and Gannett, Plates 34 and 35). A similar adaptation is used for line graphs with anomalous values (Fig. 10.1k), which by extending or exceeding the plot frame (Fig. 10.1k), climb up the plate like wild, unpruned branches (see Hewes and Gannett, Plates 108 and 123). Although today's readers might find these practices curious or bizarre, they were not uncommon in the past (for examples, see Tufte, *Envisioning* 106–7). In the 19th century, conventions for displaying statistical data remained unsettled, and because the displays were executed by hand, designers had both the opportunity and the exigency to improvise. The large public audiences of the early atlases were no doubt receptive to these practices because they were still largely unenculterated in emerging genres like bi-polar, pie, and area charts.

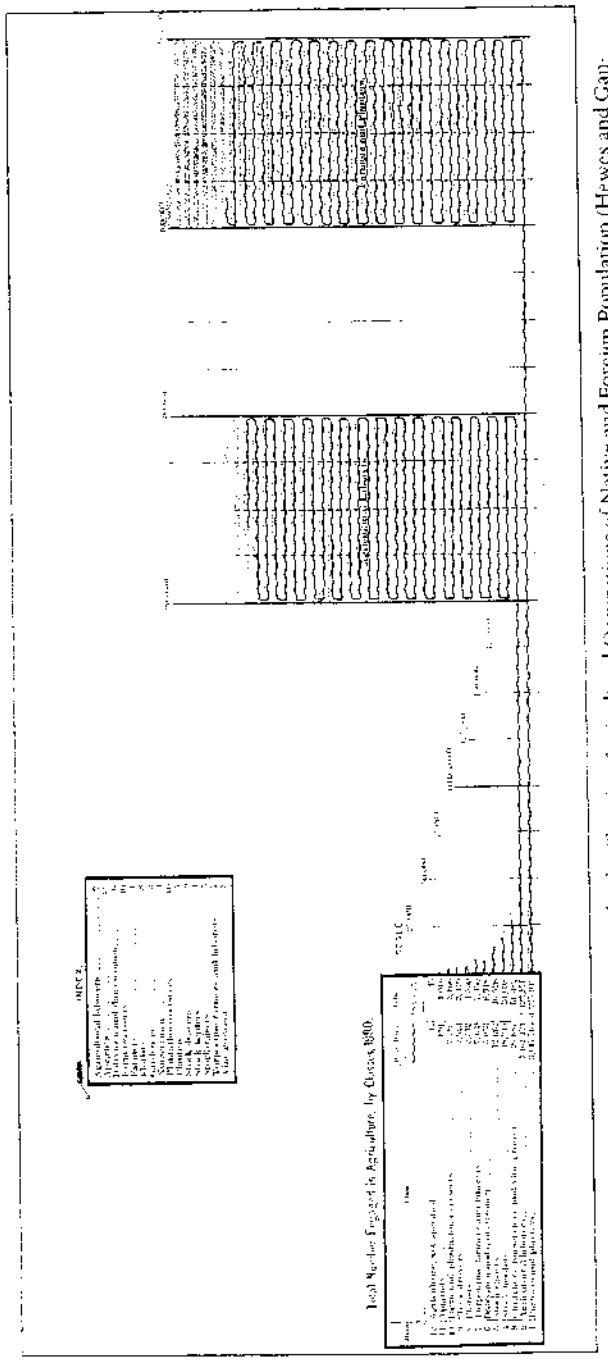

FIG. 10.3. Bar Chart from the 1883 Statistical Atlas Showing Agricultural Occupations of Native and Foreign Population (Hewes and Gannet, Plate 64) Courtesy of the Rare Book and Special Collections Department of the Northern Illinois University Libraries, Northern Illinois University, DeKalb, Illinois.

However, design novelty combined with conventional naiveté placed interpretive demands on readers. To compensate, the folio atlases (particularly the 1874 and 1898 atlases) provide ample instruction in visual literacy. Although maps and line graphs were presumed to be less challenging to readers and therefore receive little, if any, textual explanation, many charts in the 1874 atlas are explained at length in the Preface and Introduction and on the notes on the plates, leaving little to the interpretive hunches of readers.[5] Readers are taught, for example, how to read bi-polar population distribution charts (Figs. 10.1c and 10.2), which isn't surprising because they are identified as an original genre (Walker, Preface 2). However, readers also receive extensive instruction in reading pie charts, a genre that William Playfair experimented with 70 to 80 years earlier in England but with which U.S. readers may have had little prior experience. Specifically, readers are taught how to interpret a pie chart that shows four groups of blind people in the United States—males and females, native and foreign—as shown in Fig. 10.1g, with the males in the shaded segments and foreigners (males and females) in the two smaller segments (Walker, Plate LI). These divisions of the pie chart are compared to hands on a clock:

> If we may compare the radii of the circle to the hands of a clock (supposing these to be, instead of two, four, all of equal length), one hand, in these figures, always stands at six o'clock, and the others are moved around at various angles to it and to each other, to represent the distribution indicated above. (Walker, Preface 2)

The Preface and Introduction then tell readers how to interpret each of the four segments of the pie chart, instruction that would likely strike contemporary readers, fully enculturated in the genre of the pie chart, as both gratuitous and condescending.

Extensive explanations also accompanied area charts, novel forms that, unlike bi-polar charts and pie charts, no longer claim conventional status. For example, a plate in the 1874 atlas uses square area charts to represent "Church Accommodation" by religious groups and states (see Fig. 10.4). Each square contains five colored bars, four representing each state's major denominations (e.g., Methodists, Baptists, Presbyterians, Roman Catholics, etc.) and the fifth showing all others combined. The note at the top of the plate explains this system of representation:

> The interior squares represent the proportion of the population which is provided for by the aggregate sittings in the churches of all denominations. The shaded interval between the inner and out squares represents the population for which no church accommodation is provided. Where the aggregate church accommodation equals or exceeds the population over 10 years of age the shaded interval disappears. (Walker, Plate XXXI)

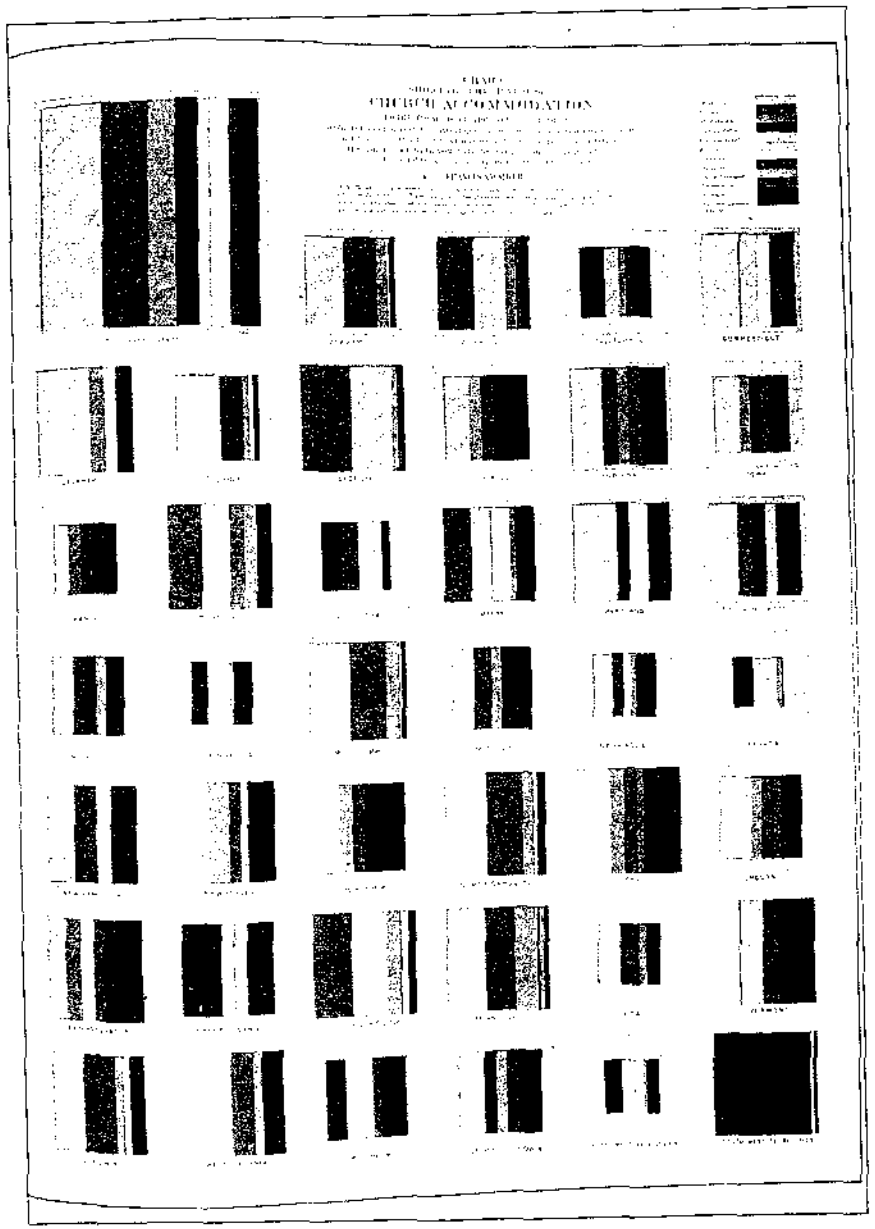

FIG. 10.4. Field of Square Area Charts from the 1874 Statistical Atlas Showing Church Accommodation by State (Walker, Plate XXXI).

So, for example, the square for Ohio (fifth row, second from the right) has no "shaded interval" and therefore has room in its churches to accommodate virtually everyone; on the other hand, Nebraska (directly above it) has a large "shaded interval" and therefore has far fewer spaces in its churches than its population. Fig. 10.1e shows another variation on the area chart that appears on a field of like charts (Walker, Plate XX), each of which shows the relative size and composition of a given state's present population (the square on the left) as well as of the native population that emigrated from the state (the rectangle on the right). Other than intuitively correlating area with population size, readers must rely on explanations in the text (Walker, Preface 3) and at the top of plate to interpret this complex system of representation.

Such explanations were far less frequent in the 1883 atlas, which used primarily maps and horizontal bar graphs. The superiority of "simple *linear*" diagrams (vii), which included bar and line graphs, was noted by Hewes and Gannet in their Preface: "Of the many kinds of diagrams hitherto used in the illustration of statistical facts, this form is at once the simplest and the most effective" (vii). Empirical research has largely since corroborated Hewes and Gannett's choice of horizontal bar graphs by finding that readers can more accurately compare data plotted along a scale extending from a baseline (Cleveland and McGill; see also Cochran, Albrecht, and Green). The 1898 atlas includes a larger variety of displays, and hence more explanations, although the explanations diminish markedly in subsequent atlases as the visual literary of readers increased and as the atlas designers shunned novelty in favor of conventional genres. In the later atlases (1914 and 1925) the variety of genres diminished, some genres (like the wind rose) disappeared, and other genres underwent additional refinements—for example, maps signified density with patterns and dots (Fig. 10.1p) rather than colors.

The atlases demonstrate a key principle of visual rhetoric—that information design is socialized by discourse communities that construct, adapt, and refine conventional practices and that enculturate users in those practices. As decade-by-decade snapshots in the evolution of data displays, the atlases modeled the process of convention building, as readers gradually became enculturated into genres that they came to understand and expect. Today, many of these forms—bar graphs, pie charts, bi-polar diagrams—have become so familiar that we don't question their conventional status as genres. This process of enculturation creates rhetorical efficiency as well as poses an interpretive problem because readers come to regard conventional forms as natural, direct representations of fact unmediated by the artificial lens of design (see Barton and Barton "Ideology"). For example, a designer might select a divided bar graph (similar to Fig. 10.1o), a conventional form with high currency, to show subdivisions among several quantities—for example, the relative health risks to consumers of various types of prescription drugs. Although deploying a divided bar graph may be more visually efficient than deploying pie charts or

separate bars for each variable, the design may undermine the readers' ability to compare data because some bar segments won't share the same baseline, an interpretive problem that in this situation could have serious consequences for readers. Nonetheless, readers will likely accept this representation because it meets their expectations as a conventional genre.

As socially constructed forms of representation, data displays, like other forms of visual language, attain conventional status within the discourse communities in which they are deployed. Through the atlases, the U.S. government sanctioned data display genres that were widely disseminated among the American public, fostering both their currency and credibility. That process was rhetorically significant because it cultivated readers' expectations over half a century, a long process compared to convention building in other domains (corporations, universities), which through new management or visual identity programs can more rapidly transform their conventional languages.

DATA DISPLAYS AS VISUAL ARGUMENTS

Visual language is also rhetorically charged because designers deploy it in specific situations to achieve certain ends. In a given situation the designer can deploy visual language to foreground or embed information, help readers organize it, speak with a certain tone, foster credibility, and perform other functions that influence readers' interpretations. Even when various forms of visual language—typefaces, illustrations, icons, screen designs—are deployed to represent the most mundane information, they can embody elements that direct attention, persuade, and shape attitudes. An entirely artificial form like a data display can be particularly tendentious because designers have a great deal of leeway to visualize data within the universe of conventional genres. That flexibility also allows designers to manipulate data, which has generated widespread concern about the ethical abuses of data design.

In the late 19th century, however, such concerns did not yet pervade public discourse about statistical data generated by the U.S. Census Office. Those who authorized and produced the atlases pursued the admirable civic goal of educating citizens about the status of the nation so that they might participate in its development, a purpose Hewes and Gannett articulated in their Preface to the 1883 atlas:

> Let these facts be expressed not alone in figures, but graphically, by means of maps and diagrams, appealing to a quick sense of form and color ... and their study becomes a delight rather than a task. The density of settlement, the illiteracy of the people, the wealth or poverty of different sections, and many other features of great importance, hitherto but vaguely comprehended, are made to appear at a glance, and are so vividly impressed as not to be easily forgotten. By such aids not only the statistician and political economist, but the masses of the people, who make public sentiment and shape public policy, may acquire that knowledge of the country and its resources which is essential to intelligent and successful government. (vii)

To achieve that civic end, then, images "so vividly impressed as not to be easily forgotten" (Hewes and Gannett vii) would serve as mnemonic devices that enabled readers to process and retain information. Nearly a century earlier, William Playfair made a similar claim in his *Commercial and Political Atlas*, arguing that with the aid of his charts "as much information may be *obtained in five minutes as would require whole days to imprint on the memory, in a lasting manner, by a table of figures*" (xii). Making information accessible and memorable to readers was the paramount goal of visualizing it in maps and charts; as a reviewer of the 1874 atlas put it, "the very reason of their being is because words and numbers cannot or will not tell the whole truth" (Brewer 85). Utilitarian, rather than argumentative, benefits justified designing data, as they continue to today.

However, designing information so that readers can comprehend and retain it is scarcely an objective, neutral process. In the statistical atlases, data are *designed* in thousands of artificial constructs that project a reading of the nation at a specific historical moment, and in that sense those constructs are highly rhetorical, even argumentative. The visual arguments that the atlases posed to the public address issues of nation building, dynamic migration, and the rapid assimilation of foreigners. Nineteenth-century graphical displays were often used to argue for public policy issues, with some of these displays envisioning epic narratives of meteorology, natural history, economics, and health (and combinations of these). They typically appeared in books and journals as foldout plates, displaying several variables on the same plot frame, including annotations about the data and historical events. These displays were exemplified by Charles Joseph Minard's chart of Napoleon's Russian campaign, which represents the army's march eastward over 400,000 strong and its retreat as it dwindled to barely 10,000 (Tufte, *Visual Display* 40–41). Minard's chart, lauded by Tufte as perhaps "the best statistical graphic ever drawn" (*Visual Display* 40), brilliantly expresses the consequences of expansionism and implicitly argues to keep French resources at home rather than squandering them on schemes abroad. Another compelling visualization of a public policy issue was articulated by Florence Nightingale's charts, in which she used a circular time pattern (akin to a wind rose) to display the death rates in hospitals during the Crimean War (Funkhouser 343–345; see also Biderman 17–18).

How were public policy issues advanced by data displays in the statistical atlases? First, the displays visualize the concept of manifest destiny by charting the deterministic narrative of westward expansion across the midwest, plains, and west. In doing so, the atlases both narrate and advocate dynamic change by envisioning a nation that is geographically mobile. All of the atlases included physi-

cal maps of the entire country, coast to coast, and the vast regions awaiting settlement. Although population maps in the 1874 atlas displayed primarily the eastern half of the country (Fig. 10.1a), the 1883 atlas and its successors included the whole country (Fig. 10.1b). To document manifest destiny, each atlas included a map tracing the population center of the country as it progressed west, beginning in 1790 near Baltimore and moving through West Virginia, Ohio, and Indiana. In the 1883 and 1898 atlases these vast, dynamic shifts in population were documented on maps showing the migration of population across states, and they were further dramatized in rank charts (Fig. 10.1i), as some of the original states lost their places to those more recently settled (see Hewes and Gannett, Plate 18; Gannett, *Statistical, Eleventh*, Plate 2).

Visualizing westward migration argued that vast regions of the nation still awaited settlement, which required additional sources of population. The atlases used several design strategies to track the movement of immigrants as they were geographically assimilated. One strategy was to show, primarily through maps, that foreigners were in fact migrating across the country and were not merely concentrated on the coast. In the 1874 atlas, maps of the eastern half of the country show the distribution of foreigners, including specific ethnic groups (e.g., Germans, Irish; Walker, Plate XXVII), and as we've seen in Fig. 10.2, bi-polar population charts for each state show the distribution of foreigners by gender and age. In the 1883 atlas, bar charts were also used extensively to locate immigrants, displaying the foreign population by state, its percentage of the state's population, and the percentages of each main ethnic group (e.g, Irish, Scotch) by state as well as some large cities (e.g., New York, Philadelphia). Virtually all of these charts displayed bars in ranked order so readers could easily compare the size of each ethnic group. The migration charts in the 1898 atlas emphatically visualize immigrants as the black segment on right of each bar (Fig. 10.1o; Gannett, *Statistical, Eleventh* 24). Collectively, these displays argued that foreigners were being assimilated geographically and playing a key role in westward expansion.

Visualizing the national assimilation of foreigners is epitomized in Fig. 10.5, a plate from the 1898 atlas showing a field of pie charts representing the relative mix of foreign immigrants by state and territory. Fourteen ethnic groups (in addition to a combined "Other Countries" group) are represented, with most of the pie charts showing at least half of them. The field of pie charts serves several rhetorical ends, principally by arguing that the foreign population is both highly diversified and well distributed geographically. Because the equally sized charts show only the *relative* concentrations of foreigners within a given state, they obscure the fact that some states had very high concentrations of certain ethnic groups—e.g., Irish in New York, Germans in Wisconsin, Scandinavians in Minnesota—and others far lower concentrations. Southern states like South Carolina and Georgia, which experienced a relatively small influx of foreigners, appear to have the same diversification as

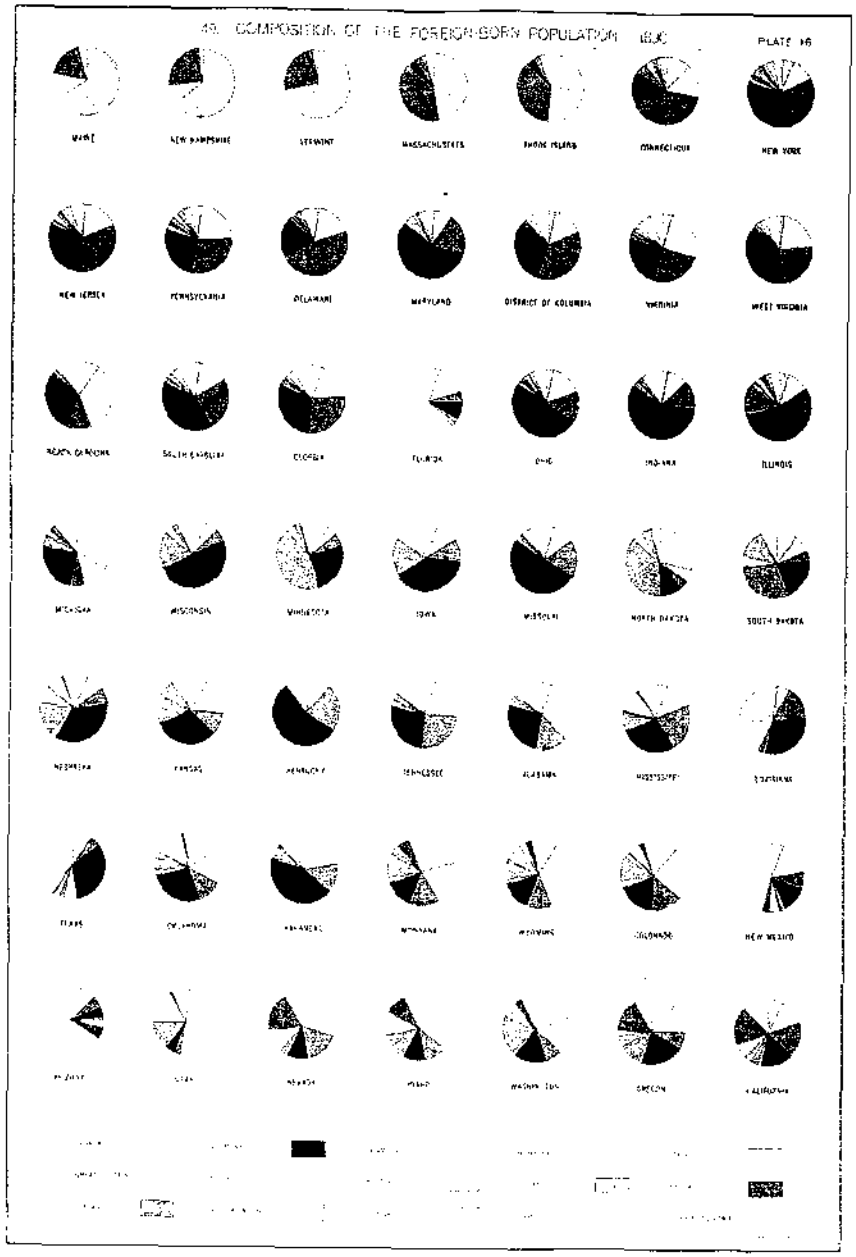

FIG. 10.5. Field of Pie Charts from the 1898 Statistical Atlas Showing the Nationalities of the Foreign-Born Population by State (Gannett, *Statistical, Eleventh*, Plate 16).

states like New York and Illinois. Because the field of pie charts prevents readers from comparing absolute values from one state to another, it makes a compelling argument for broad diversification and assimilation.

The atlases envisioned how foreigners were being assimilated not only geographically but also economically and vocationally. Although arguing visually for geographical assimilation may have partly reduced the threat of foreigners to native inhabitants, the social and economic effects of assimilation were complicated by historical circumstances. In the 1890s the western frontier was closing, and Americans were increasingly wary of foreigners, especially those from southern and eastern Europe. Anti-immigrant sentiment ran particularly high in the 1890s because jobs were scarcer during the financial downturn. "Nativist" groups opposed to immigration began to form, including the Immigration Restriction League initiated by several Harvard graduates (Daniels, *Not Like Us* 39–45; "Two Cheers" 14).

Amid these changing conditions, several visual strategies were deployed in the atlases to represent the occupations of immigrants. The presence of foreigners in the occupational displays of the 1883 atlas was so subtle that readers had to look closely to discern it. Occupations were displayed in bar graphs, with natives signified by a wavy line inside the bars that distinguished them from foreigners, a graphical technique illustrated in Fig. 10.3. In the 1898 atlas, native and foreign workers were distinguished much more emphatically, both in the form of separate bar charts displaying occupations of individual ethnic groups (e.g., Italians, Russians) and of a percent bar chart categorizing the occupations of foreigners in relation to those of other groups (Gannett, *Statistical, Eleventh* 48–49, Plate 43). The shift to a more explicit form of display places the immigrant issue squarely before the public and begs the question: By showing economic assimilation during hard times, were the designers trying to reduce the threat of foreigners, or were they fueling anti-immigrant sentiment? Depending on readers' interpretive frameworks, they might be receptive to either argument.

The 1903 atlas strikes a rhetorical compromise by combining natives and foreigners in the same display, shown in Fig. 10.6. The chart represents over 40 occupations, which are itemized in the legend below, coded numerically within the rectilinear areas on the chart, and grouped into five color-coded categories, from Agricultural Pursuits to Manufacturing and Mechanical Pursuits. The population is divided into four groups: native Whites of native parents at the top of the chart, followed by native Whites of foreign-born parents, foreign Whites, and Blacks at the bottom. This design enables even the most casual reader to see that immigrants and their children are fully integrated into a wide range of occupations that broadly mirror the patterns of native Whites and Blacks, though foreigners are less active in Agricultural Pursuits and more active in Manufacturing and Mechanical Pursuits. By juxtaposing the four population groups, the chart argues for broad assimilation but

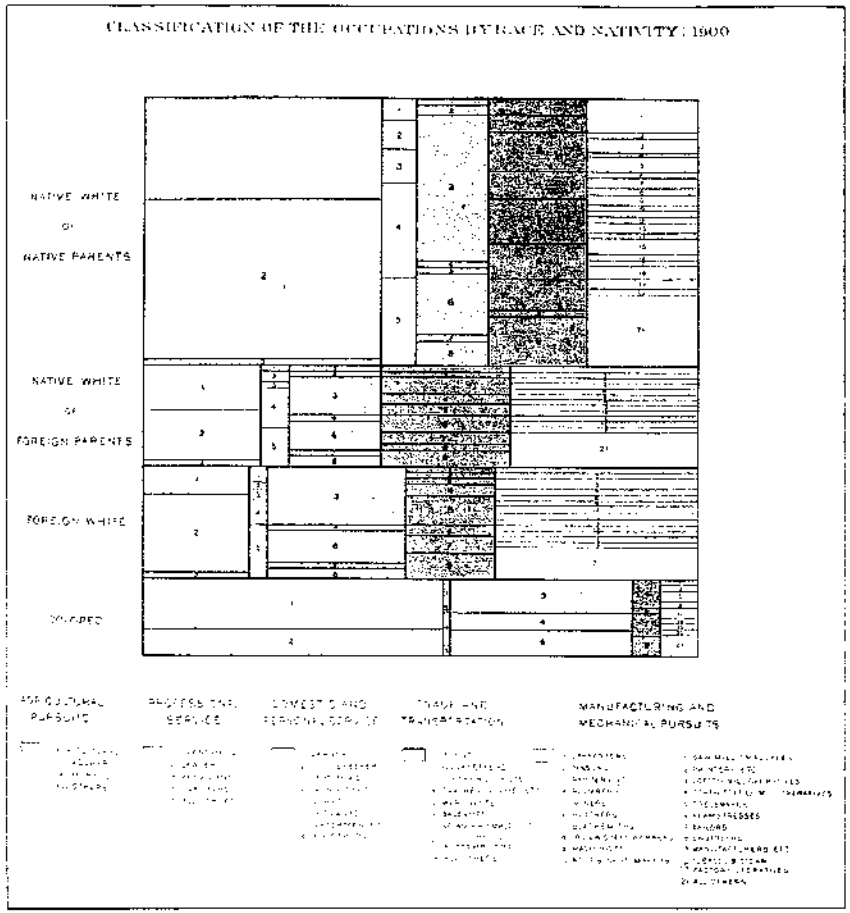

FIG. 10.6. Area Chart from the 1903 Statistical Atlas Showing the Occupations of Population Groups (Gannett, *Statistical, Twelfth*, Plate 87).

also enables readers to identify micro-level differences—e.g., the relative activity of any of the four population groups in each occupation. The intense focus on the occupations of foreigners, however, was only short-lived; data design in subsequent atlases shifted to another public policy issue—the occupational activities of children and adolescents.

Data designs, then, generally argued for the geographical and occupational assimilation of foreigners, though perhaps those designs produced mixed results with native Whites threatened by mass immigration. Visual arguments can also be advanced on the basis of how much, if at all, data are actually visualized. Designers control what is and what is *not* visualized, and that control

has rhetorical consequences, which Ben Barton and Marthalee Barton refer to as the "rules of inclusion" and "rules of exclusion" ("Ideology" 53–62). In the atlases, that control is clearly apparent in charts that downplayed, if not excluded, the foreign population. In a massive chart from the 1898 atlas showing the growth in U.S. population from the first census in 1790 (Fig. 10.1n; Gannett, *Statistical, Eleventh*, Plate 22), native Whites occupy the central core of the display, swelling with each census from top to bottom. To the right, a thin dark strip represents the Black population. On the left, however, foreigners appear only incrementally, a design strategy that marginalizes them in relation to the total population, shown beneath in an area chart that subdivides them by nationality. Graphical techniques also assuaged the impact of foreigners on public health. In the 1874 atlas, a line graph shows the incidence of diseases in both the native and foreign populations (adult and children) so that readers can compare the data (Walker, Plate XLIV). However, the line graph genre minimizes variations because the lines connecting data from one disease to another rise and fall at approximately the same angles. Subsequent atlases simply dodged the issue, as little information about diseases was designed to compare foreign and native populations.

For some issues, like occupations, including or excluding information in the atlases reflected the tenor of public discourse. The literacy of the foreign population, for example, figured importantly beginning in the 1890s with attempts to legislate literacy tests that would curb immigration, an effort that finally succeeded in 1917 (Daniels, *Not Like Us* 43–44; "Two Cheers" 14). The atlases reflected the increasing public attention to literacy and the ability to speak English. In the 1874 atlas, general illiteracy and adult White male illiteracy are plotted on maps (Walker, Plates XXIX and XXX), but in the 1883 atlas, the ability to write is mapped for foreigners as well as visualized in a bar graph (Hewes and Gannett, Plate 50). Subsequent atlases also charted illiteracy rates, including a population distribution chart in the 1914 atlas comparing data from the last and present censuses about foreigners' ability to speak English (see Fig. 10.7). Overall, the language charts argue that foreigners as a group are being assimilated linguistically into mainstream culture, though these displays selectively reveal the data—including only the aggregate numbers and excluding the rates of individual ethnic groups. As a result, readers are not invited to compare the relative literacy or English-speaking skills of Italians, Germans, Russians, or other groups.

Although data about some public policy issues appear prominently in the atlases, other data appear less frequently, if at all. In the climate of the post-Civil War Reconstruction, displays of the Black population, for example, appear consistently but sparsely and seem to reveal the nation's ambivalence about their status. Data about Blacks appear in close proximity to data about native Whites and foreigners, a gesture towards assimilation, but Blacks are stereotypically represented graphically by darker shades (Figs. 10.1e and

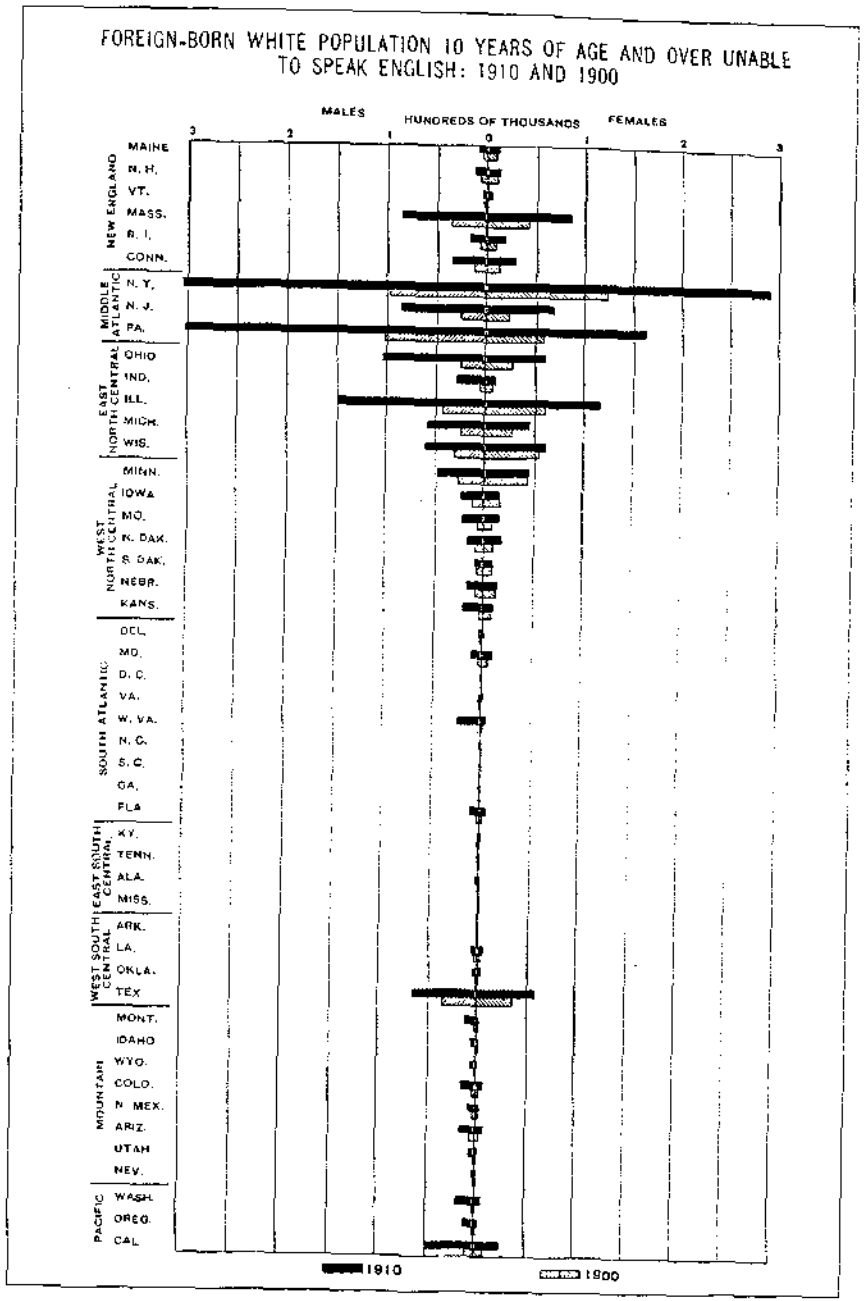

FIG. 10.7. Bi-Polar Chart from the 1914 Statistical Atlas Showing Foreigners by Sex Unable to Speak English (Sloane, *Statistical, Thirteenth*, Plate 226).

10.1n) or they are visually marginalized, illustrated by their placement on the right side of the massive population chart (Fig. 10.1n) and at the bottom of the occupational chart (Fig. 10.6). In the 1874 atlas the distribution of the Black population is charted on maps similar to those used for foreign groups. In the 1898 atlas, the Black population (relative to the White population) is visualized in rectilinear area charts for southern states (Gannett, *Statistical, Eleventh* 18), charts that reappear almost verbatim in the next two atlases. Overall, Blacks are represented relatively constantly, but minimally compared to the increasing attention given to foreigners.

Although the design of data about Blacks is limited and ambiguous, scant information about Indians is visualized, beyond an occasional map displaying reservations (see Walker, Plates XVIII and XIX). No maps chart Indian migrations and displacement, which remains one of the most compelling stories of 19th-century America. One rationale for this exclusion may be that little census data had been collected about such migrations; another may be that Indian migration directly conflicted with the mainstream narrative of westward expansion and immigrant assimilation. Whatever the practical or political reasons for not charting this story—and undoubtedly there were many—it has to be one of the most glaring rhetorical exclusions in 19th-century statistical graphics.

Today, civic discourse continues to be shaped by data design, though design is typically characterized pejoratively by caveats about how it's misused to manipulate data. Edward Tufte, one in a long line of critics, developed what he calls the "Lie Factor," which quantifies perceptual distortions that deceive readers and jeopardize the "graphical integrity" of the design (Tufte, *Visual Display* 53–77), undermining its ethos.[3] Skepticism about designed data continues to permeate public discourse in which charts and graphs appear, especially when they are embellished with "chartjunk" (Tufte, *Visual Display* 107–21).[4] Because contemporary readers are wary of deceptive charts and graphs and because computers make these forms so malleable, arguing with data displays has become a highly contested form of visual rhetoric. Rhetors who deploy charts and graphs in civic discourse, therefore, must proceed with extreme caution. Readers of the atlases a century ago, less savvy about the power of charts and graphs to construct a nation, could scarcely have imagined the rhetorical processes that the production and interpretation of those displays initiated.

DATA DISPLAYS AS CULTURAL ARTIFACTS

Visual language embodies cultural knowledge about the world and about its values, as we have already seen in the representation of public policy issues. Visual language also embodies another form of cultural knowledge—aesthetics (Kostelnick "Cultural"). However, the role of aesthetics may seem invisible because both readers and designers may be so entrenched in a given design style that they become oblivious to its influence over them. However, aesthetics permeates all areas of functional design, leaving a trail of cultural tracks. For example, a technical illustration from the Renaissance will reveal the cultural influence of the period (in the viewing angles, human figures, and other contextual details), just as a high-contrast page of sans serif text with geometrical forms will evoke early modernism. By projecting the aesthetic sensibility of a given historical moment, visual language creates rhetorical energy by cultivating and meeting readers' expectations.

In the half century in which the atlases appeared, a sea change in aesthetics occurred—from the decorative Victorian sensibility visible in the folio atlases to the machine-age functionalism of the later ones. The folio atlases reflect a late 19th-century aesthetic that fostered complexity, subtle variation, and natural forms. Although readers may not have recognized the data display genres that first appeared in the atlases, they most likely experienced an affinity with their aesthetic composition and texture. The displays are colorful, detailed, and sometimes multi-layered (e.g., the wavy line in the bar in Fig. 10.3). Shades of the same color are typically employed in the maps to create subtle gradations of population density, which invite the reader's careful study. The complex variety of the forms and their richness of detail, linework, and color predate the functional economy of modernism. Moreover, the displays rely on textual explanations for their interpretation, creating an interdependence between word and image. Notes and labels on the plates are primarily set in a serif typeface and often italicized; display text is often rendered in handwritten capitals; and decorative arrows direct readers from text to charts (see Fig. 10.3). Overall, the folio atlases reveal their historical and cultural origins by embodying an aesthetic that the designers shared with their readers and that gave the atlases a credible, authentic voice.

Although the folios embrace a delicate and highly ornamented aesthetic of the late 19th century, the latter three atlases exemplify the transition to functional modernism with its emphasis on economy and perceptual directness. Modernism fostered cultural assimilation in two key ways: Its international aesthetic visually dissolved cultural differences, and its emphasis on perceptual immediacy made data accessible to all readers, regardless of cultural background. Modernism sought to erase the stylistic conventions that separated cultures by developing an "international" style that transcended national borders and unified cultures. Clean, geometric forms supplied a basic design vocabulary for implementing the modernist program, engendering an aesthetic of cultural homogeneity that dovetailed with the melting-pot ideology of early 20th-century America.

Several design elements were deployed in the later atlases to visualize that ideology. In the 1914 and 1925 atlases, color is largely superseded by black-and-white patterns, or simply white space, virtually eliminating issues associated with interpreting color across cultures (see Horton 165–166). The segments of pie charts, for example, are no longer distinguished by color and

legends but only by blank spaces, which are directly labeled with a sans serif font, the modernist standard. This clean, objectified aesthetic is exemplified by the visual language of population maps. Figure 10.8 shows a U.S. map from the 1914 atlas showing the state-by-state percent of German immigrants. The textured patterns reveal the distribution of German immigrants: heavy in the upper Midwest and virtually nonexistent in the Southeast. No subtle or suggestive cultural tracks infiltrate this map or others like it displaying immigrant groups. Cleansed by the minimalist language of modernism, the data are visualized as hard, objective facts devoid of any cultural associations.

The minimalist, international style of modernism well served the readers of the later atlases, who were increasingly part of the melting pot, either as immigrants themselves or children of immigrants. The data not only *visualized* a burgeoning multi-ethnic society; that society was also its audience—highly diversified, representing virtually every European language and nationality (and others from around the world) as well as native Whites, some of whom may have harbored ill feelings toward immigration. This culturally and linguistically mixed audience was well matched with the international design program of modernism, which aimed to democratize design by making it accessible to all. An advocate of this philosophy, Otto Neurath attempted to democratize statistics in the early 20th century through his Isotype system of pictographic display. Neurath's Isotype used pictures (e.g., of humans, cars) in small, high-contrast, and equally sized increments, rather than as relative ar-

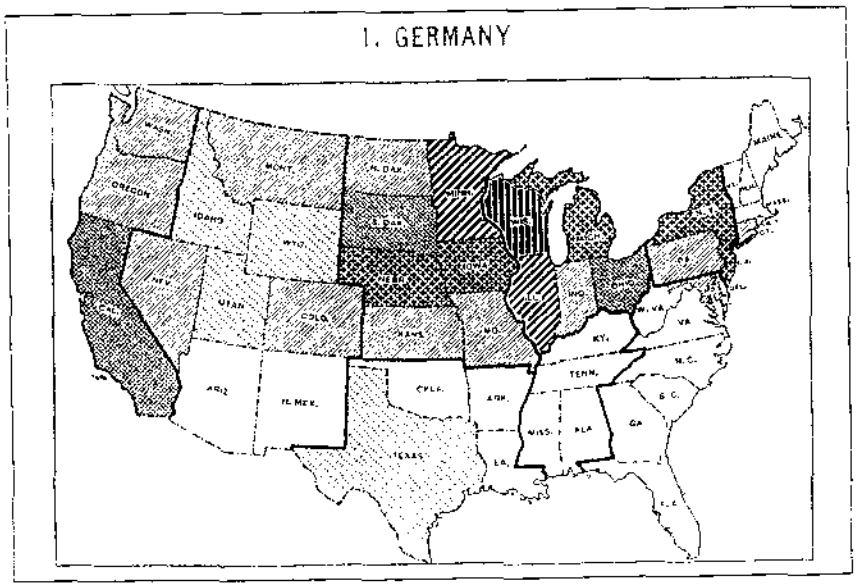

FIG. 10.8 Map from the 1914 Statistical Atlas Showing the Distribution of German Immigrants by State (Sloane, *Statistical*, Thirteenth, Plate 21).

eas as had been done previously, so that readers could accurately compare data. An extension of logical positivism, Isotype exploited visual perception so that readers could directly apprehend facts about the economic and social conditions of modern society (Lupton).[5]

The German immigration map (Fig. 10.8) illustrates several of these modernist tenets. Like most displays in the 1914 and 1925 atlases, the map stands largely on its own, perceptually linking reader and data with little textual mediation. Although a single legend keys the data patterns for the six immigrant maps that appear on the same page, readers can perceive the main themes in the data without even referencing the legend. Using black-and-white patterns to represent relative population density exploits the gestalt principle of figure–ground contrast (darker equals denser), and it flattens and economizes the maps compared to the color-coding systems used in previous atlases. The flat black-and-white patterns, however, have their drawbacks: They limit both the designer's and the reader's ability to differentiate them, and the repetitive patterns (e.g., stripes) create what Tufte calls "moiré effects" (*Visual Display* 107–11). But within the cultural framework of functional modernism, these liabilities are offset by the aesthetic and practical economies of black-and-white print.

Modernism, of course, did not have sole claim to perceptual accessibility. From the start, the designers of the atlases intended their displays to be readily perceptible to their readers—as Hewes and Gannett put it, to enable readers to see data "at a glance" (Preface vii). In the Preface and Introduction to the 1874 atlas, Francis Walker explains the perceptual qualities of its displays and their effects on the eye, both in terms of a "general impression" of the data as well as closer readings of details (Walker, Preface 2). Tufte describes these two modes—on the one hand, the big picture and on the other hand, the smaller local view—as the "macro" and "micro" levels of interpretation (*Envisioning* 37–51; see also Barton and Barton, "Modes" 150–155). All of the atlases give readers access to data on both levels, though the emphasis gradually shifts away from the micro-level access in the folios to the more perceptually immediate macro-level, a shift that generally mirrors the modernist emphasis on perceptual efficiency.

In the early atlases, especially the 1874 and 1898 atlases, graphical displays were often spread across folio pages—as in Fig. 10.5, the field of pie charts—which added another level of complexity by variegating their perceptual context. Although the segments of the pie charts (e.g., British, Austrian, or Polish immigrants) are consistently color-coded across the displays in the visual field, the larger narrative is visually fragmented into the individual profiles of each pie chart, one state at a time. The same applies to folio plates of population distribution charts: Readers can readily identify the anomalies (in asymmetrical states like Nevada in Fig. 10.2), but the profiles of other states are rendered more subtly in individual charts, as they are in the field of square area charts for church accommodations (Fig. 10.4). In these instances, the micro-level reveals more compelling information than a *glance* at the whole plate.

The rectilinear area chart of occupations from the 1903 atlas (Fig. 10.6) strikes a balance between the macro- and micro-levels. The color and grouping of elements enable readers to see the big picture and to compare variables—e.g., to see that the foreign population has a larger share of workers in Manufacturing and Mechanical Pursuits than the other population categories, and fewer in Agricultural Pursuits. On the micro-level, readers can explore the sub-plots embedded in the larger narratives. For example, they can discover that the foreign population includes few lawyers and virtually no barbers, housekeepers, or masons. Readers are empowered to access information on both levels and to shuttle freely between the two.

In the later atlases, the emphasis shifts decidedly to the more perceptually accessible macro-level. The design of the German immigration map (Fig. 10.8) emphasizes the macro-level through the visual immediacy of its high-contrast design. The bi-polar chart in Fig. 10.7 (also from the 1914 atlas) similarly foregrounds the macro-level with a linear, minimalist design. Readers can readily see the dominant patterns—heavy concentrations of non-English speaking immigrants in the Middle Atlantic states and a few other local areas—but no horizontal gridlines encourage the eye to explore micro-level data for individual states. The dot density map (Fig. 10.1p), which appeared initially in the 1883 atlas (Hewes and Gannett lix) but was refined and expanded in the 1914 atlas, exemplified this shift to the macro-level by visualizing data as tiny uniform dots. Most readers wouldn't try to count the individual dots in a given region (unlike the folio maps where readers could often, if they wished, scrutinize the data county by county). Densely concentrating in some regions and lightly dusting others, the dots on the maps provide an unmediated macro-view, a gestalt that links data and eye through direct perception. By emphasizing "seeing" over close "reading," the macro-view over the micro-view, modernist design presumed to tap directly into the perceptual faculties of readers—*any* readers, *anywhere*, regardless of their ethnicity—and therefore required minimal learning or enculturation (see Bertin 179–181; Lupton).

The shift toward a modernist aesthetic for the data displays, then, reinforced the melting-pot ideology by representing changes in population in a seemingly objective design accessible to a multi-ethnic audience. As Robin Kinross points out, however, the rhetorical "neutrality" of modernism embodied its own ideology. An aesthetic program that aimed to erase cultural difference by creating an "international" style was hardly neutral. Historical perspective further clarifies its ideological bent. Today the forms of early modernism—the rectilinear grid of steel-and-glass buildings, the sleek lines of furniture, the sans serif page of text, as well as the high-contrast displays of the last two atlases—appear starkly, even gratuitously, functional. The cultural framework of modernism has long since yielded to the nuanced, pluralistic aesthetic of postmodernism with its punctured facades, multilayered surfaces, and emphasis on contextual fit.

The cultural knowledge of aesthetics embeds the visual rhetoric of any design: Typography, screen designs, pictures, and data displays all leave their cultural tracks by embodying an aesthetic element that both meets and engenders reader expectations. The early atlases met reader expectations by projecting a delicate, decorative aesthetic, and the later atlases redefined those expectations by adopting a machine-age aesthetic that embraced an ideology of cultural neutrality. Staying in step with the shifting tides in taste enhanced the ethos and usability of the atlases. It also addressed the more specific rhetorical problem of representing immigrants to a multi-ethnic audience with forms that were ostensibly objective.

CONCLUSION

During the half century in which they appeared, the statistical atlases played a key role in defining the visual language of data displays in the United States. By experimenting with a variety of forms, imitating them in successive atlases, and educating readers in how to interpret them, the designers of the atlases developed and modeled a conventional visual language for displaying data. By envisioning the progress of the nation, the atlases also shaped civic discourse about public policy issues, particularly regarding the influx of immigrants and their assimilation geographically, vocationally, and linguistically. In doing so, the atlases also projected the prevailing tides in taste, from an aesthetic that valued ornament and close reading to one that valued economy and perceptual immediacy. In several ways, then, the atlases built a rhetorical bridge to contemporary information design.

This bridge-building process reveals a good deal about the nature of visual rhetoric in practical communication. Visual rhetoric is an intensely social process that entails convention building within discourse communities and a process of enculturation that fosters visual literacy among group members. Information design also embodies the shared cultural knowledge—values, ideologies, and aesthetic tastes—of its designers and readers at a given historical moment. Although these social elements provide a foundation for information design, visual rhetoric is scarcely deterministic. Rather it turns on readers' interpretations in specific situational contexts, one reader at a time. That some readers of the statistical atlases, however, may have initially found the data displays novel, clever, or incomprehensible testifies to the powerful social forces that drove the visual rhetoric of these images. By constructing a coherent visual narrative from a wealth census data, over a half century the atlases progressively enabled a diverse, multi-ethnic audience to envision together the nation's rapid growth.

ACKNOWLEDGMENT

I wish to thank the editors of this collection, Charles Hill and Marguerite Helmers, for their helpful suggestions on an earlier draft of this chapter.

NOTES

1. The statistical atlases were published from three to eight years after the actual census year. Copies of the 1874, 1883, and 1898 atlases appear on the Library of Congress Web Site (http://memory.loc.gov/ammem/gmdhtml/census.html), which also contains additional background information (see Dahmann).
2. According to the 1874 statistical atlas, "The Geographical illustrations, in general, require no verbal description and explanation, beyond what is given on their face" (Walker, Preface 3); a line graph is described as a "more familiar mode of illustration" (Walker, Preface 2).
3. Tufte's predecessors include Willard Brinton, whose *Graphic Methods for Presenting Facts* (1914) analyses distortions caused by areas and volumes (20–40). Several decades of empirical research have clarified and authenticated these concerns (see Cleveland and McGill; Macdonald-Ross: Cochran, Albrecht, and Green).
4. In the political arena, for example, Ross Perot was lampooned for using charts and graphs in his 1992 presidential campaign.
5. Although Neurath's Isotype system was infused with the democratic ideals of early modernism, Clive Chizlett argues that Neurath may have used his design skills in the Soviet Union in the 1930s to misrepresent mass deaths resulting from famine.

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