Kuby

CHAPTER 1

True Maps, False Impressions: Making, Manipulating, and Interpreting Maps

INTRODUCTION

Human geography studies the distribution of humans and their activities on the surface of the earth and the processes that generate these distributions. People use geographic space and interact with the environment when they grow crops, build homes, drive cars, do jobs, raise children, practice religions, cast votes, and spend leisure time. Geographers help us understand the evolving character and organization of human life on the earth's surface.

Geographers subscribe first and foremost to the view that location matters. It is significant that 305 million persons live in the United States. More significant, however, is where these 305 million persons live. Are they urban or rural? Are they spreading out or becoming increasingly concentrated? What kinds of places are attracting people, and what kinds are losing them? These are geographic questions. Similarly, the world is capable of producing plenty of food to feed its current population of 6.8 billion. Relevant questions about world hunger are geographic ones. How are the supply of and demand for food distributed spatially? What environmental, economic, and political factors account for these distributions? How are demand and supply reconciled in the international marketplace for food?

Many of the topics that you will find in this workbook are common to other sciences. Geographers have no monopoly on the study of baseball franchises, migration, AIDS, the population explosion, civil war, and air pollution. Geographers bring to the table their unique spatial perspective and interest in human-environmental relations by asking "where?" and "why there?" questions about the same pressing human problems that engage other social and environmental scientists.

The "where" question leads to five overarching themes in human geography that run through the various chapters of this book (Table 1.1). The first theme, **location**, refers not only to the exact coordinates of a point in space but also to where it is relative to other factors. **Place**, the second theme, involves the human and physical characteristics that uniquely define a place and impart meaning to its inhabitants. The third theme, **region**, defines areas that are bound together by common characteristics: Similar places and locations form common regions. In the fourth geographical theme, **movements** of information, goods, and people connect locations and regions to one another. The

TABLE 1.1 Five Themes in Human Geography

Theme	Definition	Selected Examples in Chapters
Location	The absolute position of something on the surface of the earth and its relative proximity to other related things	Chapter 1: Where do African-Americans live, and why? Chapter 6: Where are different kinds of jobs concentrated, and why? Chapter 7: What is the spatial pattern of development, and why? Chapter 8: Where are different crops and livestock grown, and why? Chapter 9: Where are major league baseball teams located, and where should new ones be put, and why? Chapter 11: Where should new housing be built in the urban area, and why? Chapter 12: Are the locations of Catholics and Protestants in Northern Ireland growing more mixed or more segregated over time?
Place	The local human and physical characteristics that uniquely define a place and impart meaning to its inhabitants	Chapter 2: What symbolic imagery represents the characteristics of the place where you live? How are these themes presented to create a place identity? Chapter 10: What can you tell about a neighborhood by observing it, and how does it compare to census data? Chapter 13: Why are people of the former Yugoslavia and Kurdistan so attached to their places of birth?
Region	An area characterized by similarity or by cohesiveness that sets it apart from other areas	Chapter 2: What are the boundaries and cultural traits of the Middle East or American Southwest culture regions? Chapter 6: Which regions specialize in which industries, and why? Chapter 9: How and why would a new baseball team affect the market areas of existing teams? Chapter 10: What kinds of subregions exist within a city, and why? Chapter 11: How and why have urban regions expanded over time? Chapter 13: How did mismatches between political and ethnic regions lead to war in Yugoslavia and Iraq?
Movement	The flow of people, goods, money, ideas, or materials between locations near and far	Chapter 3: How and why has AIDS spread throughout the United States? Chapter 4: From where do people move to your state or province, and why? Chapter 8: What kinds of food are imported from other countries, and why? Chapter 11: How will different urban growth strategies affect traffic congestion? Chapter 13: When did Islam spread to Bosnia, and why? Chapter 14: How does the movement of water or beef, or barriers to the movement of mountain lions, lead to environmental problems?
Human-Environmental Interaction	The ways in which human society and the natural environment affect each other	Chapter 2: How have humans adapted to arid climates in the Middle East and the American Southwest? Chapter 5: How does population growth in India affect the environment? Chapter 8: Which crops grow best in which climates? Chapter 11: How does urban sprawl affect the environment? Chapter 14: What are the causes and effects of environmental problems, and what are the positions of the various stakeholders?

final theme is **human-environmental interactions**. Humans and their environment interact in both directions: environmental resources constrain and benefit human societies while human activities refashion and degrade their environments. Notice in Table 1.1 that some of the case studies in the book involve several themes (i.e., the themes are not mutually exclusive).

Geography's spatial perspective—and all five themes—lead to the heavy use of maps. In the broadest sense, **a map** is a two-dimensional graphical representation of the surface of the earth. No map can perfectly represent reality. People tend to think of maps as unalterable facts, as if produced by an all-seeing overhead camera. In practice, however, mapmakers (or cartographers, as they are known in the field) exercise considerable discretion in the spatial information they display and the way they display it. You must always keep in mind that any map you look at could have been made in countless different ways, sometimes drastically altering your perception of what you see.

Cartographers (mapmakers) make five critical decisions about map construction that greatly influence the message conveyed by the map. First, they choose a particular **map projection**, which is a systematic method of transferring the spherical surface of the earth to a flat map. There is an old saying that "all maps lie flat, and all flat maps lie." It is utterly impossible to represent the three-dimensional world on a flat, two-dimensional piece of paper or video screen without stretching or compressing it in some way. Every projection is therefore distorted in one way or another, and this distortion influences the impression in the viewer's mind about the size and proximity of different regions of the world (Figure 1.1).

For example, Figure 1.1A shows the Mercator projection of the world, a map used in early navigation because all compass bearings (directions) are correct. The British Empire, based on sea power, used the Mercator projection extensively, and spread it around the world. However, this projection grossly exaggerates area as you move away from the equator. For this reason, Mercator maps were a favorite of President Reagan during the Cold War because they made the Soviet Union appear much larger than it actually was, reinforcing the impression that the USSR was a dangerous threat and thereby justifying a tough anti-Soviet stance. For the same reason, Mercator projections are unpopular among equatorial countries, whose size appears diminished. A popular projection that attempts to preserve the area of map features and avoid high-latitude distortions is Mollweide, shown in Figure 1.1B. Many international agencies, such as the World Bank, have changed the map projections they use in an effort to more accurately depict relationships between countries, not biasing any one region. For example, Figure 1.1C shows the Van Der Grinten projection, which portrays both Russia and Canada at over 200 percent larger than they actually are. The National Geographic Society used this projection for over 50 years before changing to the Robinson projection (Figure 1.1D) in 1998. The Robinson projection better portrays the relationship between land and water areas in the world and does not distort countries at high latitudes nearly as much.

Although these four examples of map projections show distortions in shape and size that can occur, they all still adhere to certain conventions that can also mislead. For instance, they all split the world through the Pacific Ocean, making Japan appear far from Hawaii and the United States. This false impression may have contributed to the "surprise" Japanese attack on Pearl Harbor during World War II. Polar projections centered on the North Pole in Figure 1.1E clearly show how close the former Soviet Union and the United States were to each other over the Arctic Ocean, a relationship you cannot see in the first four projections. Looking at this

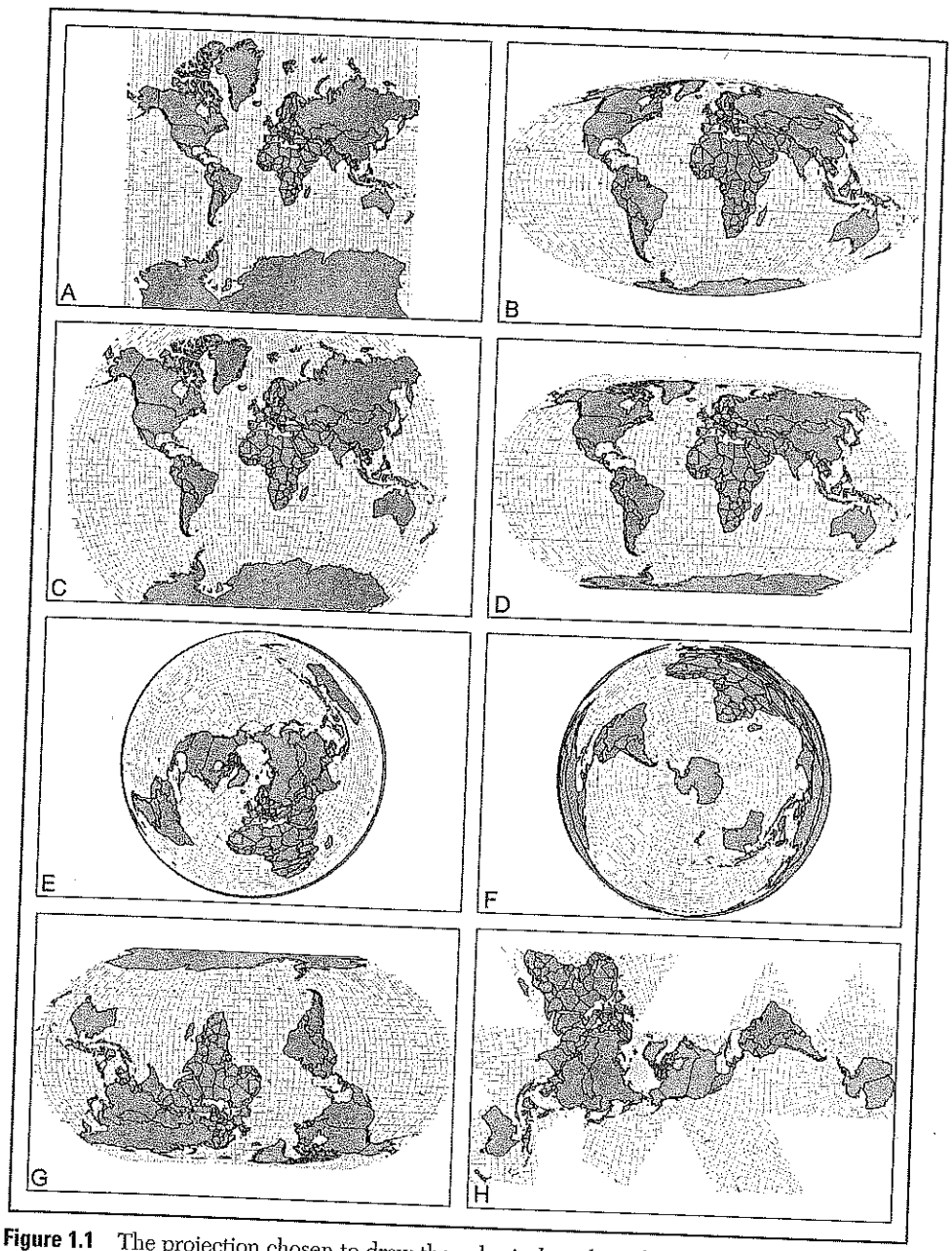


Figure 1.1 The projection chosen to draw the spherical earth on flat paper affects the shape of the map and our perception of the relationships between the map features.

projection, it becomes obvious that northern Canada and Alaska were good locations for warning stations designed to detect incoming Soviet nuclear missiles. A less common view of the polar projection focused on the South Pole and Antarctica (Figure 1.1F) makes Australia, New Zealand, Chile, and Argentina appear central to the world. In fact there is no compelling reason for adhering to the convention of showing north at the top on a map. Europe and North America typically occupy the privileged position on a map where our eyes tend to focus, reinforcing the perception of their dominant status in the world. The earth as seen from space could just as easily be depicted with south up (Figure 1.1G), a radical change that calls into question global geopolitical relations.

Finally, the Dymaxion Map™ (Figure 1.1H) reveals the landmasses situated in a worldwide ocean, without visible distortion of the relative shapes and sizes and without splitting any continents. This map, designed by the Buckminster Fuller Institute, is an attempt to show the global connections of all humanity rather than disassociated countries and places competing against each other.

The second critical decision cartographers routinely make is **simplification**. Simplification can take many forms, such as omission, straightening, exaggeration, and distortion, depending upon the map's ultimate use. Maps of Canada for educational purposes frequently omit small, uninhabited islands and straighten jagged coastlines in the Canadian Arctic, whereas maps for navigation try to show the same features with great accuracy as well as water depth and currents. Highly simplified subway maps emphasize information of potential use to a subway rider and ignore features of the human and natural environment that are unimportant to navigating the subway network (Figure 1.2). Stations five or six blocks apart in the central city appear on the map as far apart as suburban stations separated by several miles, because for most subway travelers, distance is unimportant. What matters is whether they are on the right line, how many stops until they need to get off, and whether they need to change trains. To make road lines readable on the map, they are drawn thicker than if they were drawn proportional to their width in the real world. Some buildings are considered important enough to include, but most are not. No two cartographers make these ultimately subjective decisions in the same way.

A third way to manipulate the way a map looks is by choosing a different map scale. **Map scale** refers to the degree to which a map "zooms in" on an area. Map scale can be defined as the ratio of map distance (distance between two points on a map) to earth distance (distance between those two points on the surface of the earth), measured in the same units. Every map has a scale, and the degree of generalization of information depends on that scale. A large-scale map depicts a small area (such as downtown Phoenix) with great detail. A small-scale map depicts a large area (such as the state of Arizona) but with less detail. You can remember this by considering the size of a particular feature on a map. For example, the larger your city or country appears on a map, the larger the map scale. Another way to remember it is by the fraction that defines the ratio of map distance to earth distance. On a large-scale map of downtown Phoenix, the scale might be 1/10,000, which is a larger number than 1/1,000,000 for a typical small-scale map of Arizona. A large fraction means large scale; a small fraction means small scale.

The case studies in this book explore human geography at a variety of scales. Activities at the global scale (i.e., small-scale maps) include Chapter 7 on international development levels, Activity 1 of Chapter 8 on global agriculture, and Activity 1 of Chapter 14 on global carbon dioxide emissions. At the national or regional scale are Chapter 2 on the Middle East and American Southwest culture regions, Chapter 3 on AIDS diffusion, Chapter 4 on migration to your state or province, Chapter 5 on India's population, Chapter 6 on economic specialization, Chapter 9 on baseball market areas, Chapter 12 on segregation in Northern Ireland, Chapter 13 on the wars in the former Yugoslavia and Iraq, and Chapter 14 on environmental case studies. Finally, the activities at the local scale (large-scale maps) include Activity 3 of Chapter 8 on local agricultural change in Latin America, Activity 1 of Chapter 9 on pizza restaurants in your state, Chapter 10 on your local urban landscape, and Chapter 11 on urban sprawl in Colorado Springs.

Defining the scale of analysis is important in geography. Many geographical research questions will have different answers when asked at different scales.

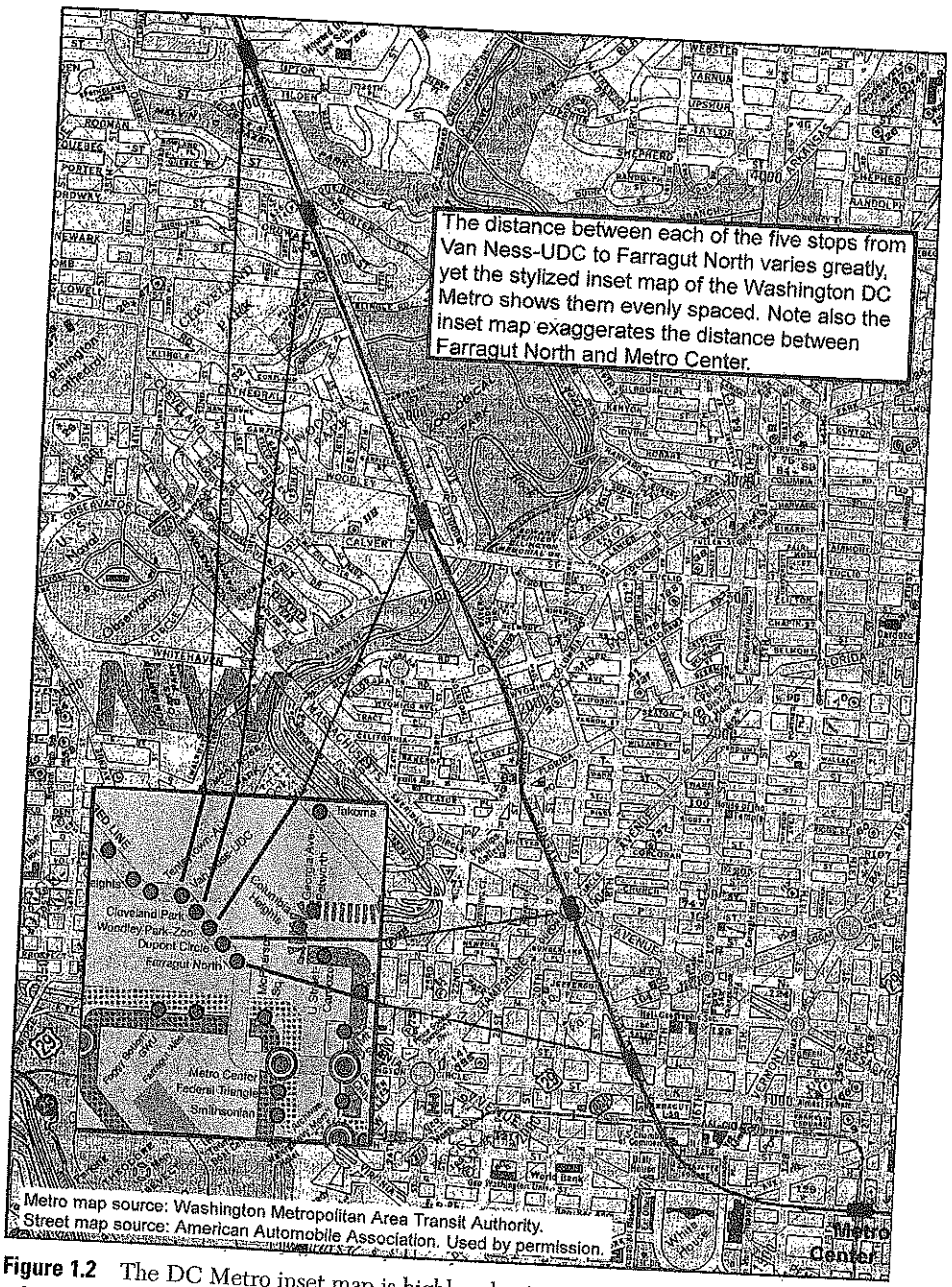


Figure 1.2 The DC Metro inset map is highly selective in that it shows only the sequential relationship between subway stops. All underlying detail is suppressed so that even distance is distorted.

Take, for instance, airport location. America's airports are bursting at the seams. Departures have more than doubled since 1980, while only a single major new airport has been built. Most major airlines, with the notable exception of Southwest, operate a hub-and-spokes system, where flights converge at several times of day from all over the country, passengers debark and switch planes if necessary, and then an outgoing bank of flights take passengers to their final destinations. If the question is whether to locate a new hub airport at a central or peripheral location, the answer is very different at the national and local scales. At the national scale, most hubs for domestic airlines are located in the *central* region of the United States to minimize detours for passengers switching planes. Major hubs are at

Figure 1.3 Denver International Airport, built in 1995, is located 20 miles east of the city center.

Chicago (United, American), Atlanta (Delta), Dallas (Delta, American), Detroit (Northwest), Minneapolis (Northwest), Denver (United), Cincinnati (Delta), Salt Lake City (Delta), Charlotte (US Air), Philadelphia (US Air), and Phoenix (US Air). Cities on the periphery of the United States, such as Boston, Miami, San Diego, and Seattle, are not used as domestic hubs because they would create huge detours for passengers traveling between most U.S. airport pairs. At the local scale, on the other hand, it would be nearly impossible to locate a new airport in a central location, even though centrality would maximize the airport's accessibility to the entire metropolitan area. The cost of the land, the security risk, the number of residents and businesses it would displace, and the large populations that would be affected by noise and traffic would pose insurmountable problems for a new centrally located airport. The only major metropolitan airport built in the last two decades—Denver International Airport—is located on Denver's eastern periphery, out on the prairie (Figure 1.3). Airport location at the local scale thus depends on an entirely different range of issues from those at the national scale.

Related to map scale is the fourth cartographic issue of data **aggregation**. The level of data aggregation influences the spatial patterns we see. By level of aggregation, we are referring to the size of the geographic units under investigation (i.e., cities, counties, states, regions, countries, or groupings of countries, such as Central America, Western Europe, or Eastern Africa). A particular pattern that is revealed at one level of aggregation does not necessarily appear at another. For example, the spatial pattern of college graduates depends on whether you consider counties or states as your unit of analysis. If asked by a high-tech employer: "Where are the highest percentages of people with a college degree?" a good geographer would answer that it depends on the level of geographic resolution you have in mind. At the state level of aggregation, Massachusetts has the highest percentage of people with a bachelor's degree or higher at 33.2 percent, and West Virginia has the lowest at 14.8 percent (Figure 1.4). Maps at the county level, however, show that some urban counties and counties with universities in West Virginia have higher percentages of college graduates than do some rural counties in Massachusetts (Figure 1.5).

Finally, the fifth way to influence the way a map looks is through the type of map you choose. General-purpose maps with a variety of common features such as

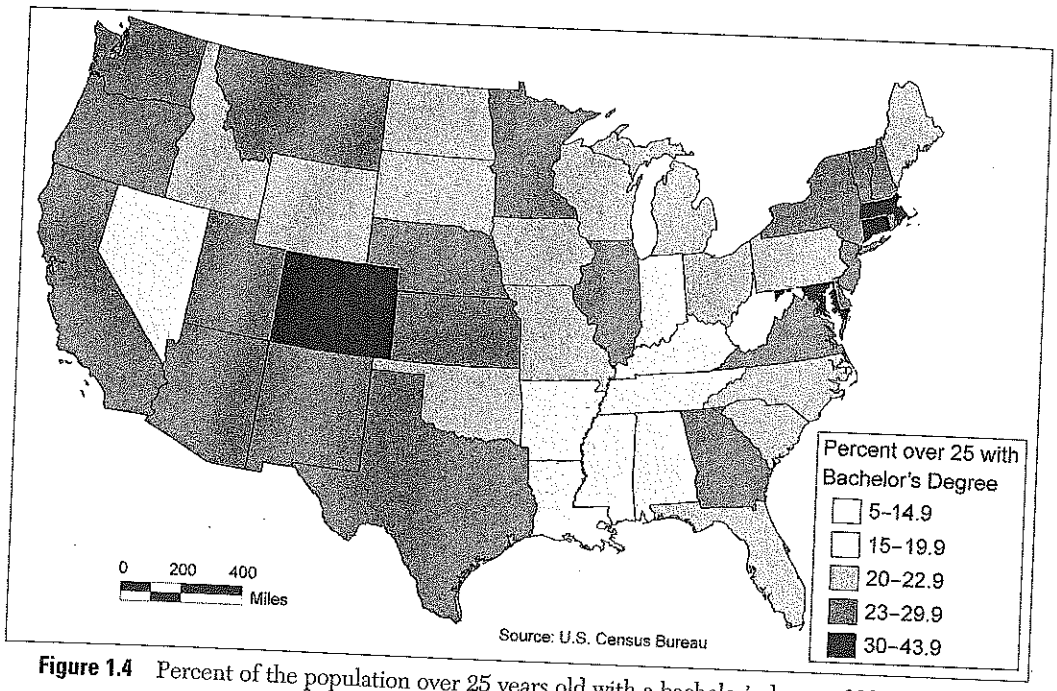


Figure 1.4 Percent of the population over 25 years old with a bachelor's degree, 2000.

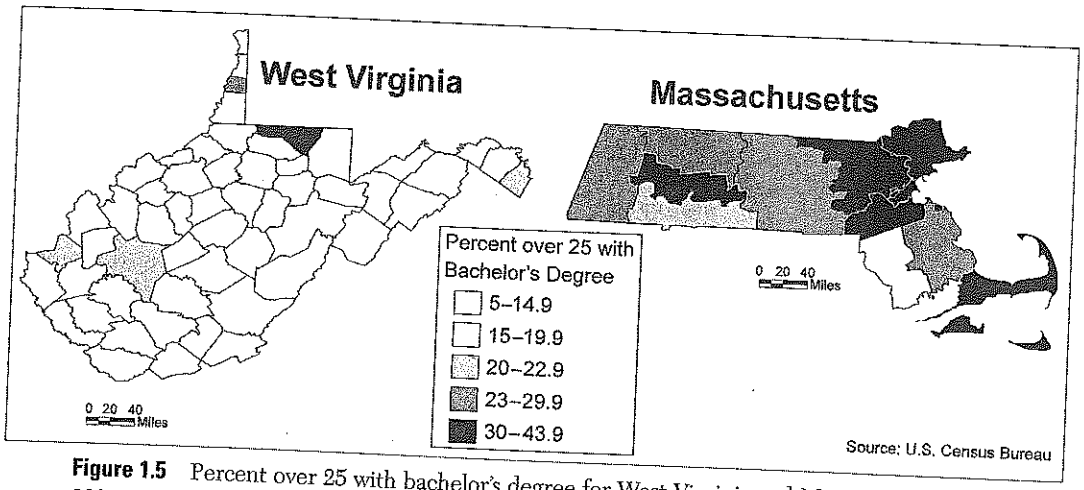


Figure 1.5 Percent over 25 with bachelor's degree for West Virginia and Massachusetts counties, 2000.

cities, boundaries, mountains, and roads are known as **reference maps**. Maps that highlight a particular feature or a single variable such as temperature, city size, or acreage in potatoes are called *thematic maps*. There are several types of **thematic maps** (Figure 1.6). **Isoline maps** show lines that connect points of equal value (*iso* means "equal" in Greek). A topographic map, for instance, shows lines of equal elevation above sea level. Crossing an isoline amounts to going up or down that surface (increasing or decreasing the value of the variable being mapped). **A choropleth map** shows the level of some variable within predefined regions, such as counties, states, or countries. It categorizes a variable into classes and depicts each class with different shading patterns or colors. **A proportional symbol map** uses a symbol such as a circle to show intensity or frequency; the size of the symbol varies with the frequency or size of the variable being mapped. Finally, **dot maps** use a

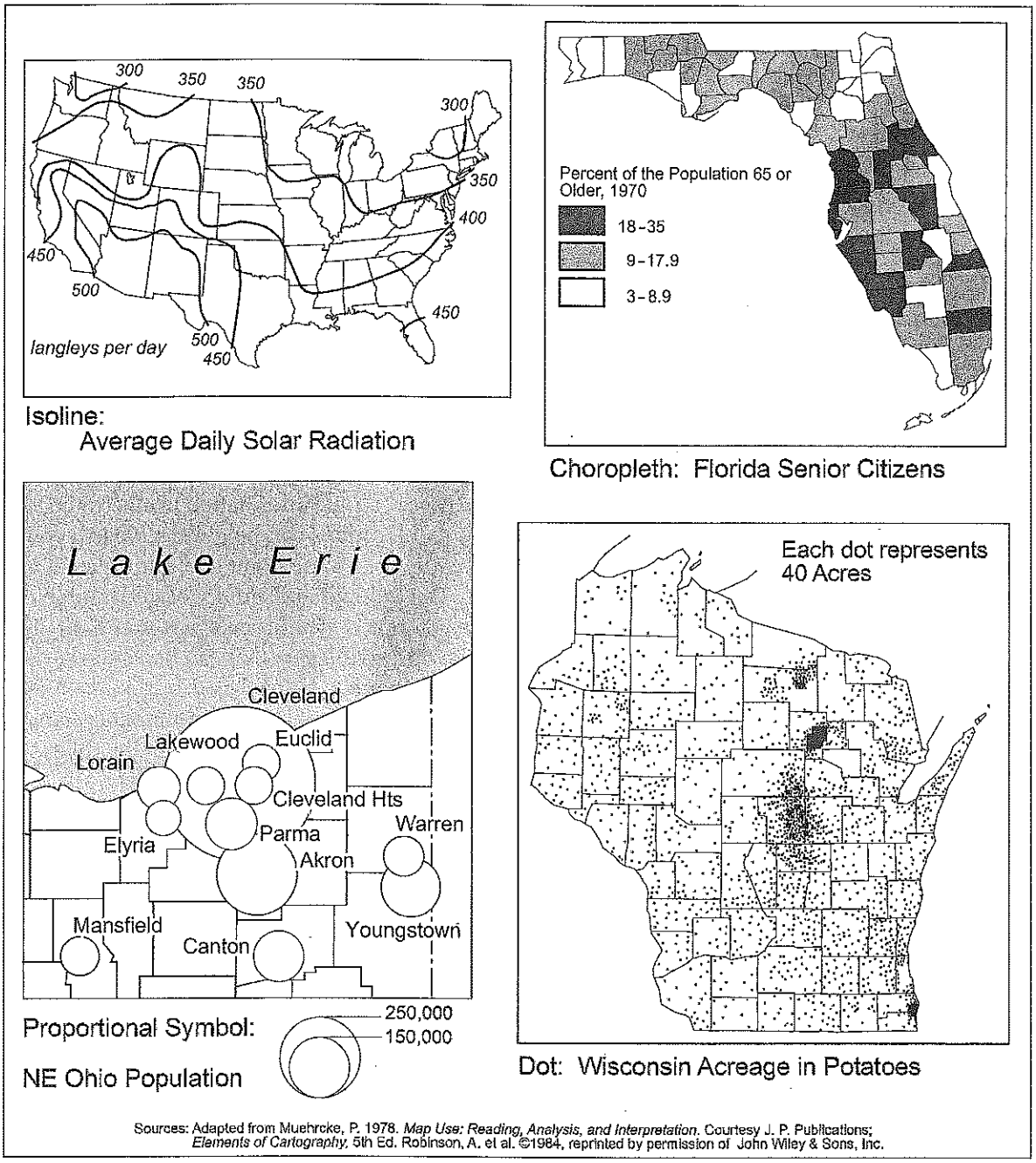


Figure 1.6 Four types of thematic maps.

dot to represent the occurrence of some phenomenon in order to depict variation in density in a given area.

The project you will work on in this chapter asks you to use **spatial data**, which have a geographic or locational component. You can place them on the surface of the earth, and therefore you can map them. Geographers commonly use two types of geographic data: primary and secondary. **Primary data** are measured or obtained directly by researchers or their equipment without any intermediary. For instance, survey research involves asking people about their shopping behavior, travel patterns, or migration history. Traffic counts can be measured by video

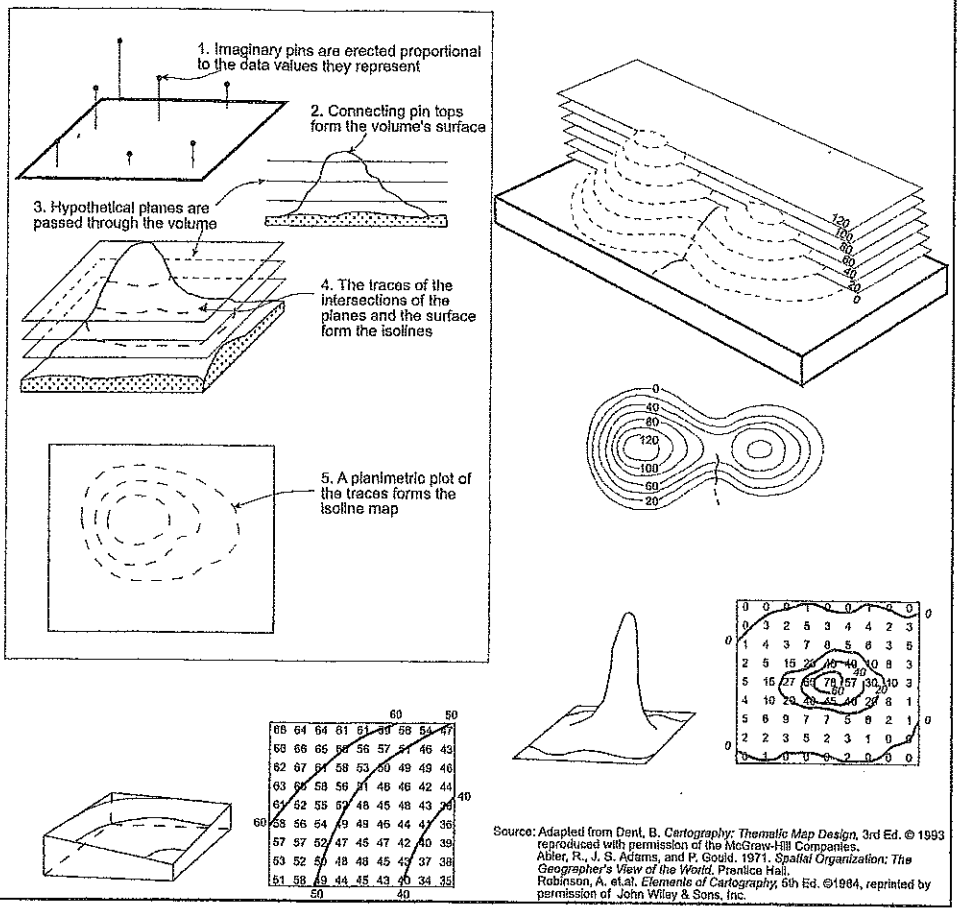
cameras, sensor plates or wires, or human observers. Geographers obtain **secondary data** from another source that has previously collected, processed, and catalogued the data. Agencies of international, national, state, and local governments collect and disseminate a veritable treasure trove of geographic information. Examples are agencies of the United Nations (www.un.org), the U.S. Census Bureau (www.census.gov), the National Oceanographic and Atmospheric Administration (www.nesdis.noaa.gov), state governments, and local planning agencies. Using secondary data can be efficient (imagine conducting your own census!) and can enable you to greatly extend the scope of your research by including a wide array of factors. In this book, most of the data you will use were obtained from secondary sources, but you will have a chance to collect primary data in Chapter 2 (postcards), Chapter 8 (foods available in your local supermarket), Chapter 9 (pizza restaurants in your state), and Chapter 10 (field observations of landscapes).

One of the most important recent trends in geography is the development of **geographic information systems (GIS)**. A GIS is, in short, a spatial database linked to a graphic display. Geographers and scientists in related fields use a GIS to store, access, analyze, and display geographic information in electronic form with user-friendly software. Addresses and locations can be given x,y earth coordinates (geocoded) within a GIS, enabling the user to pinpoint and interrelate a variety of phenomena in geographic space. The volume and variety of geographic data that can be linked using space as the reference grid literally have no limit. Different geographic information is stored in different layers that can be viewed in any combination, and their relations to each other can be analyzed.

A GIS has many useful applications in planning, environmental management, market research, and demographic analysis. You will use GIS in the following mapping exercise and observe its power to enrich geographic analysis.

The following six rules help you read an isoline map:

1. Evenly spaced isolines represent comparatively steady or constant slopes.
2. Closely spaced isolines represent steep slopes.
3. Widely spaced isolines represent slight slopes.
4. Isolines that form the "peaks" of your variable become closed circles.
5. Isolines either start and end at the edges of the map **or** form closed circles. There are no other possibilities.
6. Isolines **never split, intersect, or cross each other.**



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Abler, R., J. S. Adams, and P. Gould. 1971. *Spatial Organization: The Geographer's View of the World*. Prentice Hall.
Robinson, A. et.al. *Elements of Cartography*, 5th Ed. ©1984, reprinted by permission of John Wiley & Sons, Inc.

Figure 1.14 Rules and visual aids for isoline maps.