# CHAPTER 1

# Introduction: The Importance of Map Reading



> There are often many truths in a place or an area right before our eyes, and yet we're not aware of those truths (or features, or facts) until a depiction or a symbol or even a diagram *shows* them to us.
>
> —*Mapping* (pp. x–xi)

We see maps every day, often without really looking at them. A weather map is shown on a morning TV news show, or a map pinpoints the location of a natural disaster, rush hour traffic is displayed with colors relating speed and symbols indicating "traffic incidents." The morning paper, in addition to a weather map, might have a U.S. map that shows unemployment by state or worldwide incidence of the latest flu strain. All of these maps have been presented to us before we finish our morning coffee. As the day progresses, we might use an online map to find our afternoon appointment, an in-car GPS map for turn-by-turn directions, or a street atlas if we don't have access to GPS. A transit map might show us which train to take and the relation of our exit station to other stations. At work we might need a map to help decide where to put a new store or where to allocate money. And so it goes. Throughout the day maps pass before our eyes. Maps are ubiquitous.

But do we really get the most from these various maps? Do we stop to read them carefully? Other than knowing what the weather in our town will be today, whether the natural disaster will affect us, or if the traffic incident is on the freeway we normally drive, what have we learned from these maps? Could we use them more effectively?

Given the commonness of maps and their many uses, not being able to read maps

effectively is like only being able to read text at a third-grade level. We might be able to understand the basics, but much is lost to us.

First, although we all "know" what a map is, it is helpful to define the term as cartographers use it. Cartographers are mapmakers, and cartography is the art, science, and technology of making maps and also their study as historical documents and/or works of art. But what *is* a map? J. H. Andrews discovered 321 definitions of "map" for his article "What Was a Map?" (1999). The most common definition is: A graphic representation of all or a part of the earth or other body, drawn to scale upon a plane. However, this definition limits us because some objects we recognize as maps, such as sketch maps, are not drawn to scale, nor are some maps of preliterate peoples. Some "maps" are annotated photos or imagery, not drawn graphics. Some maps on a computer monitor or cell phone are animated. Thus, for our purposes we will define maps as spatial representations of information.

Second, we should consider the purpose or goals of maps. Maps *represent*; that is, they portray information about a place symbolically. Maps also are a form of *communication*: The cartographer conveys information to a map user. The map is the medium of communication. Maps are *visualizations*; visualization refers to exploring data and seeing data in different ways. While a series of maps of the same data could be considered visualizations, usually the term is associated with dynamic visual displays on a computer screen; the goal of visualization is to gain insight into the data. Finally, maps are *arguments*, as suggested by Denis Wood (2010, pp. 42–44); maps argue their points and can be thought of as rhetorical devices.

## CHANGES IN THE PAST 25 YEARS

There is a tendency to think that maps are maps and "if you can read one, you can read 'em all." In reality, enormous changes have taken place in maps and mapping in the past 25 years. We owe many of these changes to the computer; some map types that are now common, such as animated maps, were rarely seen because of the difficulty of drawing them and viewing them. The computer has changed the methods of creating maps, of viewing maps, of delivering maps, and of publishing maps. Thirty years ago if you wanted to go for a hike, you might have purchased a topographic map—one showing the nature of the land, hills, and valleys—from an outdoor recreation company, or you might have ordered it from the U.S. Geological Survey (USGS). Now you can download a topographic map from the USGS, or you can buy topographic software from companies such as Delorme or National Geographic that will help you plan your hike and even provide profiles of your route. You might even download large-scale topographic maps to your hand-held GPS (global positioning system) unit and navigate and create profiles of your trail with an apparatus that fits in your pocket.

Maps of many types are on the Internet; some of these maps are interactive, and you can query the map to gain information not available on a static map. Others are animated and show changes through time; haptic maps allow you to "feel" textures, and sound maps speak information to the user.

The changes in maps and mapmaking are more in their creation and delivery than in techniques of reading and using. We can download a book to an e-reader, but

we still read the words in the same manner as we read words on paper. The computer and geographic information systems (GIS) have revolutionized the ways in which maps are made, and the computer and the Internet have introduced new ways of delivering maps to users. All the same, basic map reading techniques can still be used for most map reading tasks, although some "new" map types—animated, sound, and haptic—do require looking at maps in new ways and using different methods.

## EVALUATING MAPS

Not all maps are created equal; as we shall see below, there are many hindrances to using a map. One of these obstacles is the quality of the map itself. A poorly drawn map can sometimes tell its story effectively, but an elegantly drawn map created from poor data may be worse than useless: It can mislead. I hope that the reader will be an informed and discriminating map user after reading this text.

## MAP LIMITATIONS

All maps have limitations. This is equally true for a hand-drawn map of the 12th century and for the most up-to-date computer-created map. It is true for paper maps and for electronic virtual maps. It is true for paper road maps and for maps on a GPS. The limitations are not always obvious or deliberate, nor are they necessarily bad. They come about in a variety of ways and stages in the mapmaking process—the nature of maps and of the data, the tools used, the skills of the mapmaker and map user, and the biases of the mapmaker and agency or organization making the map. In this section we look at limitations in general; limitations of specific map types are discussed in each section (see Table 1.1).

### Limitations from the Nature of Maps

Maps are usually graphic, not photographs; they are usually drawn to scale, symbolic, and flat. Each of these factors creates limitations. Photographs show everything within the view of the lens; maps are drawings and they are selective. This can be a limitation in that the map isn't inclusive. Maps are drawn to *scale*, which means that a large area is reduced in size. On a world map, the 3,794,083 square miles (9,826,630 square kilometers) of the United States might be reduced to a square inch (or square centimeter). It is not possible to show everything on any map; therefore, maps are *generalized*. The amount and type of information to be shown are selected, data are put into categories, and complex features are smoothed and simplified. Maps are *symbolic*; that is, they use icons, colors, shades, and lines to represent information. Maps are flat and the earth is round. The spherical earth is *projected*, that is, converted in a systematic and orderly way to a flat surface. Since a sphere cannot be flattened without stretching, tearing, or shrinking, flat maps have *distortions* in area, shape, distance, or angles.

**TABLE 1.1. Map Limitations**

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|---|---|
| The nature of maps | Cartographer limitations |
| Scale | Skills |
| Projection | Knowledge of subject |
| Generalization | Biases |
| Data limitations | Agency or client limitations |
| Data accuracy | Objectives |
| Positional accuracy | Biases |
| Lack of data | Map user limitations |
| Gaps in data | Lack of skills |
| Currency of data | Stereotypes |
| Technology limitations | Using wrong map for purpose |
| Drawing/creation methods | |
| Delivery method | |
| Printing | |
| Hardware | |
| Software | |

## Limitations Introduced by Data

Maps are made from data. These data may be positional, involving the latitude and longitude of a place, an address, a road, or a border. Some maps use statistical data to show such things as population; others use qualitative data such as locations of grasslands or deserts. Errors can enter when data are collected. Maps made by geographic information systems (GIS), maps on the Internet, and GPS units must be *digitized*. That is, the data must be put in a form that the computer can read. Some of this digitizing is done by humans plotting and entering the information, and thus, there is the potential for human error. On historic maps and even some modern maps there might be lack of data, gaps in the data, and even erroneous data.

One must also remember that paper maps and even electronic maps are made at a specific time and that a printed map could be many years old. Therefore, the information on the map is valid only for the date of production. Even electronic maps, GPS base maps, and maps on the web may not have the most up-to-date information; they are also limited by the date of production.

## Limitations Introduced by Technology

Through time, maps have been created using many different kinds of tools and different materials. A map's appearance and content are often determined by the tools the mapmaker uses. The oldest maps in existence were carved into clay tablets with a pointed tool, and others were incised on rock. Maps have been made on papyrus, cloth, metal, sheepskin, paper, and plastic. And, of course, maps are "made" on a computer screen.

Beginning in the second century C.E., maps were drawn on paper using pens, ink, and drawing tools such as rulers and compasses. Before the invention of printing, maps were copied over and over by hand; inevitably, errors crept into the cop-

ies, and no two were exactly alike. With the advent of printing, maps were exactly reproducible, but different methods of printing—woodcut, copper plate, lithography, and offset lithography—introduced new limitations. Woodcut maps tended to be less detailed than copper plate maps; color was difficult to use with these two methods and was applied by hand. Lithography allowed shading, and color was relatively easy to print. Offset lithography permitted rapid production of thousands of copies.

In the last third of the 20th century, computers were introduced into mapmaking, and today the majority of maps are made using computer *software*. Again, there are limitations. Software used for mapping is of several types: dedicated mapping software, GIS, and illustration or drafting software. Each of these has limitations. GIS is a powerful analytical tool for spatial data and is widely used for mapmaking. "Smart maps" can be made using GIS: Such a map has information associated with each point, line, or area on it, and the map can be "queried" to find that information. But some kinds of maps can't be made with GIS, and the map is only as good as the software capabilities and the user's skills. If no analysis of data is required, the cartographer may use illustration software such as Adobe Illustrator or CorelDraw, or he/she may combine two types of software. As a reader, you do not always know how a map was created.

## Limitations Introduced by the Mapmaker

The mapmaker's skills with drawing equipment or software has a bearing on the final map. Did the map drafter draw an angle slightly off, was the GIS technician knowledgeable about cartography and maps, or was he/she following default options of the software? Maps are not always created by professionals who have knowledge of cartography or of GIS systems. The mapmaker might not have any knowledge of the subject being mapped but may simply be entering data into a software program. Mapmakers have biases. In the words of John K. Wright (1942), "mapmakers are human" (p. 527).

## Limitations Introduced by the Map Agency or Client

Maps are not neutral. Indeed, often maps are created by people with an "axe to grind." An organization might want to stop a commercial development and will create maps that emphasize its point of view; a transportation company might want to show that its routes are shorter; while another company might want to show that it is more centrally located than a competitor. In all of these cases, some information might be left out or deemphasized, and other information might be distorted or enhanced. In the early days of railroads, for example, companies created distorted maps that straightened out their routes and changed the sizes of states to "show" that their routes were more direct and quicker. Maps are often made for advertising, and the company wants to emphasize its products. These maps are examples of *persuasive cartography* in which the *main objective or effect is to change, or in some way influence, the reader's opinion or conclusion*. Maps are also used as instruments of propaganda, a subgroup of persuasive maps. While there are many examples from

World War II and the Cold War, propaganda maps have existed throughout history and continue to be made today.

## User Limitations

We must not ignore the map user in this discussion of limitations. A user who lacks map reading skills may misinterpret a map or "read into" the map information that can't be learned from the map alone by projecting his or her stereotypes and misinformation onto the map. A common mistake is using a map for the wrong purpose. Most maps are designed for specific purposes or jobs. For example, one cannot get much climate information from a general-purpose map or road information from a weather map.

## Significance of Map Limitations to Map Reading, Analysis, and Interpretation

Why is understanding map limitations important to map users? The more knowledgeable a user is about maps, the better his or her interpretation of them. Maps are powerful tools, but they are not intuitive. Misreading a map, even a GPS map, can result in getting lost, or worse, when navigating a boat, plane, car, bicycle, or trail; agencies can allocate funds inappropriately, poor choices of proposed routes can be made, and one can gain erroneous impressions of places—their sizes, their people, their nature. The limitations will be part of the following discussions of different map types and their uses.



# MAP READING, MAP ANALYSIS, MAP INTERPRETATION

The terms *map reading, map analysis,* and *map interpretation* are often used interchangeably, but they are not synonymous. I define and use the terms in this book in the following way: Map reading refers to the most basic aspects of map use: finding locations, recognizing symbols and what they stand for, and rudimentary way-finding. Map analysis involves calculations with maps, such as determining steepness of slope and gradient, computing areas, and drawing profiles. Map interpretation is a high-level map use that may involve more than one map to determine the nature of an area or distribution. It requires recognizing and describing spatial patterns, relating and correlating geographic patterns, and essentially bringing all of the available map information together to study a place or subject.

## FURTHER READING

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