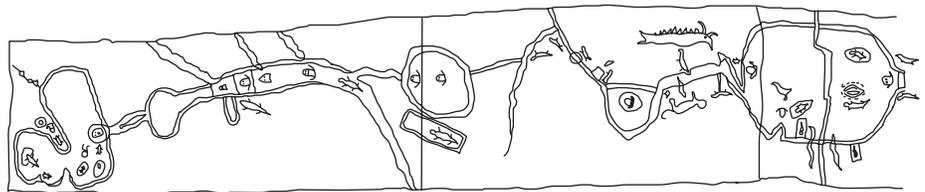
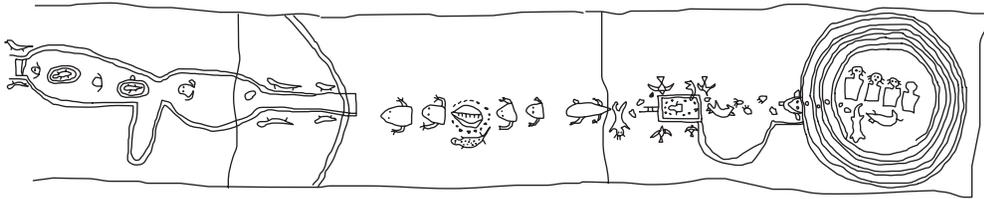
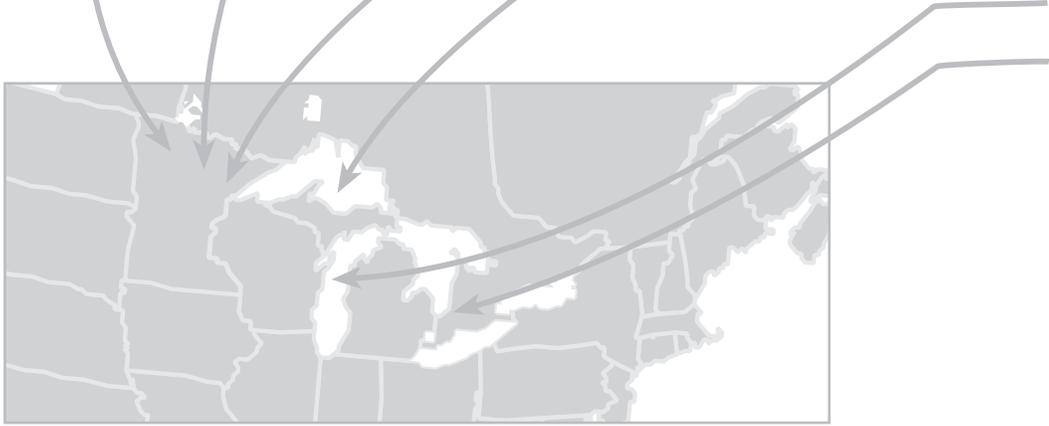
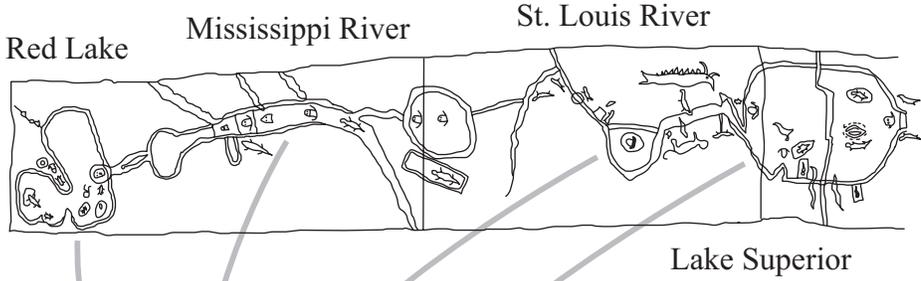


This is a chapter excerpt from Guilford Publications.
Making Maps: A Visual Guide to Map Design for GIS, John Krygier and Denis Wood
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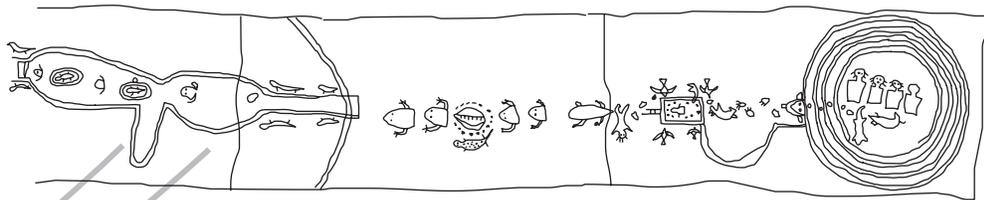




What is it?



Lake Michigan



Lakes Erie, Huron, & Ontario

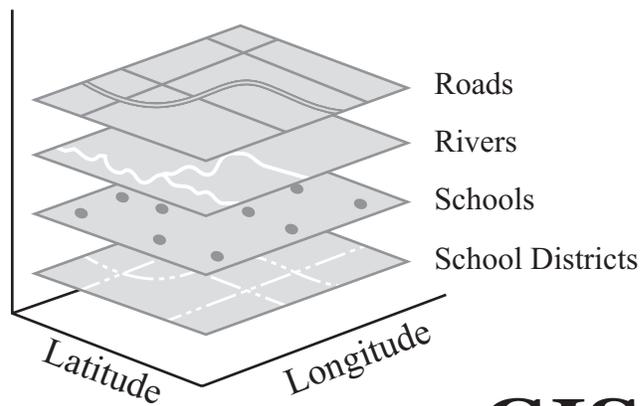


It's a Map

Ojibwe (Native American) ca. 1820

Maps are a powerful way of thinking about the earth.

This Native map, drawn on birch bark (which accounts for its shape), shows the migration legend of the Ojibwe, from the creation of their people (on the right) to their home in the upper Midwest (on the left). The left and central portions of the map show Lake Huron, Lake Superior, and Red Lake in Minnesota. The right side of the map relates the spiritual realities of the Ojibwe origins with important spiritual guides symbolized along the route. The map is a sophisticated synthesis of spiritual and physical geography, revealing the vital importance of making maps in the context of your life and belief systems.

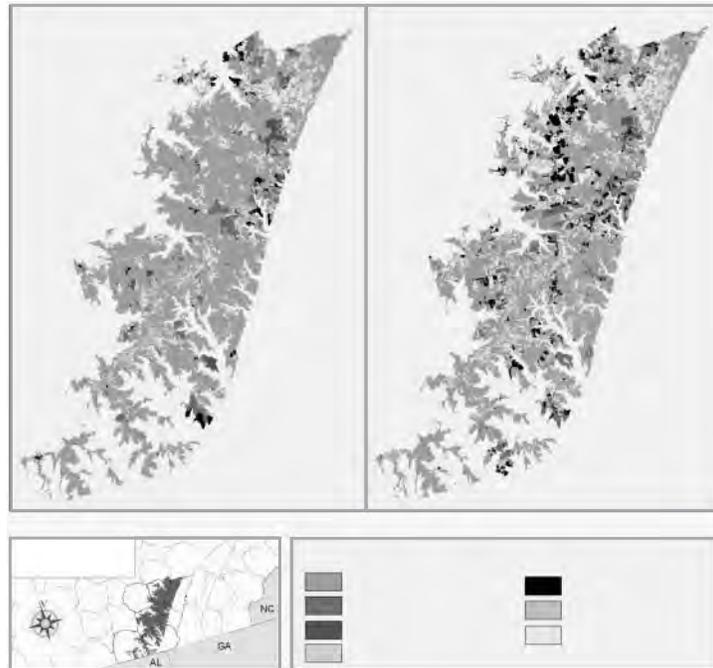


GIS

Technological Changes

Geographic Information Systems (GIS)

Technological changes have made the mapping and analysis of geographic information a daily part of how we understand the world. Geographic Information Systems (GIS) consist of digital map layers that store a multitude of geographic facts by location: water features, property parcels, floodplains, roads, political boundaries, and so on. Digital map layers are linked to a database of “attribute” information. Each property parcel, for example, contains information such as the owner, address, zoning, and value of the property. Each stream and river contains information including the name of the feature, its length, and flow.



Forest change in Tennessee

GIS is an excellent way to inventory geographic facts, but its power lies in its analytical capabilities. Jon Evans of Sewanee University used GIS to analyze forest change in Tennessee. Combining satellite data and GIS map layers, Evans' GIS analysis revealed a 14% loss in native forests and a 170% increase in pine plantations between 1981 and 2000. The *quality* of forests is a politically sensitive issue. The lumber and paper industry and certain U.S. government policy-makers claim U.S. forests are increasing in area. Biologists argue that diverse native forests are being replaced by dangerous monoculture tree plantations: not all trees make a forest. Evans' GIS analysis and the resulting maps provide quantitative and visual evidence for the growing debate over forest quality and policy in the U.S.

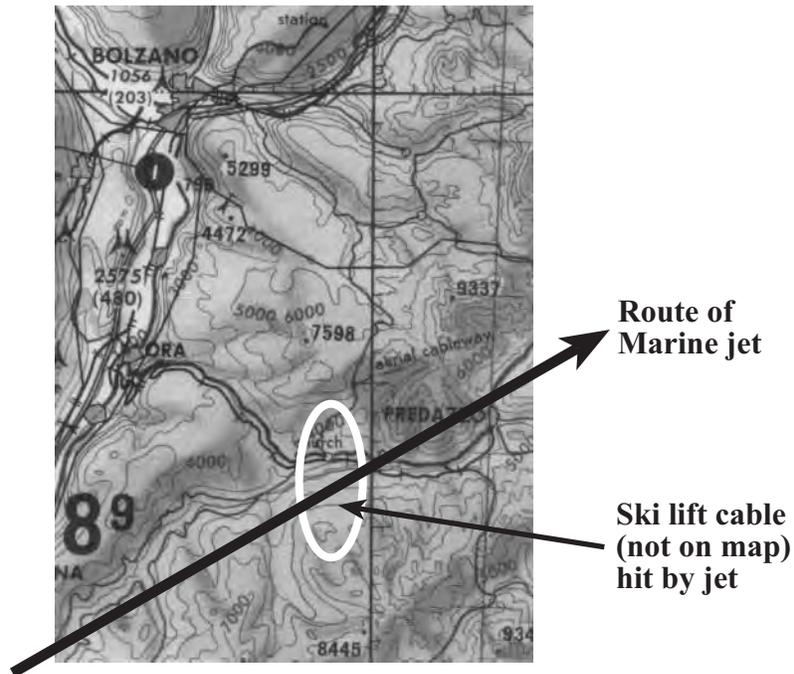


Maps Kill!

Military targeting maps

Maps have long been used to fight wars, win battles, and kill people.

Targeting maps help to fine-tune bombing during military campaigns, to destroy certain select targets and people and not others. Royal Air Force pilots are briefed with a terrain model prior to a bombing mission during World War II (top). Geographic Information Systems – and maps of bombing targets – are at the core of strategizing and planning bombing missions for the war in Iraq (bottom).



20 killed near Cavalese, northern Italy

Despite a long tradition of map making, and expensive and extensive new technologies for making maps, maps still can fail and so kill.

U.S. Marine Corps jet struck and severed a ski lift cable spanning an Alpine valley in northern Italy in 1998, sending the ski lift gondola crashing to the earth, killing 20 people.

The jet crew did have a map of the area, but not one that showed the ski lift cable. The cable was shown on Italian maps, but the Pentagon prohibits the use of maps made by foreign nations.

Map users and makers should always be critical of maps: maps have the power and potential for failing that every human-created object has.



*Juan de la Cosa's map of the known world,
from the early 16th century.*

Discoveries with Maps

Maps generate new understanding

Maps don't simply locate things: they can lead us to insights, discoveries, and new ways of understanding. We see geographic patterns, and those patterns may lead us to think about things in a new way.

When maps of the then known world were first made in the 16th century, people immediately noticed provocative patterns: the earth's continents seemed to fit together like pieces of a puzzle. Many explanations for these patterns were put forth for debate.



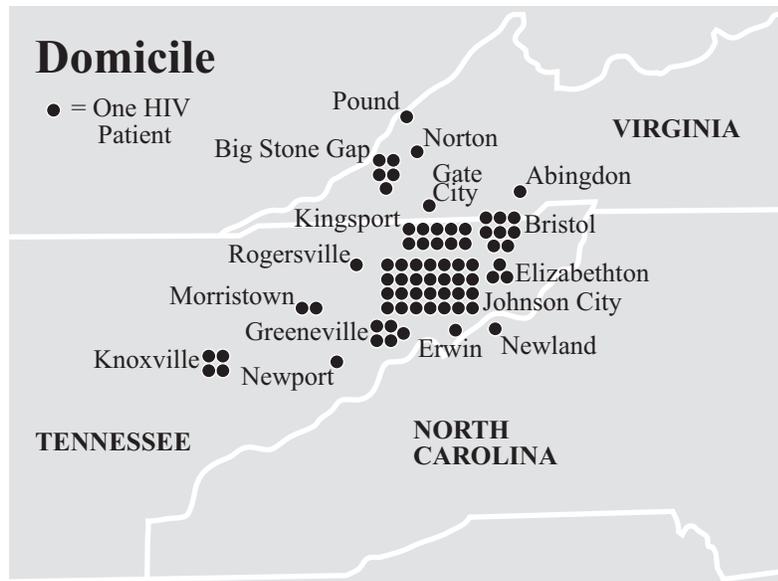
Geologic and fossil commonalities in dark grey, spanning different “continents” in Pangea.

Plate tectonics

Geologic evidence gathered by Alfred Wegener and others suggested that a single large continent, Pangea, had indeed preceded the current configuration of the continents. Evidence included geologic and fossil characteristics common to continents now widely separated. But how did the continents move?

Geologic research in the 1950s and 1960s led to the understanding that molten rock from deep inside the earth pushes up along major cracks in the earth's crust, building new crust, and pushing and moving the huge plates, upon which the continents rest. Plate tectonics is now accepted as the explanation for the continental patterns on maps that intrigued humans for so long.

Map making is powerful, as it can lead us to discoveries of new things about the natural and human world.

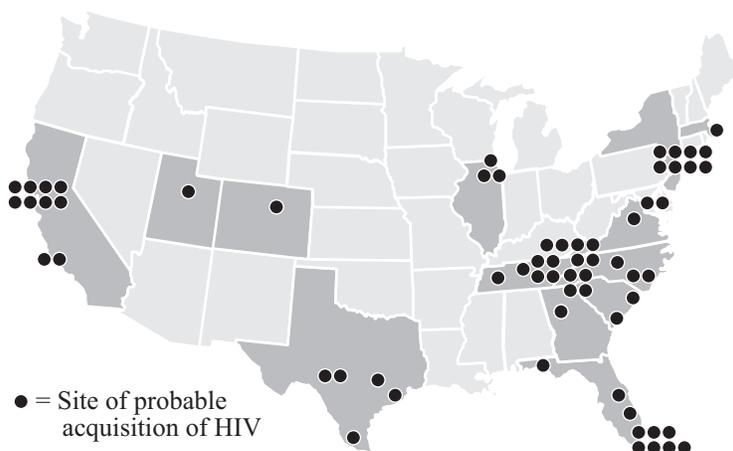


Thinking Visually with Maps

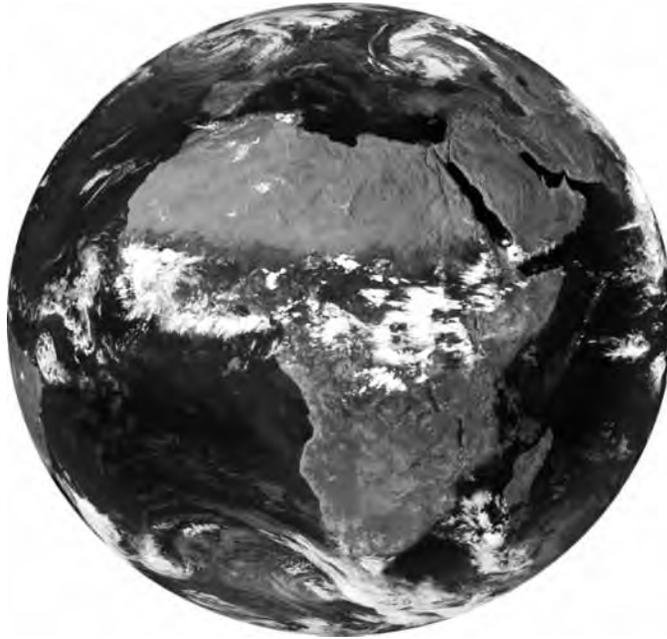
HIV patients in rural Tennessee

Maps are a powerful way to think things through. Abraham Verghese used maps to help think about his HIV-infected patients in the mid-1980s. Dr. Verghese practiced medicine in rural Tennessee. He and his colleagues were stunned when HIV-infected patients began to dominate their practices. What was this urban problem doing in rural Tennessee? "There was a pattern in my HIV practice. I kept feeling if I could concentrate hard enough, step back and look carefully, I could draw a kind of blueprint that explained what was happening here..." Dr. Verghese borrowed a map of the U.S. from his son. With the map spread on his living room floor, he marked where his HIV patients lived. He labeled the map **Domicile**, but he could as well have called it "Birthplace," for most of his patients were men who had come home to die.

Acquisition



Dr. Verghese next mapped where his HIV patients lived between 1979 and 1985. The places on the **Acquisition** map “seemed to circle the periphery of the United States” and were mostly large cities. “As I neared the end, I could see a distinct pattern of dots emerging on this larger map of the USA. It evening I had been on the threshold of seeing. Now I fully understood.” Dr. Verghese learned of a circuitous voyage, a migration from home and a return, ending in death. It was “the story of how a generation of young men, raised to self-hatred, had risen above the definitions that their society and upbringings had used to define them. It was the story of hard and sometimes lonely journeys they took far from home into a world more complicated than they imagined and far more dangerous than anyone could have known.” Patients that appear on both maps are those “who had the virus delivered to their doorstep... hemophiliacs or blood transfusion recipients who got tainted ... blood products.” The maps Verghese made on his living room floor might not be much to *look* at, but the *thinking* they inspired was rich.



Maps Shape How We See

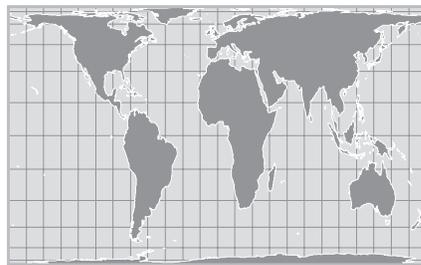
The earth is really big and complex

Maps are small and show only a few of the multitude of human and natural features. When making maps, we strip away selected details and flatten the earth's surface, showing what we could not otherwise see.



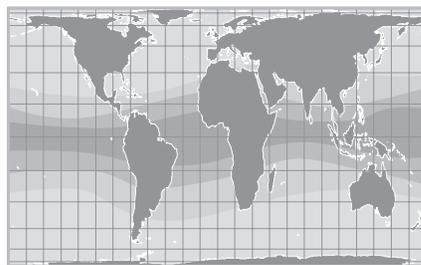
Less detail

Map makers remove detail to show what they choose to show.



Entire earth, all at once

Map makers flatten the earth's entire surface. This map stretches continental shapes, revealing distortions that occur when we flatten the earth's surface.

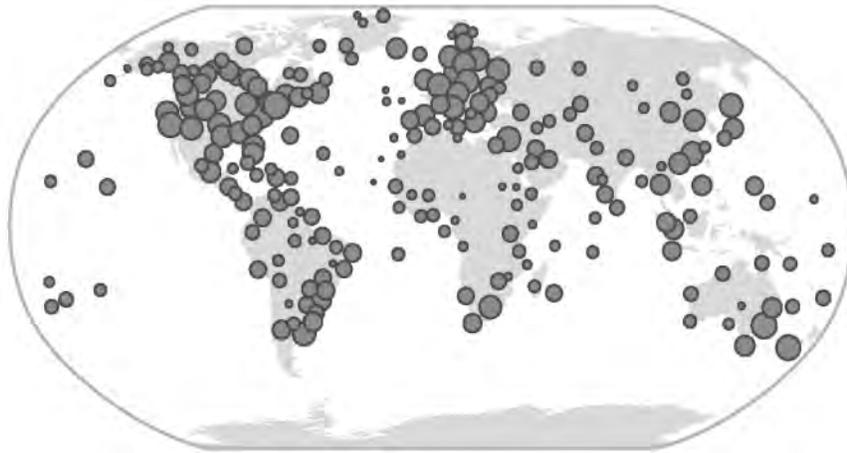


Seeing the invisible

On maps we can record what is visible to us – coastlines – and what is not visible to us – temperatures.

The impossible is natural

Global temperature is something we could never “see” without maps. Nevertheless, such an impossible “view” of the world is now quite natural to us: our maps shape how we “see” the world.



*The geography of the internet:
larger circles = more internet hosts.*

The internet

The internet lets anyone make maps

Changes in technology have always affected map making. The invention of printing made it easy to duplicate and distribute maps, providing more people with access to maps and the knowledge they store. The internet is having a profound impact on map access. Free internet mapping sites provide both basic and sophisticated map-making capabilities. With internet access, and the ability to point and click, anyone can make maps.



Areas crossed by two or more radioactive clouds during the era of nuclear testing in the American Southwest, 1951-62.

What Is a Map?

A graphic statement that locates facts

Graphic: visual display of marks which stand for something else. An airplane shape on a map implies an airport.

Statement: To put forth information, a formal embodiment of facts or assertions.

Locating facts: Tangible and intangible phenomena located in geographic space: what we can see (roads, rivers) and what we cannot see (temperature, radiation), varying in amount (population) and kind (vegetation types).

Making Maps

How do you make a map?

Why are you making your map? What are you intending to do with it? Who is your audience? Are they experts or novices? Young or old? What should the map assert? What do you want your map to communicate to those who see it? You must decide *why* you are making the map before you make it. *Chapter 2.*

Mappable data: Given your purpose, what data do you need? Roads? Rivers? Coastlines? Population? Toxin levels in wells? Number of deer per county? Some data are free and easy to find. Other data exist, but at a cost. The facts you need may not exist at all, and you may have to collect them yourself or pay someone to do so. Locating and processing mappable data can be among the most expensive and time-consuming parts of making maps. *Chapter 3.*

Map-making tools: Which tools will you use to make your map? Internet map-making sites are free but limited in data and map-making capabilities. Geographical Information System (GIS) software is more sophisticated and flexible but expensive to purchase and more difficult to use. Select appropriate map-making tools based on the kind of map you want to make: you cannot make every map using internet sites, but you don't need GIS for every map either. *Chapter 4.*

Map design: Given the reason you are making the map, mappable data, and map-making tools, how do you make a map that fulfills your goals - a map that works? Key issues include the geographic framework, map layout, intellectual and visual hierarchies, map generalization and classification, map symbolization, and the use of type and color. *Chapters 5-12.*

“Who died and made you the map police?”

Jill. *Home Improvement*. (TV, 1991)

“Is that the same map?” Jincey asked. She pointed to the large map of the world that hung, rolled up for the summer, above the blackboard behind Miss Dove. “Is China still orange?”

“It is a new map,” Miss Dove said. “China is purple.”

“I liked the old map,” Jincey said. “I liked the old world.”

“Cartography is a fluid art,” said Miss Dove.

Frances Gray atton. *Good Morning, Miss Dove*. (1954)

more information...

Three excellent books situate mapping in its broader human context: Daniel Dorling and David Fairbairn, *Mapping* (Longman, 1997); Mark Monmonier, *How to Lie with Maps* (2nd ed., University of Chicago Press, 1996); and Denis Wood, *The Power of Maps* (Guilford Press, 1992). Check out the journal *Cartographic Perspectives*; published by the North American Cartographic Information Society.

This book draws from numerous texts, which can be consulted for more information: Borden Dent, *Cartography: Thematic Map Design* (5th ed., McGraw-Hill, 1998); Ian MacEachren, *Some Truth with Maps* (Association of American Geographers, 1994); and Phillip and Juliana Muehrcke, *Map Use* (4th ed., JP Publications, 1998). Also consulted were M.J. Kraak and J. Ormeling, *Cartography: Visualization of Spatial Data* (Longman, 1996); Arthur Robinson et al., *Elements of Cartography* (6th ed., Wiley, 1995); and Terry Slocum et al., *Thematic Cartography and Visualization* (2nd ed., Prentice Hall, 2003). These folks are the map police.

An older generation of mapping textbooks are worth looking at: F.J. Monkhouse and H.R. Wilkinson, *Maps and Diagrams* (Methuen, 1952); J.S. Keates, *Cartographic Design and Production* (Wiley, 1973); and two wonderful textbooks by Erwin Raisz: *General Cartography* (McGraw-Hill, 1938) and *Principles of Cartography* (McGraw-Hill, 1962).

The most comprehensive overview of academic research on mapping is Ian MacEachren, *How Maps Work* (Guilford Press, 1995).

Sources: The Ojibwe map (pp. xii, 1-3) redrawn from Selwyn Dewdney, *The Sacred Scrolls of the Southern Ojibway* (University of Toronto Press, 1975). The forest change map (p. 5) is courtesy of Jon Evans. The RA terrain model image (p. 6) is from the *Geographical Review*, Oct. 1946. The Iraq military targeting map (p. 6) was found floating on the internet. The Cavalese map (p. 7) is courtesy of the Harvard Map Library, Harvard University. IDS data (pp. 10-11) from Graham Verghese, *My Own Country: A Doctor's Story* (Vintage, 1994) and "Urbs in Rure: Human Immunodeficiency Virus Infection in Rural Tennessee" (*Journal of Infectious Diseases*, 160:6). The internet hosts map (p. 14) is based on one from Matrix Net Systems. Internet road maps from Mapsonus.com, and U.S. Census map from the U.S. Census American Factfinder. The radioactive cloud map is from Richard L. Miller, *Under the Cloud: The Decades of Nuclear Testing* (Two-Sixty Press, 1999).