MAPS: AN INTRODUCTION

Maps are the basic tools that geographers use to interpret and convey information. The geographer's greatest ally is the map. They can present enormous amounts of information very effectively, and can be used to establish theories and solve problems. Furthermore, maps are often fascinating, revealing things no other medium can. It has been said that if a picture is worth a thousand words, then a map is worth a million.

We should remind ourselves that a map - any map - is an incomplete representation of reality. In the first place, a map is smaller than the real world it represents. Second, it must depict the curved surface of our world on a flat plane, for example, a piece of paper. And third, it contains symbols to convey the information that must be transmitted to the reader. These are the three fundamental properties of all maps: scale, projection, and symbols.

Understanding these basics helps us interpret maps while avoiding their pitfalls. Some maps look so convincing that we may not question them as we would a paragraph of text. Yet maps, as representatives of the world all, to some extent, distort reality. Most of the time, such distortion is necessary and does not invalidate the maps message. But some maps are drawn deliberately to mislead. Propaganda maps, for example, may exaggerate or distort reality to promote political aims. We should be alert to cartographic mistakes when we read maps. The proper use of scale, projection, and symbolization ensures that a map is as accurate as it can be made.

ANALYZING MAPS

Whether you are reading a text, watching a video, or looking at a map, it is always best to have a plan – an approach – in which you can amass as much information as possible in a methodical way. An acronym that is extremely helpful in assessing the reliability and accuracy of a map is **TODALSIG**. The letters stand for title, orientation, date, author, legend, scale, index, and grid.

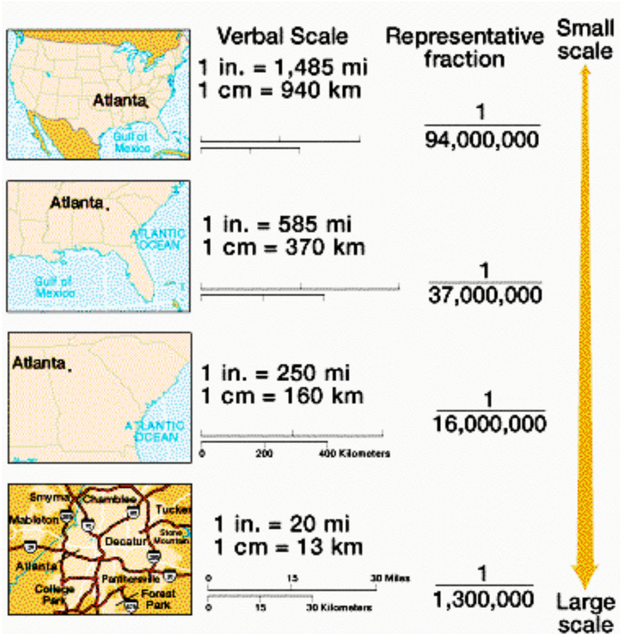
Source: de Blij, Murphy, and Fouberg, Human Geography: People, Place, and Culture, 8th Edition, John Wiley & Sons Inc., 2008 (p. 17)

The title tells you what the map is about, what area of the world you are seeing, or even the type of map it is. The orientation helps you figure out basic direction (e.g., the **cardinal directions** – North, South, East, and West). A **compass rose** is commonly used for this map element. The date tells you when the map was made. This is important so one knows if the map is up to date, or – in the case of historical maps – when in time the map represents. The author tells you who made the map, the source. This is particularly valuable in determining the map's reliability, and in recognizing the potential for bias or point of view. The legend – or key - helps you interpret the map based on any special colors or symbols that appear on the map. The scale tells you how the actual distance compares to the distance on the map (e.g., 1 in = 1 mi). The index is a list of locations found on the map that correspond with a grid, that, in turn, helps you find the locations (e.g., latitude and longitude).

Now, quality maps possess most of the elements of TODALSIG, but not all elements are necessary for the map to be reliable or useful. For instance, an index is usually only necessary for a map with an overabundance of place names or locations, as is the case with most road maps. Additionally, no single map tells you an entire story. Often, several maps, and even more often, several scales must be utilized to grasp the bigger picture.

MAP SCALE

Scale as a term truly has two meanings that geographers are concerned with. The most common definition of scale is the territorial extent of something; how expansive or extensive it is. In this instance, the larger the scale, the greater the size. However, in contrast, the scale of a map reveals how much the real world has been reduced to fit on the page or screen on which it appears. It is the ratio between an actual distance on the ground and the length given to that distance on the map, using the same units of measurement. This ratio is often represented as a fraction (e.g., 1:10,000 or 1/10,000). This means that one unit on the map represents 10,000 such units in the real world. If the unit is 1 inch, then an inch on the map represents 10,000 inches on the ground, or slightly more than 833 feet. Such a scale would be useful when mapping a city's downtown area, but it would be much too large for the map of an entire state. As the real-world area we want to map gets larger, we must make our map scale smaller. As small as the fraction 1/10,000 seems, it still is l0 times as large as 1/100,000, and 100 times as large as l/1,000,000. If the world maps in this book had fractional scales, they would be even smaller. A large-scale map can contain much more detail and be far more representative of the real world than a small-scale map. Look at it this way: when we devote a half page of this book to a map of a major city (such as the Chicago area to the left), we are able to represent the layout of that city in considerable detail. But if the entire country in which that city is located must be represented on a single page, the city becomes just a large dot on that small-scale map, and the detail is lost in favor of larger-area coverage. So the selection of scale depends on the objective of the map.



The map of the United States at the top is smaller scale as compared with the larger-scaled map of Atlanta at the bottom.

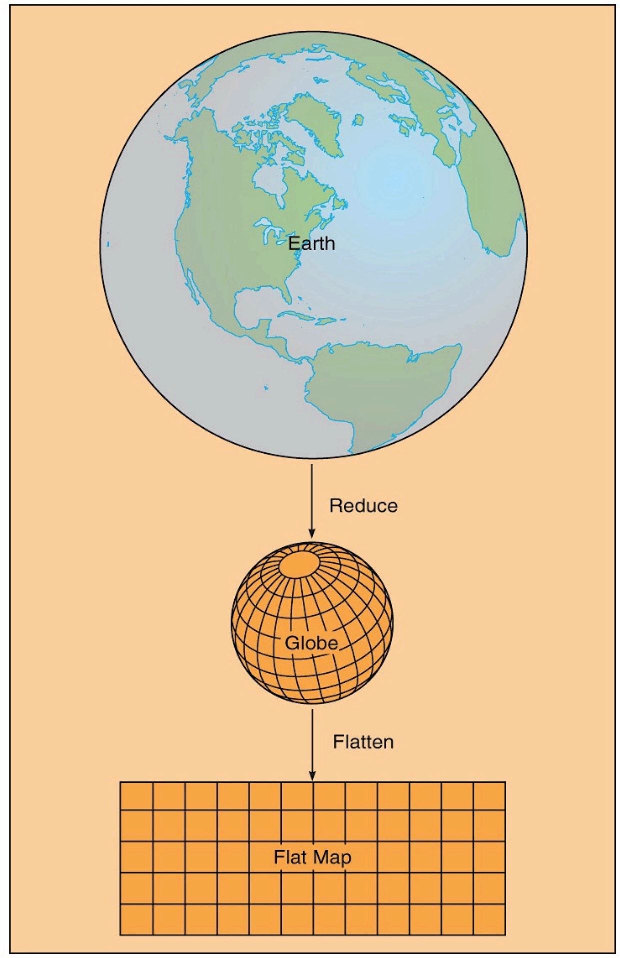
However, when you examine maps in your readings and texts, you will note that most, if not all of them, have scales that are not given as ratios or fractions, but in graphic form. This method of representing map scale is convenient from several viewpoints. Using the edge of a piece of paper and marking the scale bar's length, the map reader can quickly – without calculation – determine approximate distances. And if a map is enlarged or reduced in reproduction, the scale bar is enlarged or reduced with it and remains accurate. That, of course, is not true of a ratio or fractional scale.

MAP PROJECTIONS

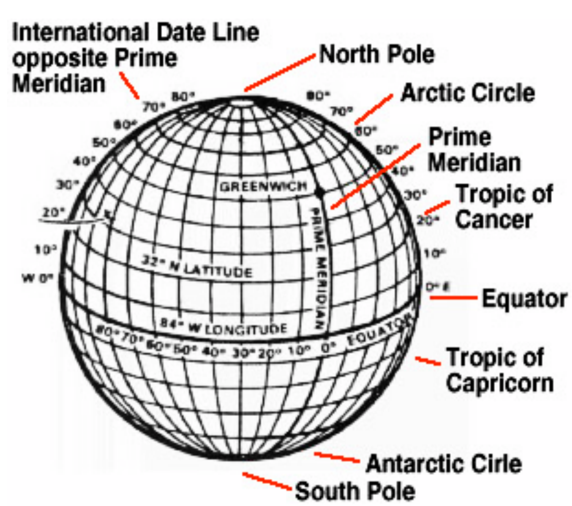
For centuries cartographers have worked to represent the spherical Earth, or part of it, on a flat surface. To get the job done, there had to be a frame of reference on the globe itself, a grid system that could be transferred to a flat page. Any modern globe shows that system, usually at 10-degree intervals north and south from the equator, called **parallels**, and another set of vertical lines, converging on the poles, often shown at 15-degree intervals and called **meridians**. On a spherical globe, parallels and meridians intersect at right angles.

NUMBERING THE GRID LINES

The grid lines, of course, are imaginary, and do not show on the Earth's surface (unless demarcated on purpose). For the horizontal latitude lines, the **equator**, which bisects the Earth midway between the poles, was designated 0º (zero degrees) latitude, and all parallels north and south of the equator were designated by their angular position. As such, the **North Pole** is 90º-north latitude, and the **South Pole** is 90º-south latitude. The parallel midway between the equator and the pole, thus, is 45° north latitude in the northern hemisphere and 45° south latitude in the southern hemisphere. Also useful are



the Tropics of Cancer and Capricorn, which lie at approximately 23.5° north and south latitude, respectively. Since the Earth rotates on its axis slanted at approximately 23.5°, the **Tropic of Cancer** represents where the Northern Hemisphere is tilted toward the Sun to its maximum extent, which occurs during the summer solstice (usually around June 21). The opposite is true for the **Tropic of Capricorn,** in which the Sun's direct rays reach furthest south on the winter solstice (usually around December 21).

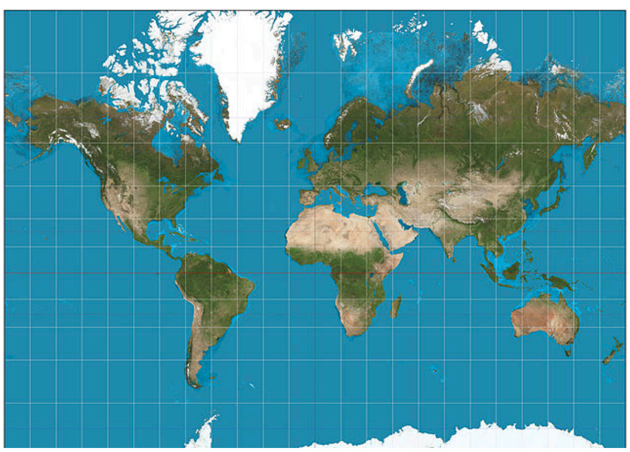


However, the (vertical) longitude lines presented no such easy solution. Among the parallels, the equator is the only one to divide Earth into equal halves, but all meridians do this. During the second half of the nineteenth century, maps with conflicting numbers multiplied, and it was clear that a solution was needed. The most powerful country at the time was Britain, and in 1884, international agreement was reached whereby the meridian drawn through the Royal Observatory in Greenwich, England, would be the **Prime Meridian**, 0º (zero degrees) longitude. All meridians east and West of the prime meridian could now be designated by number, from 0º to 180º east and west longitude.

The **International Date Line** (**IDL**) is an imaginary line on the surface of the Earth that runs from the North to the South Pole opposite of the Prime Meridian and demarcates backward calendar day from the next. It passes through the middle of the Pacific Ocean, roughly following the 180° longitude but it deviates to pass around some territories and island groups.

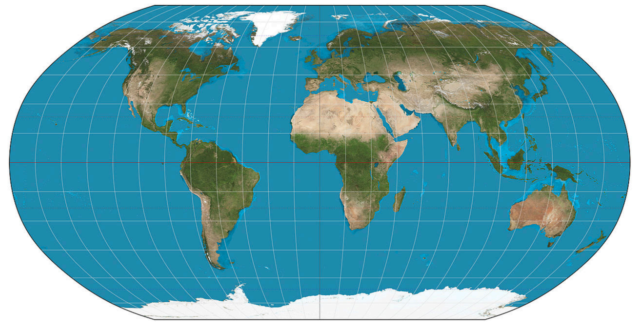
TYPES OF PROJECTIONS

But what happens when these lines of latitude (parallels) and longitude (meridians) are drawn to intersect at right angles? At the equator, the representation of the real world is relatively accurate. But go toward the poles, and distortion grows with every degree until, in the northern and southern higher latitudes, the continents appear not only stretched out but also misshaped. Because the meridians cannot be made to converge in the polar areas, this projection makes Antarctica look like a giant, globe-girdling landmass.

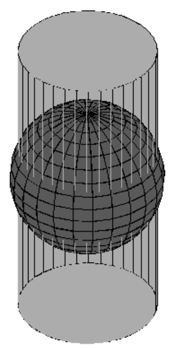


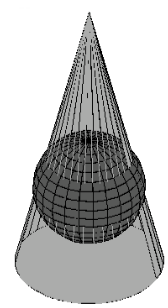
Looking at this representation of the world, you might believe that it could serve no useful purpose. But in fact, the **Mercator projection** (shown above), invented in 1569 by Gerardus Mercator, a Flemish cartographer, had (and has) a very particular function. Because parallels and meridians cross (as they do on the spherical globe at right angles, direction is true everywhere on this map. Thus the Mercator projection enabled navigators to maintain an accurate course at sea simply by adhering to compass directions and plotting straight lines. It is used for that purpose to this day.

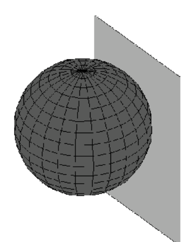
The spatial distortion of the Mercator projection serves to remind us that scale and projection are interconnected. One might imagine that the spatial (areal) distortion of the Mercator projection is so obvious that no one would use it to represent the World's countries. But in fact, many popular atlas maps (Mercator also introduced the term atlas to describe a collection of maps) and wall maps still use a Mercator for such purposes. The **National Geographic Society** published its World maps on a Mercator projection until 1988, when it finally abandoned the practice in favor of the **Robinson projection** developed by an American cartographer (shown below).



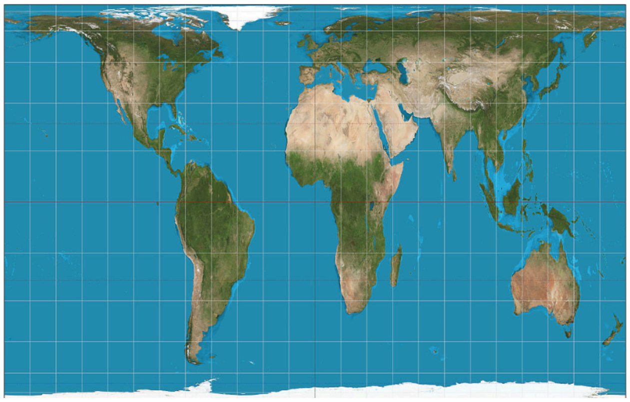
The Mercator projection is one of a group of projections called **cylindrical projections.** Imagine the globe's lines of latitude and longitude represented by a wire grid, at the center of which we place a bright light. Wrap a piece of photographic paper around the wire grid, extending it well beyond the north and south poles, flash the bulb, and the photographic image will be that of a Mercator projection. We could do the same after placing a cone-shaped of paper over each hemisphere, touching the grid, say, at the 40th parallel north and South; the result would be a **conic projection**. If we wanted a map of North America or Europe, a form of conic projection would be appropriate. Now the meridians do approach each other toward the poles (unlike the Mercator projection), and there is much less shape and size distortion. And if we needed a map of Arctic and Antarctic regions, we would place the photographic paper as a flat sheet against the North and South Poles. Now the photographic image would show a set of diverging lines, as the meridians do from each pole, and the parallels would appear as circles. Such a **planar projection** is a good choice for a map of the Arctic Ocean or the Antarctic continent.







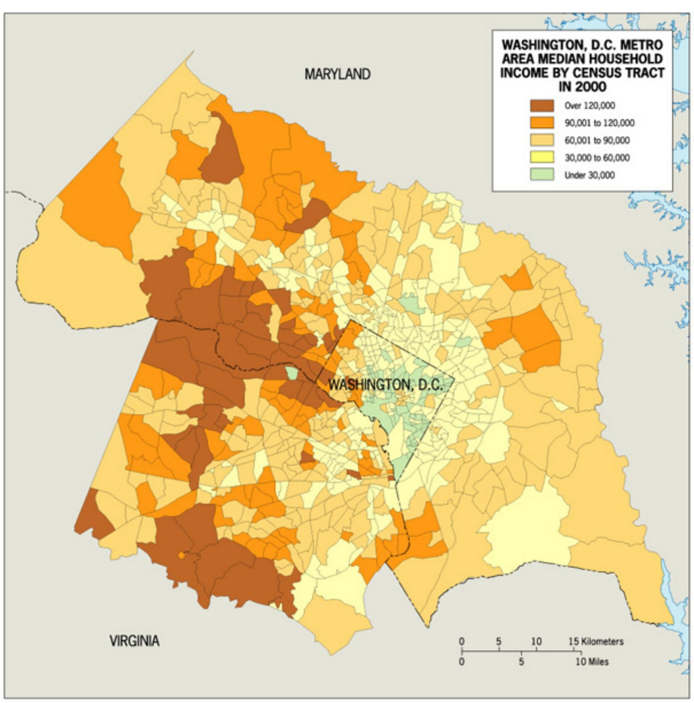
Projections are chosen for various purposes. Just as the Mercator is appropriate for navigation because direction is true, other projections are designed to preserve areal size, keep distances real, or maintain the outlines (shapes) of landmasses and countries. **Conformal projections** are those that are designed for maximum accuracy based on the shape preservation of the polygons (e.g., the lines of latitude and longitude). The Mercator projection was designed with this in mind. By contrast, equal-area projections are designed to preserve the actual size and shape of the landmasses. The



Robinson projection does a better job of this as opposed to the Mercator projection, for example.

Projections can be manipulated for many needs. In this course, we examine global distributions of various phenomena. For instance, the **Gall-Peters projection** (shown above) – a cylindrical and conformal projection - has gained increasing popularity since it more accurately displays the relative size of the landmasses. Proponents of this projection often site how the Mercator projection disproportionately overemphasized the size, and therefore the importance, of the countries and nations in the Northern Hemisphere.

Additionally there are two general types of maps – reference and thematic. **Reference maps** show absolute locations (places) and geographic features. **Thematic maps** do a better job of conveying relative locations. These maps tell a story about the degree of an attribute, the pattern of its distribution, or its movement.



SYMBOLS ON MAPS

The third fundamental property of a map is its symbolization. Maps represent the real world, and this can be done only through the use of symbols. Some examples include prominent dots for cities, lines for roads, and patterns or colors for areas of water or land. Point symbols are used to show individual features or places. Line symbols include not only roads and railroads, but also political and administrative boundaries, rivers, and other linear features.

Some lines on maps do not actually exist on the ground. When physical geographers do their fieldwork they use contour maps including lines that represent a certain consistent height above mean sea level. The spacing between contour lines immediately reveals the nature of the local topography (the natural land surface). When the contour lines at a given interval (e.g., 1000 feet) are spaced closely together, the slope of the ground is steep. When they are widely separated, the land surface sloped gently. This is known as a **relief or topographical map**. Other lines on maps are not visible in nature, such as weather maps that show points of equal pressure (isobars) or temperature (isotherms). All of these invisible lines are called **isolines**.

Area symbols take on many forms and are used in various ways to represent distributions and magnitudes. Maps showing distributions, display the world – or parts of it – divided into areas shaded or colored in contrasting hues.

TECHNOLOGY AND ITS IMPACT ON MAPS

Global Positioning Systems (GPS), satellite imagery, and remote sensing are new technologies that have changed the world. GPS technology has become much more common and is found in cars and phones alike. GPS uses latitude and longitude coordinates to determine an exact (absolute) location on the Earth.

Geographic Information Systems (GIS) use geographic information and layers it into a new map showing specific types of geographic data. In many ways, GIS is the new geography, allowing geographers to analyze new data in ways never before imagined.

Arial photography also allows geographers to see land use changing over time by comparing pictures if places from years past to current photographs. Other technologies, such as Google Earth and other high-tech systems, are revolutionizing the way we look at the world. Satellite images, remote sensing (data collected by instruments that are physically distant from the area of study), and aerial photography are bringing places from around the world onto our computer screens at home, at work, and at school.