Social Education 77(1), pp 7–13

Beyond La Niña, La Pinta, and La Santa María: The Invention and Mental Mapping of the New World[1]

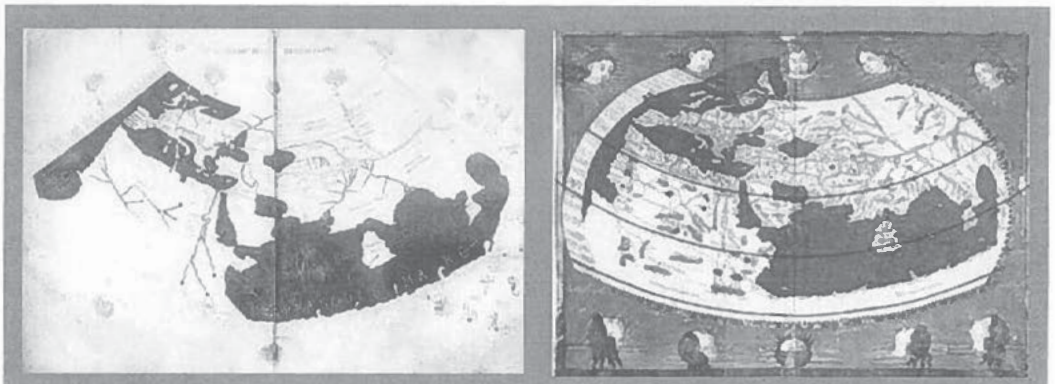
Luis Martínez Fernández

The gradual unveiling of the Americas took place in the context of a Europe in transition between the Middle Ages and the Renaissance, also of transition from feudalism to capitalism, from small regional kingdoms to absolute monarchies, and from a world view dominated by religion and scholasticism to another based on skepticism, humanism, and experimentation. These transitions, to be sure, were gradual, occurring at different times in different places. Although they were contemporaries, Christopher Columbus and the cartographer and explorer Amerigo Vespucci represented two different worlds, a waning Middle Ages and a dawning Renaissance, worlds that collaborated and clashed as Europeans strove to make sense of a potentially new world gradually unfolding before their eyes and in their minds.

Contrary to the still repeated misconception that before 1492 Europeans believed the earth was flat, it had long been established that it was round. Actually, as far back as the second century, Claudius Ptolemy had calculated the size of the earth, which he estimated to be 28 percent smaller than its actual size. He also produced a fairly accurate map of the known world, which was rediscovered during the Renaissance and became an important source of cosmographic knowledge (bottom left).

Vespucci is likely to have been more influenced by Henricus Martellus's 1489 map (bottom right); and he believed that Earth's circumference was 24,000 miles, very close to its actual size.[3]

Columbus was emblematic of the Middle Ages, a deeply religious man and a crusader at heart. He drew his cosmology deductively, mainly from the Bible and a few philosophical authori-



left: Map 1. Ptolemy Map; right: Map 2. Martellus Map. See page 12 for more details.

"Beyond La Niña, La Pinta, and La Santa María: The Invention and Mental Mapping of the New World," by Luis Martínez Fernández. From *Social Education*, January/February 2013. Article and maps used with permission.

above left: Map 3, The Ecumene Schematic Map, right: Map 4, Toscanelli Map. See page 12 for more details.

ties. Columbus believed in the medieval Catholic dogma of the Ecumene, a cosmovision in which the world's landmass consisted of three connected continents (Europe, Asia, and Africa), each with its own great river (Don, Ganges, and Nile), and each with its own race (descendents of Japheth, Shem, and Ham), all of these triads being reflections of the Holy Trinity.

Columbus was a self-taught man who embraced an unconventional cosmovision based on even less reliable calculations. He accepted the views of Paolo Toscanelli, a Florentine physician and mathematician, whose 1474 map made the world even smaller, and Marinus of Tyre's measurement of Eurasia which was 45 degrees longer than Ptolemy's and 125 degrees longer than it actually is.[4]

The compounding effect of these miscalculations led Columbus to believe that it was feasible to reach Asia by crossing the Atlantic Ocean, known then as Occidental Ocean.

Columbus's first voyage (1492–1493) shook the cosmological, philosophical, and religious foundations of Europe, as explorers, cosmographers, theologians, and cartographers scrambled to make sense of the puzzling geographic information gradually making its way to Europe from half way around the globe (below left). Columbus interpreted the geographic observations from his first voyage according to the idea of the Ecumene, concluding that he came in contact with the Indies, inhabited by Indians, and that the largest of those islands, Cuba, was the legendary island of Cipangu (Japan).

During his second voyage (1493–1496), Columbus revisited Cuba and Hispaniola and several new islands of varying sizes (below right).

This time, however, in spite of what the natives told him, he claimed that Hispaniola, and not Cuba, was Japan; and that Cuba was actually the Malay Peninsula protruding from the Asian mainland. Precisely at the point when Cuba began to appear to be an island, instead of continuing to sail westward, Columbus ordered his ships to turn back—but not before making his crew take an oath affirming that Cuba was not an island.

left: **Map 5** Columbus's first voyage (1492–1493), right: **Map 6** Columbus's second voyage (1493–1496). See page 13 for detailed explanation.

above: **Map 7** Juan de la Cosa produced the first map portraying Cuba as an island in 1500.

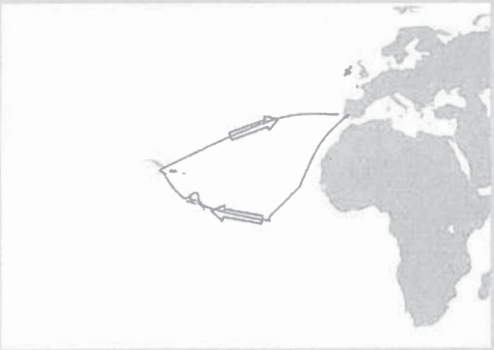
Ironically, one of the men who took the oath, navigator Juan de la Cosa, produced the first map portraying Cuba as an island in 1500. (see **Map 7** above.)

Vespucci was born and raised in Florence, the epicenter of the Renaissance, where he received a privileged education, and later worked as a merchant for the de Medici family. Renaissance minds like his approached the question scientifically, seeking and analyzing empirical evidence in order to reach conclusions about the nature of the islands and landmasses encountered by the European explorers. For him the budding idea of a New World was not a dogmatic conclusion but rather a hypothesis to be tested with subsequent voyages and explorations.

Over the next few years, Columbus, on the one hand, and Vespucci, on the other, embarked on parallel explorations to determine the nature of the lands Columbus took to be the Indies.

During his third voyage (1498–1500), Columbus ventured farther south and came in contact with the mainland of South America, near the Gulf of Pariah, which separates Trinidad and the coast of Venezuela; there he stood in awe of the basin of the great Orinoco River, and now scrambled to redraw the map of the world and to find a place for the seemingly continental landmass he found (below left). He turned to another Biblical explanation: the Orinoco, he concluded, flowed from the Garden of Eden.

In his first voyage (1499),[5] Vespucci reached the Cape of San



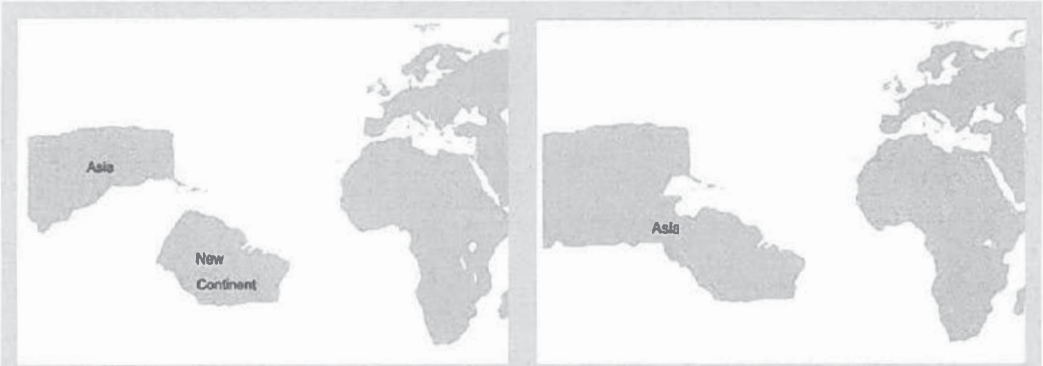
left: **Map 8** Columbus's third voyage (1498–1500), right: **Map 9** Vespucci's first voyage (1499). See page 13 for detailed explanation.

Roque near the northwestern tip of Brazil and then sailed west toward Venezuela where he coasted from the Gulf of Pariah all the way to Maracaibo, in present day Venezuela (below right).

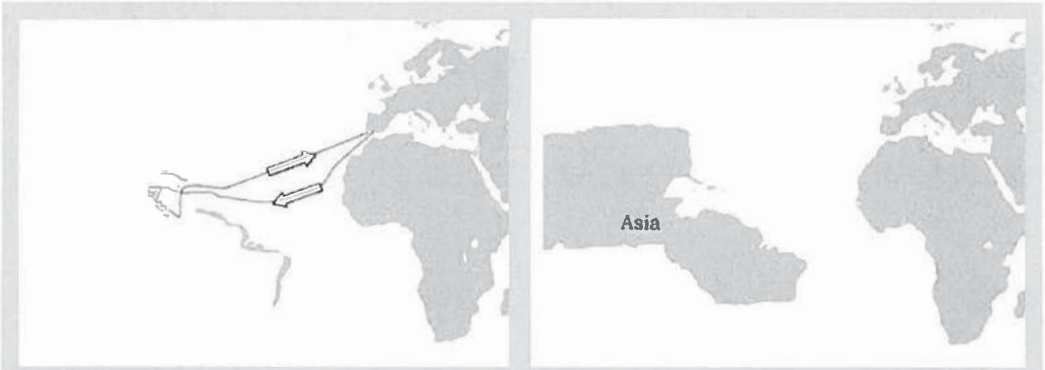
He, like Columbus, believed that those coasts were part of a large continental mass. Soon thereafter, Pedro Álvarez Cabral, sailing for Portugal, navigated south along the Brazilian coast to about 15 degrees south of the Equator, thus expanding the mental map of the southern continent to a massive territory stretching between at least Porto Seguro, Brazil and Maracaibo.

By the year 1500, these mystifying discoveries produced two competing interpretations: Columbus concluded deductively (below left) that because islands could not produce rivers of the magnitude of the Orinoco River, the landmass to the south was "a mighty continent that was hitherto unknown," which God had concealed from Europeans until that point.[6]

This new continent, he believed, was separated from the islands and mainland to the north, which he claimed all along were Asia. On the other hand, Vespucci hypothesized that all of the islands and landmasses constituted a single continent, Asia (below right), believing that it was a "fourth part of the earth."[7] Both explorers embarked on yet another round of voyages, to test their respective ideas. In 1502, Columbus led a fourth exploration, setting out toward the yet unknown isthmus of Central America in search of a water passage separating what he now believed was Asia to the north and the new continent to the south (illustration next page: top box, map at the left).



left: **Map 10** Columbus's hypothesis (1500), right: **Map 11** Vespucci's hypothesis (1500). See page 13 for detailed explanation.



left: **Map 12** Columbus's Fourth voyage (1502–1504), right: **Map 13** Columbus's Final Conclusion. See page 13 for detailed explanation.

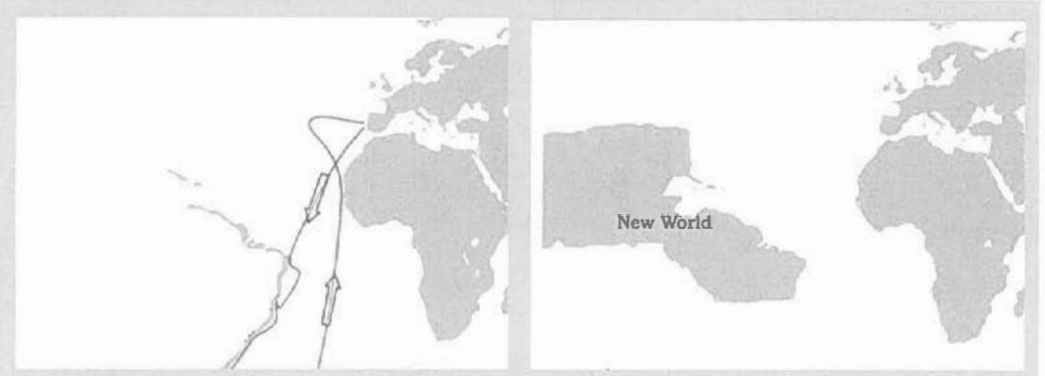
He believed that finding an oceanic passage would prove his new theory of two different continental masses. After coasting from Honduras to as far south as Panama without finding any water passage, he discarded the two-continent theory, returning to his earlier Ecumene-based proposition that all of the lands belonged to Asia; when he died in 1506, he was still convinced of that (top right). As a result of this voyage, Columbus recurred to another Biblical explanation, interpreting information about prodigiously rich gold mines in Central America as the Mines of Ophir in Panama, which produced the gold to build Solomon's temple.

Vespucci, meanwhile, set out in his second voyage (1501–1502)[8] in search of more evidence to support his hypothesis of a new single continent.

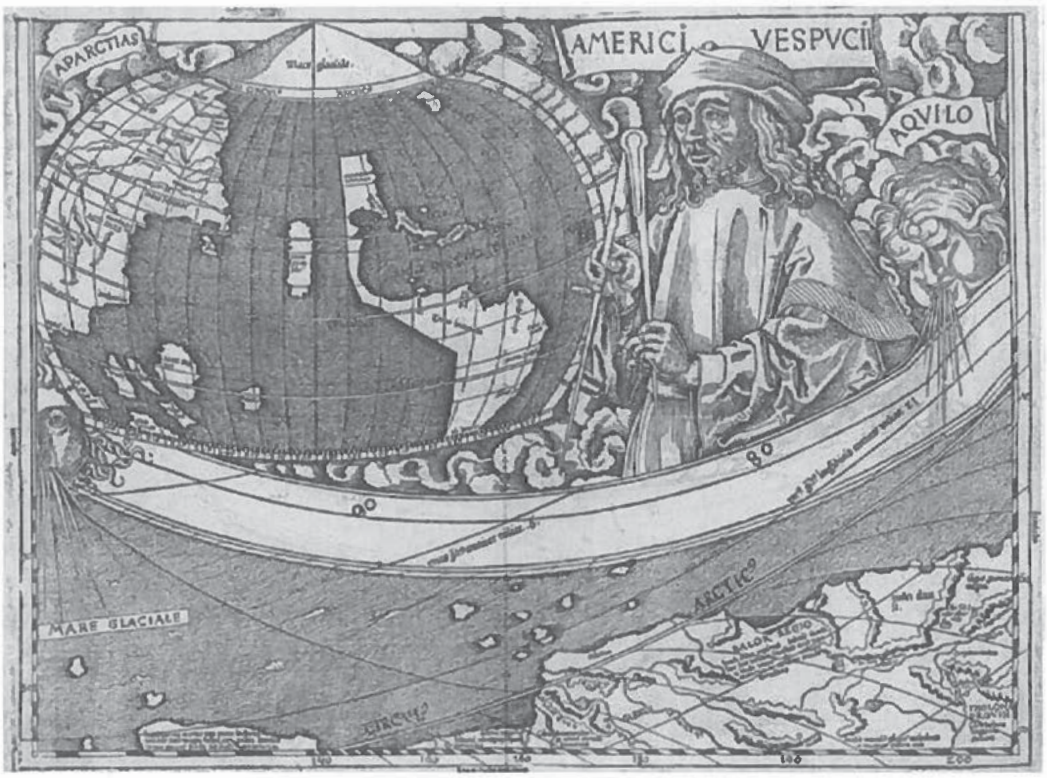
In order to prove that it was a new continent, he had to rule out that it was Asia, so he sailed southward way beyond the point where Asia's southernmost point was believed to be located. Vespucci's expedition reached what later came to be known as Río de la Plata, Argentina, located 34.5 degrees south of the Equator. Based on this evidence he inductively concluded that all of the newly discovered lands and continents, indeed, constituted a new world.

So who "invented" America? Was it Columbus or Vespucci? Arguably it was neither and it was both. The invention and mental discovery of America required the mystic zeal of a prodigiously stubborn Columbus, whose deeply religious worldview allowed him to embark on explorations and theories summarily dismissed by his learned contemporaries. It also required a Renaissance man like Vespucci, who proposed hypotheses and sought empirical evidence to make sense of the new lands eventually named the Americas in his honor.

In 1507, Martin Waldseemüller produced the very first map with the word "America" stamped over South America. This map and others produced in the next few years reflected the Europeans' continuing uncertainty about the size, shape, location and connectedness of the new world that continued to unveil itself. Two things, though, remain clear: no one refers to the new lands as Columbia and no country celebrates Vespucci Day.



left: **Map 14** Vespucci's Second Voyage (1501–1502), right: **Map 15** Vespucci's Final Conclusion. See page 13 for detailed explanation.



above: **Map 16** In 1507, Martin Waldseemüller produced the very first map with the word "America" stamped over South America.

Notes

1. A few segments of this essay appeared previously in "1492: First Encounters, the Invention of America and the Columbian Exchange," *Revista Brasileira do Caribe* 6, no. 11 (2005), 13–31.
2. Edmundo O'Gorman, *The Invention of America* (Westport, Conn.: Greenwood Press, 1972). Also see Eviatar Zerubavel, *Terra Cognita: The Mental Discovery of America* (New Brunswick, N.J.: Rutgers University Press, 1992) and Enrique Dussel, *The Invention of the Americas* (New York: Continuum, 1995).
3. Felipe Fernández-Armesto, *Amerigo: The Man Who Gave His Name to America* (New York: Random House, 2008), 69–72.
4. Helen Wallis, "What Columbus Knew," *History Today* 42, no. 5 (May 1992): 17–23; www.historytoday.com/helen-wallis/what-columbus-knew.
5. Vespucci claimed that he embarked in four expeditions to the New World. The historical sources that mention four voyages, however, have been held suspect by many scholars; and there is a consensus that he had only two voyages—one in 1499, and the other in 1501–1502. The graphic reconstruction used here is derived from maps that appear in http://olinuris.library.cornell.edu/exhibitions/vespucci.
6. Christopher Columbus, *Four Voyages to the New World* (Gloucester, Mass.: Peter Smith, 1978), 129–130.
7. Fernández-Armentos, *Amerigo*, 71. See Vespucci's letters in: http://mith.umd.edu/eada/html/display.php?docs=vespucci_letters.xml&action=show.
8. See note 5. If the questionable 1497 voyage is discounted, his 1501–1502 voyage is his second.

Luis Martínez Fernández *is professor of history at the University of Central Florida, where he teaches courses on Latin American and Caribbean history. He is also a trustee of the College Board and was a member of the History Academic Advisory Committee that produced the "College Board History Framework" and revised the U.S. History AP course (2006–10). His books include* Fighting Slavery in the Caribbean *(1998) and* Frontiers, Plantations, and Walled Cities *(2010).*

More about the maps and where to find them on the Web

Map 1: **Ptolemy map** originally in his *Geographia*, circa 150 AD. This 1482 edition is an example of the rediscovery of classic works during the Renaissance. Source. http://upload.wikimedia.org/wikipedia/commons/2/23/PtolemyWorldMap.jpg

Map 2: **Henricus Martellus map** of 1489 is based on Ptolemy's map but portrays a smaller Asia and the Indian Ocean does not appear as a landlocked body of water. Source: http://upload.wikimedia.org/wikipedia/commons/4/4d/Martellus_world_map.jpg

Map 3: **The Ecumene** as represented in a schematic map of the world by Bishop Isidore of Seville (560-636 AD). Note the three known continents inhabited by the three known races. The east appears on top of the map rather than on the left, a reflection of the greater importance of the east, where the Holy Land of Jerusalem is located. Source: http://idlespeculations-terryprest.blogspot.com/search?q=isidore.

Map 4: **Toscanelli map** (1474). The original of his map has been lost but it has been reconstructed based on information from the letter that accompanied the map. Source: Lawrence J. Burpee, *An Historical Atlas of Canada* (Toronto: Thomas Nelson and Son Limited, 1927). Map by John Bartholomew and Son, Ltd., Edinburgh Geographical Institute. www.heritage.nf.ca/exploration/toscanelli.html; see also, http://cartographic-images.net/252_Toscanellis_World_Map.html.

More about the maps and where to find them on the Web (continued)

Map 5: **Columbus's 1st voyage** (1492–1493) showing the lands he coasted, including several small islands in the Bahamas, Cuba's northwestern coast, and a good portion of the northern coast of Hispaniola.

Map 6: **Columbus's 2nd voyage** (1493–1496) reflecting his encounter with numerous Leeward and Windward islands, Puerto Rico, and Jamaica. It also reflects his coasting of southern Cuba. He insisted that Cuba was the Malay Peninsula and embraced the idea that Hispaniola was Japan.

Map 7: **Juan de la Cosa's map** of 1500 shows the geographical knowledge accumulated at the time from various explorations. It is the first map in which Cuba appears in the shape of an island (1500). Source: http://upload.wikimedia.org/wikipedia/commons/b/b5/1500_map_by_Juan_de_la_Cosa-North_up.jpg.

Map 8: **Columbus's 3rd voyage** (1498–1500), including his first encounter with South America.

Map 9: **Vespucci's 1st voyage** (1499). In all fairness, this voyage should be credited to Alonso de Ojeda, who organized and led the expedition. Many question the validity of his account of a first voyage in 1497 and therefore the 1499 voyage is widely referred to as number one. The graphic reconstruction presented here is derived from maps created by Nij Tontisirin and Boris Michev, in Oris and Ulin Libraries, Cornell University. http://olinuris.library.cornell.edu/exhibitions/vespucci

Map 10: **Columbus's hypothesis**. The lands and islands discovered so far are parts of two separate continental masses: Asia to the north and a previously unknown continent to the south.

Map 11: **Vespucci's hypothesis**. The lands discovered thus far are all connected and appear to belong to Asia.

Map 12: **Columbus's 4th voyage** (1502–1504) during which he sets out to find an oceanic passage between what he believes to be Asia and a new continent to the south.

Map 13: **Columbus's final conclusion**. He died holding on firmly to these ideas, leaving the Ecumene intact and never giving up on his belief that Cuba was not an island.

Map 14: **Vespucci's 2nd voyage** (1501–1502). It reflects how far south he went in search of a passage to what he believed was the Indian Ocean. See comment on Map 9, above.

Map 15: **Vespucci's conclusion**. Columbus's failure to find an oceanic passage between the northern and southern continents validated his contention that all of it was a connected landmass, and his southward coasting of the continent demonstrated that it could not be Asia because it went as far south as 34.5° below the Equator, if not farther.

Map 16. A facsimile of **Waldseemüller's world map** from his *Universalis Cosmographia* (1507). While the larger map includes the name "America," this insert shows the term "Terra Incognita" (unknown land). It does, however, show what was known of the American continents as connected, and separated from Asia. Source: http://upload.wikimedia.org/wikipedia/commons/thumb/c/c0/Waldseemuller_map_2.jpg/1280px-Waldseemuller_map_2.jpg

The Map

Land lies in water; it is shadowed green.
Shadows, or are they shallows, at its edges
showing the line of long sea-weeded ledges
where weeds hang to the simple blue from green.
Or does the land lean down to lift the sea from under,
drawing it unperturbed around itself?
Along the fine tan sandy shelf
is the land tugging at the sea from under?

The shadow of Newfoundland lies flat and still.
Labrador's yellow, where the moony Eskimo
has oiled it. We can stroke these lovely bays,
under a glass as if they were expected to blossom,
or as if to provide a clean cage for invisible fish.
The names of seashore towns run out to sea,
the names of cities cross the neighboring mountains
-the printer here experiencing the same excitement
as when emotion too far exceeds its cause.
These peninsulas take the water between thumb and finger
like women feeling for the smoothness of yard-goods.

Mapped waters are more quiet than the land is,
lending the land their waves' own conformation:
and Norway's hare runs south in agitation,
profiles investigate the sea, where land is.
Are they assigned, or can the countries pick their colors?
-What suits the character or the native waters best.
Topography displays no favorites; North's as near as West.
More delicate than the historians' are the map-makers' colors.

Elizabeth Bishop

GEOGRAPHY AND YOU

HOW MAPS LIE

Never head down a little pink line to deception.

BY LEAH FLECKENSTEIN

Through the 1940s, British school children studied maps of the Empire. At that time, "the empire" sprawled across nearly a quarter of the globe in uniform hues of pale pink, blue, or yellow. Hanging against the classroom wall, Britain's territory seemed even more extensive by a coy cartographic trick. Australia made a dual appearance at each end of the map. After all, a little extra coverage never harmed patriotism.

Such tiny deceptions are common in maps. Like any interpretation of data, maps can reflect the desires of their creators. That is why, for example, the earliest maps showed the cartographer's own country at the center of the universe.

Wishful thinking can produce another type of deception. Think of the blue, blue water on maps that beckon tourists to vacation spots. Bending the truth can encourage people to share a vision. Why else would developers illustrate proposed shopping malls with landscapes devoid of dumpsters but replete with full-grown trees?

LEAH FLECKENSTEIN *is a free-lance writer based in Syracuse.*

"Most decent maps are collections of little lies," says Mark Monmonier, a professor of geography in the Maxwell School of Citizenship and Public Affairs. Monmonier is the author of *How to Lie With Maps*, which discusses deceptions that are inherent in maps. The critically acclaimed book also reviews methods of creating maps that interpret census data or that are used to influence planning boards.

"What people have to remember," he says, "is that any given map is just one way, out of many, to present the information. Maps look impressive. People believe in them when they should be more critical."

Innocent Deceptions

On the most benign level, the "lies" maps tell are practical omissions. Since maps are scale models of reality—say of a large city or several states—too much detail is cumbersome. In shrinking reality so it can be effectively stored in a glove compartment, map-makers omit features by necessity. Depending on scale, streets may vanish or suburbs be swallowed by their neighboring city.

Beyond just trying to fold a road map back into its original neat rectangle (or crumpling it into a wrecked tangle), most people, at one time or another, have been frustrated by a map. As an example, Monmonier points out the widespread tendency to show highway interchanges that drivers can't actually make.

"Not all big lies told by maps are deliberate or devious," he adds. "Ignorance, mistakes, and even a bit of mischief account for many cartographic lies."

There are examples of map-maker whimsy, such as the Michigan football fan who created the towns Goblu (Go Blue) and Beatosu (Beat Ohio State University) on a 1979 Michigan highway map.

A mortifying and costly mistake occurred when Seattle was omitted altogether from the American Automobile Association's road map. "It fell through the editing crack," explained an embarrassed official. Disconcerting, too, was the disappearance of Ottawa from an airline tourist map.

More likely to affect the average map user are oversights, such as inclusion of "paper" streets—roads that were planned but never built—and "trap" streets inserted by map-making companies to catch unwary plagiarists.

One reason American maps are not

Produced by The Berkeley Electronic Press, 1991

"How Maps Lie," by Leah Fleckenstein. From *Syracuse University Magazine*, December 1991. Used with permission.

Syracuse University Magazine, Vol. 8, Iss. 1 [1991], Art. 7

all they should be, Monmonier says, is the unwillingness of the public to pay top dollar for quality maps. Years of free highway maps paved the way for a sort of take-maps-for-granted attitude.

European countries, he says, generally produce better-quality maps. Not only do they have more companies that undertake the expensive cartographic process, but their countries are smaller.

Political Plotting

In the United States, it is the U.S. Geological Survey that is officially in charge of mapping the country. The entire 3.5 million square miles (with the exception of Alaska) is depicted on a series of maps at a one-inch-to-2,000-feet scale.

The maps are supposed to be updated every 10 years, but because mapmaking is so expensive and the coverage so expansive, that task is far behind. Found in stationery stores or stacked in map drawers in libraries, these maps are used by hunters, developers, hikers, politicians, and scientists for a multitude of purposes.

"Topographical maps show very strong biases," says Monmonier. "There is a lot they aren't showing, like certain military installations or what kind of neighborhood is being depicted. Camp David isn't labeled on topographical maps, though it is clearly identifiable."

The omission that burns him up the most is the determined absence of known waste dumps.

"We have Super Fund sites that hold toxic waste, but these sites aren't shown because they might embarrass polluters or local officials. Some claim that, as these dumps will be 'cleaned up soon,' they shouldn't be featured. That excuse doesn't wash because there are a lot of other temporary structures shown on topographical maps." He points out that "temporary structures" such as off-shore shipwrecks, drive-in movie theaters, and abandoned railways are regular features on topographical maps.

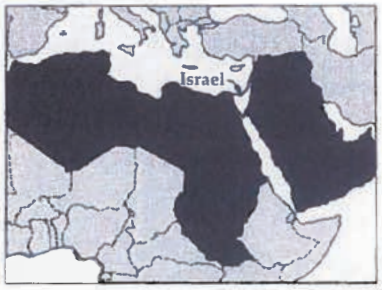
Love Canal is one stunning example of an ignored waste dump. A 1946 map of Niagara Falls, New York, shows the infamous canal as a thin line, with no indication that it had been used for chemical waste since 1942. In the mid-fifties the canal was filled in, homes were built in the area, and a public

MAPS USED FOR PROPAGANDA

The German Library of Information published a weekly news magazine, *Facts in Review*, between 1939 and 1941 to garner sympathy for Germany. This map, published two years before Germany invaded the Baltic states, boasted of voluntary efforts to bring German citizens back to their homeland from foreign countries.

These maps, while always in black-and-white, effectively used shading to strengthen its assertions. In his book, *How to Lie With Maps*, Mark Monmonier observes that, "The map's pictorial symbols dramatize the repatriation by showing proud, brave, obedient Germans clutching their suitcases and lining up to board ships sent to 'lead [these] lost Germans back home to the Reich.' To the east in stark, depressing black looms the Soviet Union, and to the south in pure, hopeful white lies Germany."

VIEWS OF THE MIDDLE EAST



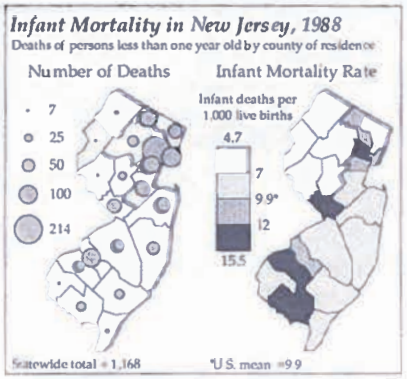
Labeled as "The Arab World," the map on the left, which appears in a 1990 pamphlet promoting an atlas of Jordon, is self-described as a "political one" in the caption. Perhaps that explains the absence of Israel, the unlabeled territory south of Lebanon (through which passes the label "Palestine"). The outlines of Jordan mark its old territory, claiming the West Bank which Israel conquered in 1967. The fact that the countries are all the same color carries an obviously political message.

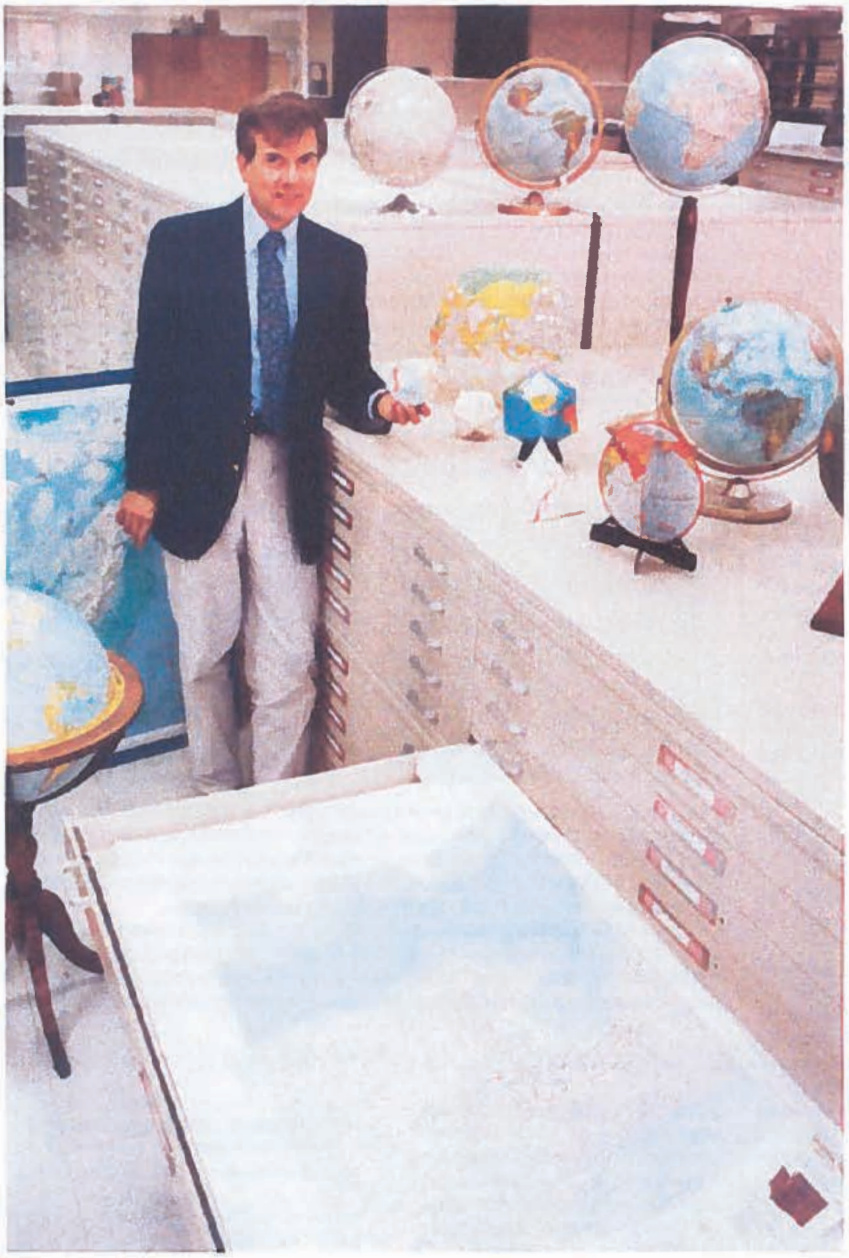
The map on the right, also shows all Arab countries the same shade. In this instance, though, the effect is one of unified menace. Israel looks small and defenseless in this map produced by the Jewish National Fund of Canada during the 1973 war. While the map is accurate in comparing land mass, it does not give a sense of Israel's strong support from other sympathetic countries at the time.

SAME DATA, DIFFERENT APPEARANCES

These maps depicting infant mortality rates in New Jersey show the benefit of using complementary maps to examine the same data. The map on the left simply shows the number of deaths in each county. It does not compare that number to population or overall number of births. The map on the right does. A choropleth or "patch" map, it sets data break-off points and uses gradations indicative of, in this case, four levels of categorization.

While the map on the left appears to indicate an alarming death rate in the northeast corner of the state (note the overlapping cluster of circles), putting those numbers into context shows that the mortality rate is equally serious mid-state and in the southwest.





Mark Monmonier, professor of geography, in mapland at SU's Bird Library. The author of *How to Lie With Maps* warns that, like any form of human communication, maps are subject to the whims and biases of their creators.

school spanned the chemical dump. A map produced 10 years ago does not feature the filled-in canal, or its history.

While maps serve as guides, they can have strong political purposes. Maps are used to claim territory (Argentina still shows the Falkland Islands on its national stamps) or to disclaim territory (recent maps from Latvia and Estonia don't show the overshadowing Russian border).

Sometimes countries have differing interpretations. The territory of Kashmir is shown on both Indian and Pakistani maps as belonging to their respective countries, while more impartial sources show the disputed boundary with a dotted line.

Most chilling are the propaganda maps, especially those produced by Nazi Germany. In his book, Monmonier states: "No other group has exploited the map as an intellectual weapon so blatantly, so intensely, so persistently, and with such variety."

The Nazis' deliberate manipulation of apparently standard maps prior to World War II was intended to direct sympathy toward Germany and away from the Allies. One map uses a comparison of British territory (13 million square miles) to Germany's (264,000 square miles) to imply Allied greed. The caption under the tiny map of Germany queries the reader, "The Aggressor Nation?" (For other examples of propaganda maps see the sidebar on page 37.)

If you're looking at a map produced by the Soviet Union between 1939 to 1969, you'd best not trust it to get you from Lenin's tomb to Red Square. The security police bolstered a systematic fake map campaign, which reached its peak during the Cold War. Although officials kept the real versions under lock and key, they disseminated the false versions abroad as well as in their own country to create distrust—especially among foreign militaries—for the accuracy of their maps. This scheme was abandoned as costs mounted and satellite technology punctured such duplicity easily.

Syracuse University Magazine, Vol. 8, Iss. 1 [1991], Art. 7

Home Soil

In the U.S., maps that serve political purposes are common. As the Bush administration tackles the reapportionment of wetlands, generalized maps will be used to evaluate huge tracts of land that may, or may not, be opened to developers.

Cartographers have little influence over that process, as maps are compared with satellite and aerial photos of the same area. But even impartial maps can be cropped, "simplified," or embellished with distracting detail.

"Generalized maps can provide a quick and dirty way to define any large area," Monmonier says. "The smaller your scale, the more you can hide."

Recent focus on congressional redistricting in New York City and other large urban centers has been in the news this summer. Despite the claims by some groups of unfair reapportionment, Monmonier says this is a hard process to corrupt.

"Congressional redistricting is closely regulated by the courts and has very strict guidelines," he explains. "Although these maps can be corrupted to some extent, it would be hard to say whether redrawn lines are deliberate attempts solely to break up political groups. Of course, those involved in redistricting want to keep incumbents in office. But they can't just carve in a slice of a neighboring district. If district 'A' has 45,000 constituents and district 'B' has 40,000 constituents, you can bet the circuit court judge will refuse those boundaries."

The Data's In

While maps are most commonly used to show terrain, maps also show data. Census figures, employment gains and losses, health statistics and thousands of other data are all regularly transformed into data maps.

This, says Monmonier, is where the real danger for misinterpretation and self-deception awaits.

"User friendly" mapping software is one of the biggest boondoggles for the unwary map reader. Lightning-fast reconfigurations can uncover the most favorable relationship between data and their maps. [See the map on page 37 for an example of manipulated infant-mortality statistics.]

"Anyone interested in public policy—voters, administrators, politicians, consumers, or marketers should know that while maps based on census data can provide useful information, they can also communicate flagrant distortion," Monmonier warns.

Because statistical maps often display data collected on the basis of large areas—counties, states, or countries—the biggest problems occur with inaccurate appearances of uniformity. For example, if a county has one big town sprouting from an otherwise rural area, statistics from the town will be spread thinly over the entire territory. A naïve reader or analyst will be mistaken if he or she uses that "spread out" information to make assumptions on individual households.

Another way to change the face of the data map is to change the "breaks" between levels. For example, if a marketing company wanted to show a suburban area as being "high-income," it might create a choropleth—or "patch"—map to make its point, with differently shaded areas indicating levels of mean income. The key consideration is how the data are grouped. If only three income levels are used, and the top one begins as low as, say, $20,000, the reader would be presented with a map that looks impressive but not truly reflecting "high income."

The best way to remove bias, Monmonier says, is to compare many maps featuring the same data. He sees future atlases as being "graphic scripts" that can compare many maps in sequence.

Gray-scale tones can be effective in data maps because the different intensities—from white, to gray, to black—connote objectively. Color, however, is far more subjective.

"Colors mean different things to different people," Monmonier points out. "If you asked 10 different people to put colors 'in order' to reflect intensity, you'd have 10 different results."

With this in mind, color can confuse viewers, or can be another way to influence emotions. While many colors fail miserably on most data maps (weather maps are a major exception), traditional cartography takes advantage of the common perception that light yellow means "desert," brown means "high altitude," green means "vegetation," and blue "ocean." Viewers would have a subtle change in perception if, for example, California is portrayed as pale yellow on one map and verdant green on another.

"People respond emotionally to some colors, such as blue and red," Monmonier states. "Red, for instance, is associated with fire, warning, heat, blood, anger, courage, power, love, military force, and Communism."

Comparison's Sake

For those interested in viewing maps with a more critical eye, Monmonier stresses again that maps are just as prone to errors or misinterpretation as any large body of data. The best way to remove bias, he says, is to compare many maps featuring the same data. He sees future atlases as being "graphic scripts" that can compare many maps in sequence.

He's working on his own graphic script—a project he calls "atlas touring." Now up and running on a Macintosh computer, the program allows map comparison of an area over a period of time. While the program might fall into the trap of providing maps or graphs for contrived purposes, Monmonier says the advantage with atlas touring is that the user has control over the information.

Monmonier hopes his tool eventually will be used to chronicle social changes, diseases, and environmental concerns.

"If you have layers upon layers of data, all hung on essentially the same framework, you'll be more likely to spot trends in, say, cancer rates," he explains.

"With these types of tools, viewers don't have to settle for one freeze frame and have that be the sum of their knowledge. They can see one hundred maps using the same data to get the most complete picture." He pauses, thoughtfully. "Maps are not going to stand still much longer." ■

theguardian | TheObserver

From shopping to warfare, why maps shape our minds as well as our planet

Apple's new mapping software is under intense scrutiny – but a series of new books and an exhibition demonstrate that cartography is a huge and growing influence

Vanessa Thorpe, arts and media correspondent
The Observer, Saturday 22 September 2012 07.56 EDT

A world map based on the writings of Claudius Ptolemy, the first geographer, published in 1482 by the German cartographer Nicolaus Germanus as part of his Cosmographia. Photograph: Corbis

Maps are at the centre of a worldwide commercial power struggle this weekend as Apple faces criticism of the technology it has developed for its new smartphone. But two new books and an exhibition at the Royal Geographical Society reveal that maps have been at the centre of both politics and commerce down the ages, as well as key to the development of the human imagination.

In his new book, *On The Map*, Simon Garfield explains that, just as the empires of the past understood that marking territory was crucial, so Google and its rivals now wield influence. They are even implicated in border disputes. Garfield describes how in 2010 the Nicaraguans cited Google Maps in support of their action when they invaded Costa Rica. Brian McClendon, who developed the mapping technology bought up by Google in 2004, told Garfield that the Nicaraguans argued that they were justified in moving onto the extra territory accidentally assigned to them.

And Garfield believes the commercial and political significance of reliable maps can only grow. "Not only will it become the decisive element in the smartphones and apps we buy, it is also the way that shops will find out when we are nearby," he said.

A revived interest in representations of planet Earth is also reflected in Jerry Brotton's book, *A History of the World in Twelve Maps*, out last month, and in an exhibition of globes at the Royal Geographic Society in London next month.

"The amount of interest in maps and globes at the moment has probably got something to do with the fact that we are all able to find ourselves on maps now at the touch of a screen," said Garfield. Throughout history, he points out, the centre of a map of the world has been the place to be, and today individuals find themselves at the centre courtesy of their smartphones.

"It used to be Jerusalem that was placed at the centre of Christian maps," said Garfield. "Or in China, it would have been a place called Youzhou. Now for the first time we are all at the centre."

Histories of cartography often start in AD150 when Claudius Ptolemy, the first "geographer" to use the term, wrote a book about the skill of map-making. He laid out rules about the geometric lines of latitude and longitude and gave co-ordinates for more than 8,000 locations in the ancient world. But Garfield believes it is possible to look back further, to the moment when the human mind began to develop.

"In *Unweaving the Rainbow,* Richard Dawkins suggests that map-making is one of the basic things that first distinguished us from animals. We needed to explain to each other where to hunt, so spatial awareness, plus the skills of representation and communication, had to develop."

In his book about maps, Brotton, a professor of renaissance studies at Queen Mary, University of London, examines the difficulties faced by map-makers through the stories of 12 key maps, going from Ptolemy's ground rules right up to Google Earth, and taking in influential Islamic and East Asian works.

He concludes that maps rarely come without an agenda. "The idea of the world may be common to all societies, but different societies have very distinct ideas of the world and how it should be represented," he writes. Garfield sees the history of cartography as a way to understand political influence too. "It is always about the proprietorial impulse," he said. "A map says not only 'We know all this', but often 'We own all this' too."

This is clear when shipping routes, the paths to gold and spices, are first traced, and even with British Ordnance Survey maps, which Garfield believes conveyed a sense of power and territory.

The appeal of maps can also be purely visual. "I am a sucker for all kinds of maps and it seems that lots of people are," said Garfield. "For many, the best ever is the 17th century Atlas Maior made by Joan Blaeu. It is just an absolutely wonderful thing – the coffee-table book of its day, complete with wonderfully strange creatures in the sea."

A fresh interest in hand-drawn and personalised maps is providing some antidote to the advance of digital technology, Garfield thinks. The work of artist Grayson Perry, who maps out British social mores with his wall tapestries, is an example. Garfield also notes the enduring appeal of maps in children's literature, from *Treasure Island* to *The Chronicles of Narnia* and *The Hobbit*. JK Rowling's Marauder's Map in the Harry Potter books is a recent example. "Vladimir Nabokov also did a wonderful map of the characters in *Ulysses* and of where they all go in one day," said Garfield.

Peter Bellerby, a professional globemaker, fell under the spell of cartography five years ago when he tried to make a globe for his father's birthday and he has not stopped since. "I had to figure out the very basics of globemaking," he has explained. "How to make perfectly spherical balls for instance." A selection of his work will be displayed at the Royal Geographical Society next month.

Garfield owns two globes. "There are things you can only get from a globe," he said. "There used to be one in every Victorian classroom and, even if it wasn't consulted, it was a symbol of power."

As the battle for pre-eminence in smartphone maps escalates, there will be slip-ups and deliberate misrepresentations on the way, he says. There always have been: for two centuries the state of California was shown as an island. And for a century the mountains of Kong stretched across Africa, until a French explorer found they were not there, while names are a political minefield.

"We have places that are named that are claimed to be owned by three different countries," Google's McClendon told Garfield. "And they have two or three names associated with them."

WORLD VIEWS

The Hereford Mappa Mundi (circa 1300)

Drawn on a single sheet of calfskin, this is the largest medieval map known to still exist. Written in black ink, with additional red and gold, it records how scholars interpreted the world in spiritual as well as geographical terms. The 500 or so drawings include 15 biblical events, 420 cities and towns and eight pictures from classical mythology.

The Mercator projection (1569)

The standard map used in most schoolbooks and newspapers. The projection flattens the Earth on to a rectangular page, distorting the outline and proportions of the continents (Greenland appears larger than Africa, but is one-fourteenth its size).

Atlas Maior (1665)

Joan Blaeu's magisterial and comprehensive world atlas was the most expensive book in the 17th century. The original 11-volume Latin edition included the world's continents, individual countries, islands, cities and towns, each decorated with miniature portraits, coats of arms, great ships and mystical characters.

Google Maps (21st century)

Google has set the standard for online cartography, using satellite imagery and street view data that creates a picture of the world more accurate and detailed than anything before.

The Salt Lake Tribune

Students learn about mapping, environment through dance

Green Map • Online access allows anyone to see shops, parks and transit that helps the planet.

BY CAROL LINDSAY SPECIAL TO THE TRIBUNE

PUBLISHED MAY 2, 2012 5:16 PM

Repertory Dance Theatre, Weber State University's Moving Company and the geography department joined 800 other communities in 60 countries to create and choreograph an environmental Green Map for residents of Ogden. The Green Map system — which marks places such as public transit stops, secondhand stores and environmentally minded businesses — was developed in 1995 as a means of encouraging participation in sustainable community development around the world.

Weber State took the system a step further and added dance as a means of sharing knowledge. Ogden is the first city to combine its Green Map with dance.

The geography department worked to identify local sustainable businesses and map them online. The dance department used the information from the map to develop dance performances and spread the word encouraging a more sustainable life.

"Just about anything can be taught through dance. Because children learn through kinetics, dance is an excellent format to reinforce what they are learning," said Joanne Lawrence, professor of dance at WSU.

Lawrence worked with Repertory Dance Theatre in Salt Lake City to develop the program.

Each year, Weber State does an outreach program in the community. This year, it decided to use the green map project. Lawrence and her students took the mapping and dance project to schools in Ogden, where the students learned dances about water, plants and animal life that were represented by icons on the map.

Dancers from Weber State University performed at schools during assemblies. They worked closely with fourth- and sixth-graders at Horace Mann Elementary twice a week for 10 weeks, teaching them mapping and dance.

Students would re-create a biome, such as the high desert, by holding poses that represented rocks, cactus and sage while other students would move as animals through the dancescape, Lawrence said.

Geography majors would help the children identify places they thought were important to map, and they would display their creations in the classroom.

Students at Horace Mann were given a pre-test and a post-test in geography, and teachers said the results were positive.

"We plan to do more in-depth assessment as to how learning is increased through dancing," Lawrence said.

Ashley Remkes, a fourth-grade teacher at Horace Mann Elementary, said the dance went "really well."

"We were talking about animals and their environment," Remkes said. "It helped them understand dance and the subject we were studying."

Jordan Porter, a senior majoring in geography, was responsible for the computer aspect of the project. Porter enjoyed getting outside his box and interacting with other departments. "Working with the eccentric dance students was a big and welcomed change from the typical science students I am used to encountering," Porter said. "Their open spirits made for a very fun and rewarding project."

closeup@sltrib.com

"Students Learn about Mapping, Environment through Dance," by Carol Lindsay. *Salt Lake City Tribune*, May 2, 2012. Used with permission.

International Journal of Health Geographics

BioMed Central

Review

Open Access

The shape of the global causes of death

Anna Barford* and Danny Dorling*

Address: Social and Spatial Inequalities Group, Department of Geography, University of Sheffield, Sheffield, UK

Email: Anna Barford* - Anna.Barford@sheffield.ac.uk; Danny Dorling* - Danny.Dorling@sheffield.ac.uk

* Corresponding authors

Published: 23 October 2007

International Journal of Health Geographics 2007, 6:48 doi:10.1186/1476-072X-6-48

Received: 10 August 2007
Accepted: 23 October 2007

This article is available from: http://www.ij-healthgeographics.com/content/6/1/48

Abstract

Background: World maps can provide an instant visual overview of the distribution of diseases and deaths.

Results: There is a particular geography to each type of death: in some places many thousands of deaths are caused by a particular condition, whilst other equally populous areas have few to no deaths from the same cause.

Conclusion: Physicians and other health professionals often specialise in the specifics of causes, symptoms and effects. For some practitioners gaining a worldview of disease burden complements smaller scale medical knowledge of where and how people are affected by each condition. Maps can make health related information much more accessible to planners and the general public than can tables, text, or even graphs. Ten cartograms based on World Health Organisation Burden of Disease data are introduced here; alongside seven based on data from other sources. The Burden of Disease cartograms are the latest in a much larger collection of social, economic and health world maps.

Introduction

In this paper we introduce a new collection of cartograms, depicting geographies of medicine, health care, disease and death. Cartograms have a long but sparse history in medical mapping. The history we can reconstruct is one of similar ideas being repeatedly rediscovered in both Britain and the United States, often with little knowledge of earlier discoveries. There are almost certainly examples of their discovery and use for medical mapping in other countries, given the spontaneity with which the idea appears to be independently reborn time and again (but we have failed to find them).

To our knowledge medical cartograms were first employed by Wallace in 1926 [1] to create a new base map of the counties of the State of Iowa that was explicitly designed to allow coloured pins to be placed on the map each representing a reportable disease notification. Any clustering of the pins on that map would be much more likely to represent an actual cluster of significance on the ground. Three decades later, in 1955, Ian Taylor [2] independently produced "an epidemiological map" for use in the British ministry of health upon which were drawn the then current boroughs of London, each sized as a box of equal height drawn with width in proportion to population and filled with crosses to represent the notifications of poliomyelitis in each borough during the year 1947. The height of the crosses within each box was thus proportional to the rate of notifications.

Fifteen years later (1970) in the second edition of his Atlas of disease mortality Melvyn Howe [3] employed a popu-

International Journal of Health Geographics 2007, **6**:48 http://www.ij-healthgeographics.com/content/6/1/48

lation cartogram of the United Kingdom upon which various squares and diamonds were placed representing the peoples of the major cities, towns, counties and boroughs. These were then coloured by the age and sex standardized rates of particular diseases as they effected the populations. In 1965, which was five years earlier, and back over in the United States Levison and Haddon [4] had demonstrated how it was possible to use a population by area cartogram of upstate New York to investigate whether spatial clustering of Wilm's tumour or cervical carcinoma was occurring there in the early 1960s. Back in Britain, Hunter and Young in 1971 [5] showed how cartograms could be used to plot the influenza epidemic of that decade across England and Wales using a series of cartograms.

The first use of computer-created population cartograms in medical mapping was pioneered in America by Selvin and his colleagues during the mid eighties [6-9], but still the benefits of using cartograms in medical mapping were not widely recognised, mainly because of the difficulties of creating cartograms by computer and their arbitrary nature. A series of cartograms of mortality rates by area for many different diseases appeared in a cartogram based atlas of Britain [10]. The new algorithm to produce cartograms suitable (in general) to use as a base for medical mapping was only developed and made available three or four years ago [11].

The new form of mapping which has recently been applied to world data, including mortality data [12-14], makes maps using an algorithm based on the physics of heat transfer [15]. This algorithm allows the density of a variable to become equal everywhere on the map. For example, on a map of deaths attributed to Vitamin A deficiency, the relatively large area of Pakistan denotes the relatively large proportion of all such deaths in the world that occur there (Figure 1). Similarly, Brazil cannot be seen on this map because very few Vitamin A deficiency-related deaths are thought to occur there. This scaling of the area of each territory by the number of deaths there due to a particular cause is achieved whilst allowing coastlines and borders to expand, contract and crumple. Thus territories appear distorted yet recognisable, somewhat like a caricature of the world. Note too that here we do not consider geographical variations within territory boundaries. For illustrations of sub-national variations in a range of measures see the Gapminder website [16].

Data availability is crucial to making these maps. Collecting and estimating good quality data that is internationally comparable is a challenging task. Recently the quality of World Health Organisation statistics has improved, particularly in terms of data accuracy and the number of territories for which data are collected and estimated. It is important of course to remember that the quality of data will vary both between territories and between causes of death, and that even the world total number of people dying each year is an estimate that is hard to verify. The original data, which is publicly available, includes a level of uncertainty indicator for each country for each cause and also a set of confidence limits for all cause mortality in each country. There are still issues of uncertainty even in that which is most certain. However, the situation now is far better than it was a decade ago. One example of dramatically improved data used here is the 'World Mortality in 2000: Life Tables for 191 Countries' [17]. This report was released because reporting of mortality data has been poor in many territories, despite the importance of this information for health policy.

The maps shown here are a subset of a broader mapping project, Worldmapper. These and many other health-related maps are available on the Internet and can be downloaded at no cost to the user. At the time of writing the Worldmapper project's health related maps include reshaping the world according to: health care quality, numbers of nurses working, physicians working, HIV prevalence, maternal mortality, stillbirths, infant mortality, malnutrition, malaria cases, hospital beds and spending on public and private health care. Other mapped indicators, which are also related to health, include maps of money, war, trade, labour, education and transport. Also available are the data used to make these maps, technical notes about the data used for these maps, and posters of these maps for use in education [18].

Some 200 maps of disease and death are to be made available during 2007. A subset of these maps is shown below. Figures 1, 2, 3, 4, 5, 6, 7 and 8 rely on a related key source of data about death derived from the Global Burden of Disease Project [19], which provides world data on over 130 causes of death, ranging from Sexually Transmitted Infections, to Cancers, to Accidental Deaths. Figure 8 shows where deaths would occur if only age and sex determined age of death, and where you lived had no effect, it is based on the life table data [17] from the same source. The most recent references to these WHO projects now appear as book chapters [20] and journal articles [21].

In the following information about each of these maps, the Global Burden of Disease (GDB) number and International Classification of Disease (ICD) numbers are given for reference purposes. These maps have been selected to demonstrate the ways in which certain causes of death are distributed. This form of mapping may be one of the clearest ways to demonstrate the significance of the well-known axiom that poverty is linked to early death (Figure 9 shows the world distribution of poor people, measured by the United Nations Development Programme's Human Poverty Index). It is generally understood that in

International Journal of Health Geographics 2007, 6:48 http://www.ij-healthgeographics.com/content/6/1/48

Figure 1
Worldmapper Map 413: Vitamin A deficiency deaths in 2002.

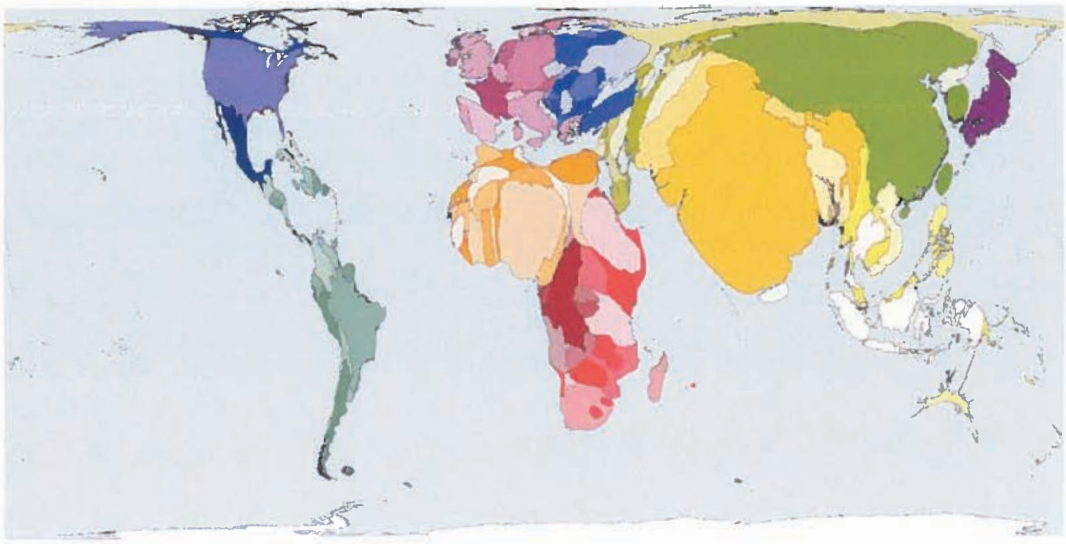


Figure 2
Worldmapper Map 368: All deaths (numbers in the year 2002).

International Journal of Health Geographics 2007, 6:48 http://www.ij-healthgeographics.com/content/6/1/48

Figure 3
Worldmapper Map 371: Deaths from communicable, maternal, perinatal and nutritional conditions in 2002.

Figure 4
Worldmapper Map 380: Childhood cluster deaths in 2002 (includes: Pertussis, Poliomyelitis, Diphtheria, Measles and Tetanus).

International Journal of Health Geographics 2007, 6:48 http://www.ij-healthgeographics.com/content/6/1/48

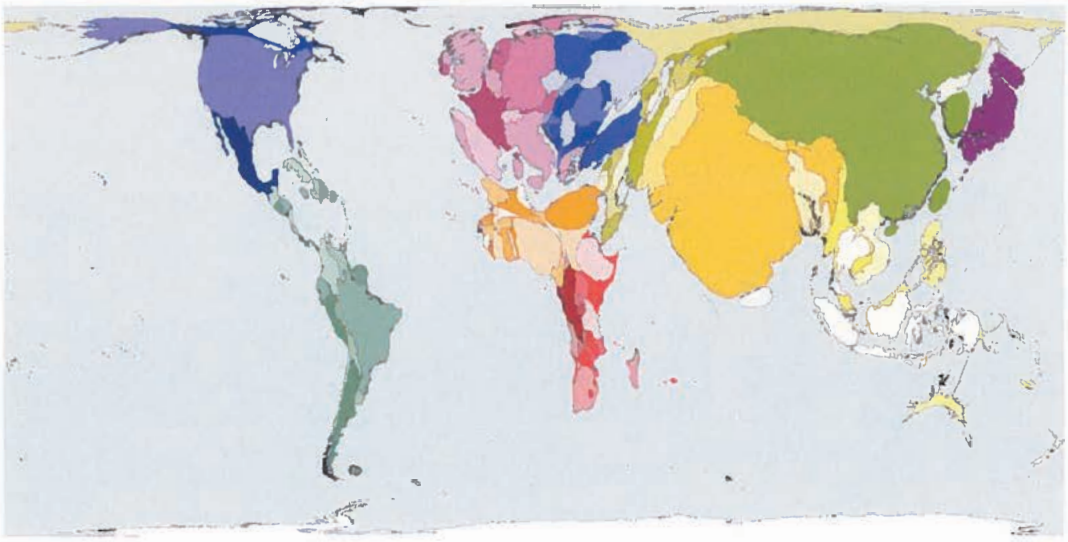


Figure 5
Worldmapper Map 417: All Chronic disease deaths in the year 2002.

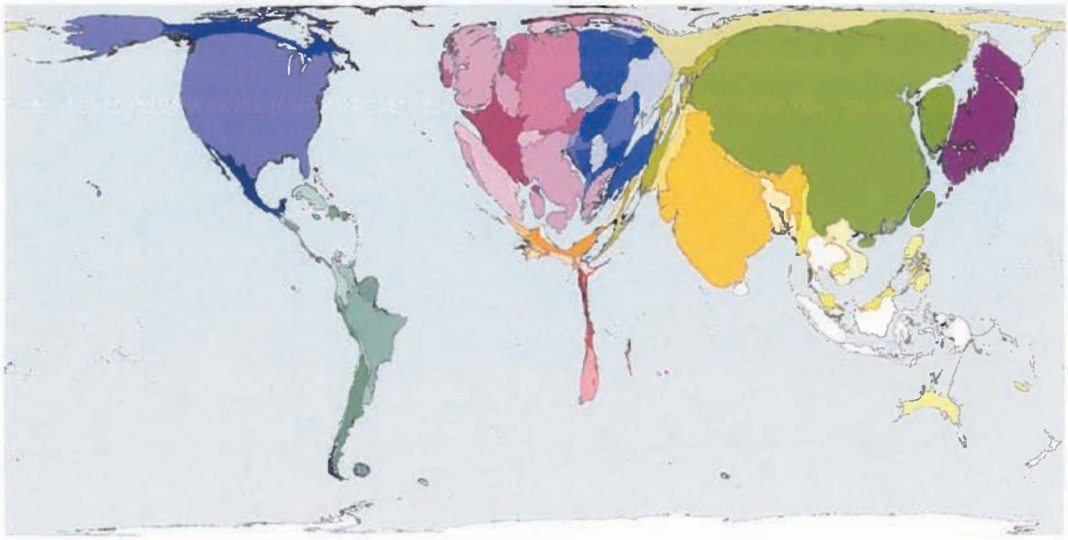


Figure 6
Worldmapper Map 425: Trachea, Bronchus and Lung Cancer deaths in 2002.

International Journal of Health Geographics 2007, 6:48 http://www.ij-healthgeographics.com/content/6/1/48

Figure 7
Worldmapper Map 444: Alzheimer and other dementias deaths in 2002.

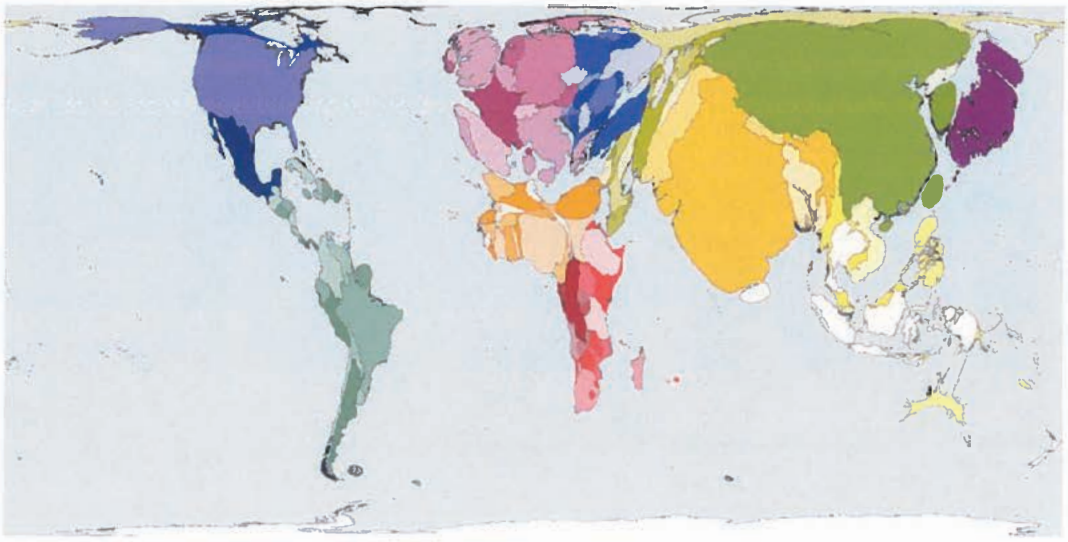


Figure 8
Worldmapper Map 367: Expected deaths (estimated for 2001).

International Journal of Health Geographics 2007, 6:48 http://www.ij-healthgeographics.com/content/6/1/48

some places most young people die from preventable diseases, whilst elsewhere people survive long enough for the vast majority to die from the conditions of old age; but it is revealing to see the extent to which this is the case when the world is drawn to reflect the numbers.

To understand the distribution of diseases requires first understanding the global distribution of people. People are distributed very differently to land (the land distribution is shown in Figure 10). The distribution of people is the most simple map of who is at risk of disease and is shown in Figure 11 where areas are drawn in proportion to population in the year 2002. Of course, different people face different risks depending on a large number of factors. Figure 12 illustrates how these too are unevenly distributed by showing the world shaped by the elderly population aged 65 years or more. Figure 13 shows one additional risk factor for one group: the world shaped by the number of men who smoke. Lastly in introduction it is worth looking again at Figure 9 which shows the world shaped by the proportion of people living in poverty as internationally understood.

All the deaths estimated to have occurred worldwide in 2002 are mapped in Figure 2. That was a total of 57 million deaths. This map looks roughly similar to a map of population, although Latin America appears to have a lower proportion of all deaths occurring there, than the proportion of the world population that live there. India, China, Nigeria and the United States are where a large proportion of all deaths occurred in 2002 – these are also some of the more populous territories on earth. The original WHO source data groups diseases in a particular way and we have adopted their grouping here.

Roughly a third of all deaths in 2002 were caused by communicable, maternal, perinatal and nutritional conditions these can ostensibly almost all be controlled by public health interventions. The world shaped to show the locations of these 18 million deaths is drawn in Figure 3. The look of this map contrasts with the preceding map: territories in the South and East have generally expanded relative to those territories in the North and West. The anomalies are Australia and New Zealand, which have tiny areas due to both their small populations and the small number of deaths there due to these causes. [Source information: GDB cause U001 I. Communicable, maternal, perinatal and nutritional conditions; ICD9: 001–139, 243, 260–269,279.5, 280–281, 285.9, 320–323, 381–382, 460–465, 466, 480–487, 614–616, 630–676, 760–779, ICD10: A00-B99, G00-G04, N70-N73, J00-J06, J10-J18, J20-J22, H65-H66, O00-O99, P00-P96, E00-E02, E40-E46, E50, D50-D53, D64.9, E51-64].

The 1 million deaths used to shape Figure 4 are all those caused by vaccine-preventable childhood diseases. These diseases are Pertussis, Poliomyelitis, Diphtheria, Measles, and Tetanus. In many parts of the world these diseases do not threaten the lives of children – either because the disease has been locally wiped out, or vaccinations are used to protect almost all children, and/or treatment is available to those who do contract these diseases. This map shows that children living in South America, North America, Western Europe and Japan are usually quite safe from the threat of these diseases. Children living in Eastern Europe and the Middle East are also relatively unlikely to be killed by these diseases; it is in parts of Southern Asia and Africa where most children die due to childhood cluster diseases. It should be noted that where diseases do not result in death, serious disability may have been caused. [Source information: GBD cause U011 5. Childhood-cluster diseases, ICD 9: 032, 033, 037, 045, 055, 138, 771.3; ICD 10: A33-A37, A80, B05, B91]

Figure 1 shows a much rarer cause of death but a major cause of disability: Vitamin A deficiency (which is a major cause of blindness in the tropics). This map shows the distribution of the 20,000 deaths that this deficiency is estimated to have caused in 2002. The vast majority of these deaths occurred in African territories; most deaths outside of Africa were in India, Pakistan, Bangladesh, Nepal and Thailand. These deaths are related to education and the availability of vitamin A – a good and varied diet is enough to prevent almost all of these deaths. Vitamin A can be found in milk, carrots, green leafy vegetables and animals' livers. [Source information: GBD cause: U056, ICD 9: 264, ICD 10: E50].

Figure 5 represents the geography of all deaths caused by chronic diseases. Together with Figure 3, the deaths shown in this figure show the causes of all deaths attributable to disease worldwide. In 2002, there were 33.6 million deaths from chronic causes. These deaths include cancers, diabetes, diseases of the heart, the respiratory tract and the digestive tract. This map looks similar to Figure 2; the most obvious exception is that a larger proportion of deaths from chronic diseases occur in Europe, whilst fewer occur in Africa. [Source information: GBD cause U059 II. Chronic diseases, ICD 9: 140–242, 244–259, 270–279 (minus 279.5), 282–285 (minus 285.9), 286–319, 324–380, 383–459, 470–478, 490–611, 617–629, 680–759; ICD 10: C00-C97, D00-D48, D55-D64 (minus D 64.9) D65-D89, E03-E07, E10-E16, E20-E34, E65-E88, F01-F99, G06-G98, H00-H61, H68-H93, I00-I99, J30-J98, K00-K92, N00-N64, N75-N98, L00-L98, M00-M99, Q00-Q99].

Cancers are a major cause of disease and each group of cancers can be used to draw a differently shaped world.

International Journal of Health Geographics 2007, 6:48 http://www.ij-healthgeographics.com/content/6/1/48

Figure 9
Worldmapper map 174: Human Poverty (as defined by the United Nations Development Programme).

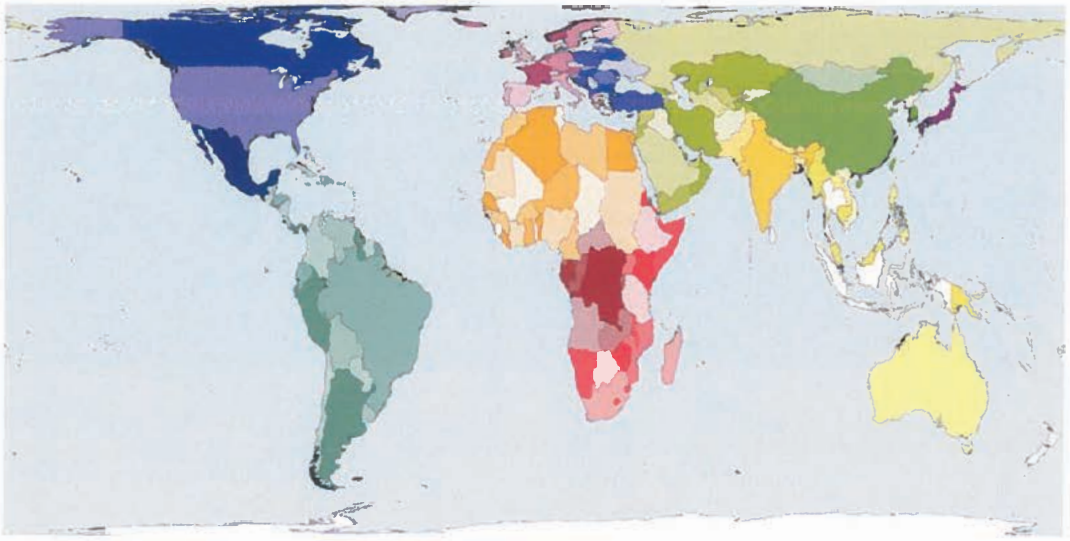


Figure 10
Worldmapper map 1: Land area. See [18] for further details.

International Journal of Health Geographics 2007, 6:48 http://www.ij-healthgeographics.com/content/6/1/48

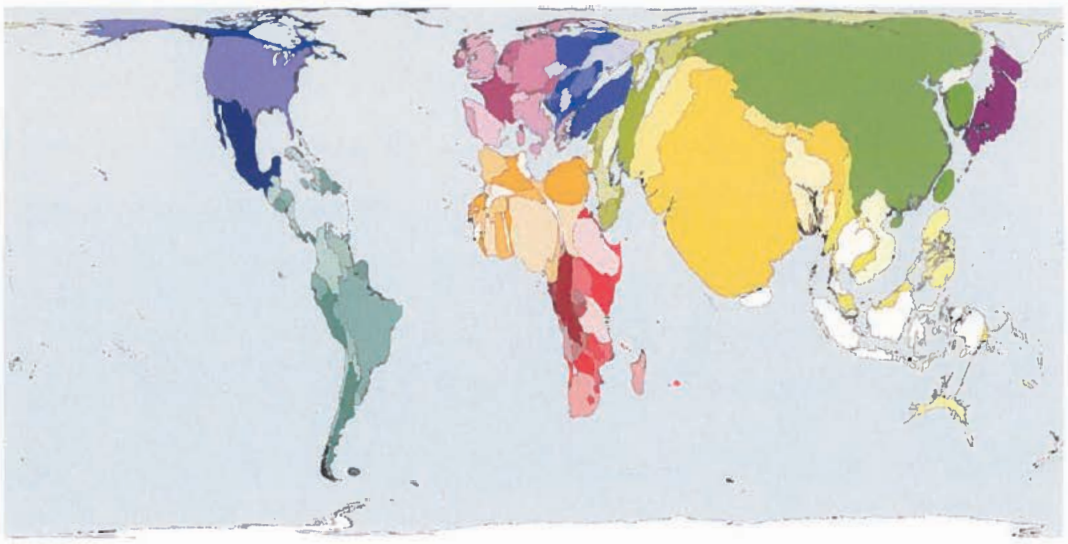


Figure 11
Worldmapper map 2: Total Population (estimated for 2002).

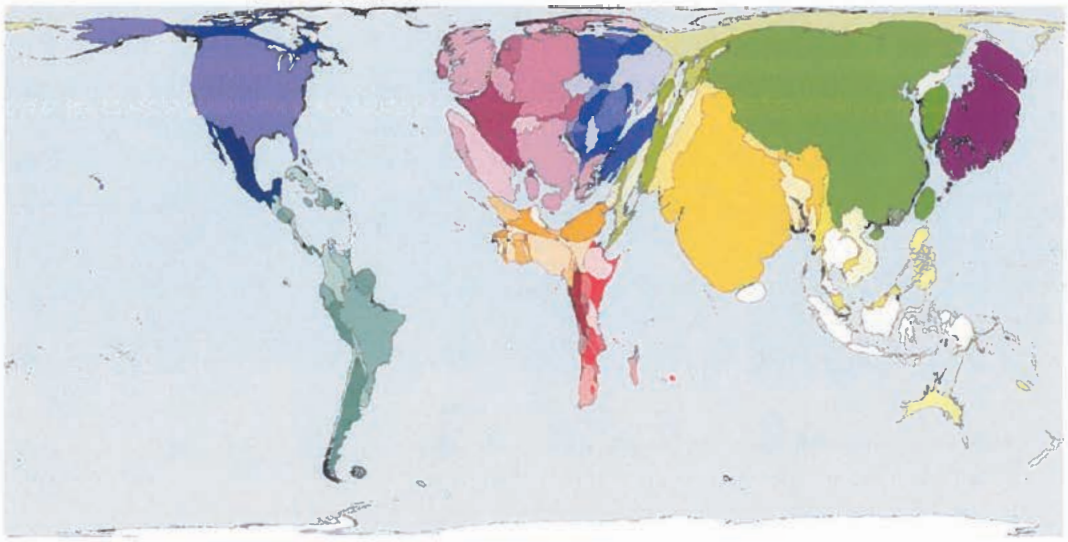


Figure 12
Worldmapper map 6: Total Elderly (people aged 65 years and older, estimated for 2002).

International Journal of Health Geographics 2007, 6:48 http://www.ij-healthgeographics.com/content/6/1/48

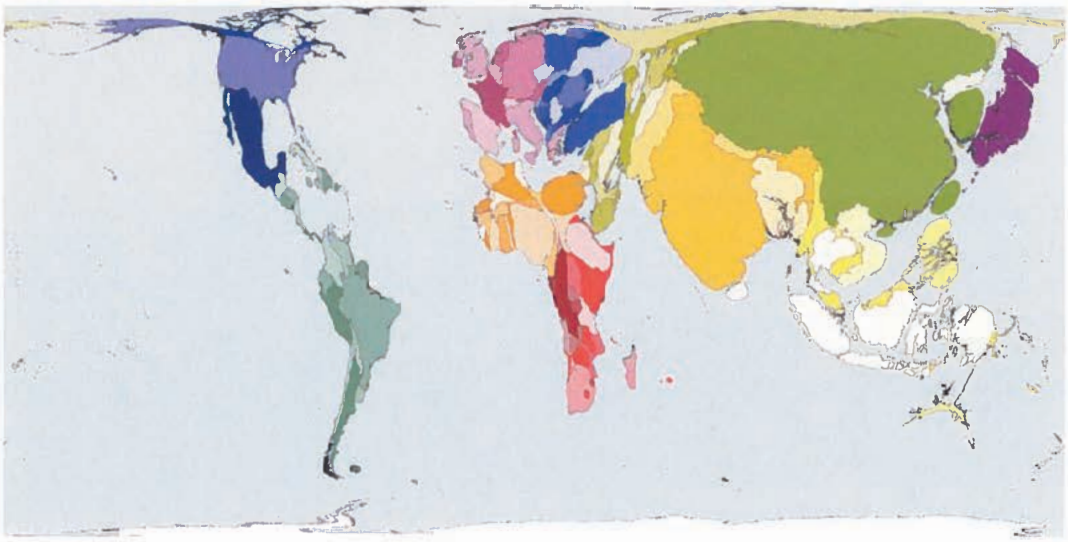


Figure 13
Worldmapper map 242: Men Smoking (numbers estimated for 2002).

The distribution of deaths shown in Figure 6 is of those due to cancers of the trachea, bronchus and lungs. These are all strongly smoking related. In 2002, 1.2 million deaths worldwide were due to these causes. These causes of death generally occur more in richer territories – the United States, Western and Eastern Europe, South Korea and Japan are prominent on this map. However, China also has a large area as more and more tobacco is sold there (historically mainly to men). Due to the low proportion of all people killed by the cancers in Africa, that continent has shrunk to become barely visible on this map. [Source information: GBD: U067 7. Trachea, bronchus and lung cancers; ICD 9: 162; ICD 10: C33-C34].

Figure 7 is a map of deaths from Alzheimer's disease and other dementias. These were thought to have caused and contributed to some 400,000 deaths worldwide in 2002. However, this diagnosis and the estimates based on it are especially error-prone. Many people do not reach an age where these conditions are likely, as they die from some other cause first. Other than India and China still being the location of high proportions of worldwide deaths (due to the large populations living in these territories), this map shows an inverse distribution to the map of deaths from childhood cluster diseases (Figure 4). India, China, Western Europe, the United States, Japan and South Korea have large areas on this map. [Source information: GBD cause U087 6. Alzheimer and other dementias; ICD 9: 290, 330, 331; ICD 10: F01, F03, G30-G31].

This short series of cartograms hopefully demonstrates quite clearly how where you live affects what you are likely to die from. It may also be of use to those already familiar with these statistics who have not seen them in this form before. The maps also allow us to experiment with alternative possibilities. Imagine if the world was changed, if from today onwards only our sex and age affected when we die; if where we lived became immaterial. Figure 8 shows the redistributed 57 million deaths that would be expected to have occurred, had worldwide average age-sex specific mortality rates applied everywhere. The statistics behind this figure have been calculated on the assumption that access to health care, prevalence of infectious diseases, and many other factors become equal. This map shows what could happen, Figure 2 shows what does happen.

The differences between Figure 2 and 8 are due chiefly to the differences in age composition (and less so gender). On Figure 8 the excess death count in the African continent shrinks considerably (because the populations in the countries in this continent typically have a much younger age structure), whereas the death count increases notably for the United States, Canada, and Europe (which have an older age structure), somewhat increases for Japan and China, and stays about the same for India.

Policy makers could well benefit from seeing the world through images such as these. In some cases policy makers

International Journal of Health Geographics 2007, 6:48 http://www.ij-healthgeographics.com/content/6/1/48

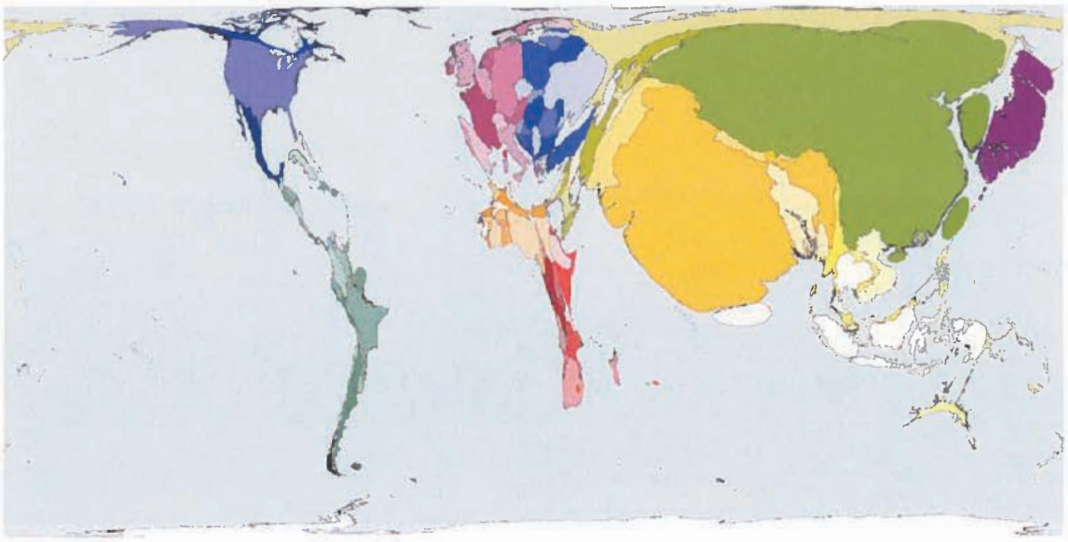


Figure 14
Worldmapper map 292: Self-inflicted deaths (estimated for 2002).

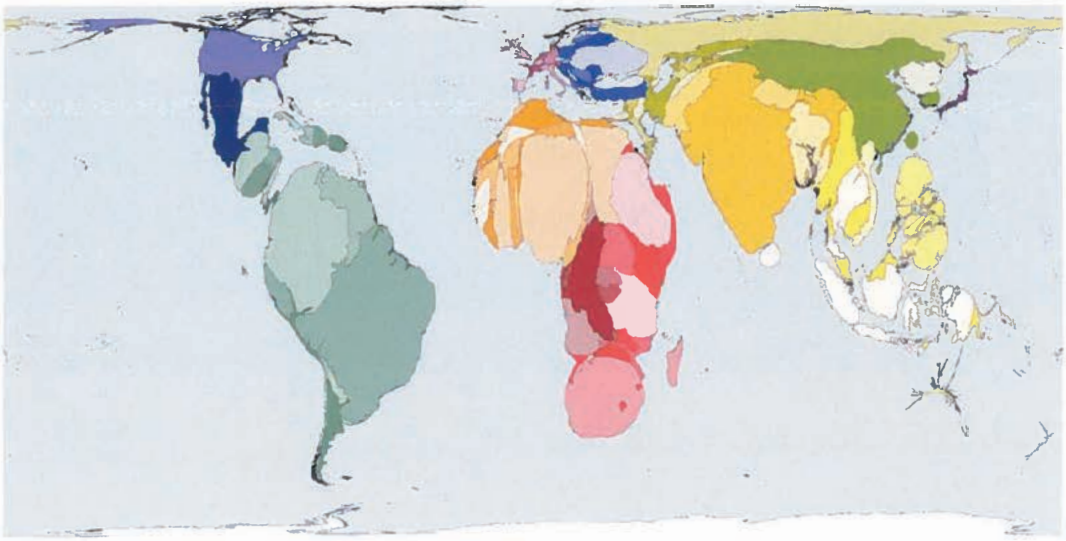


Figure 15
Worldmapper map 291: Violent deaths (estimated for 2002).

International Journal of Health Geographics 2007, 6:48 http://www.ij-healthgeographics.com/content/6/1/48

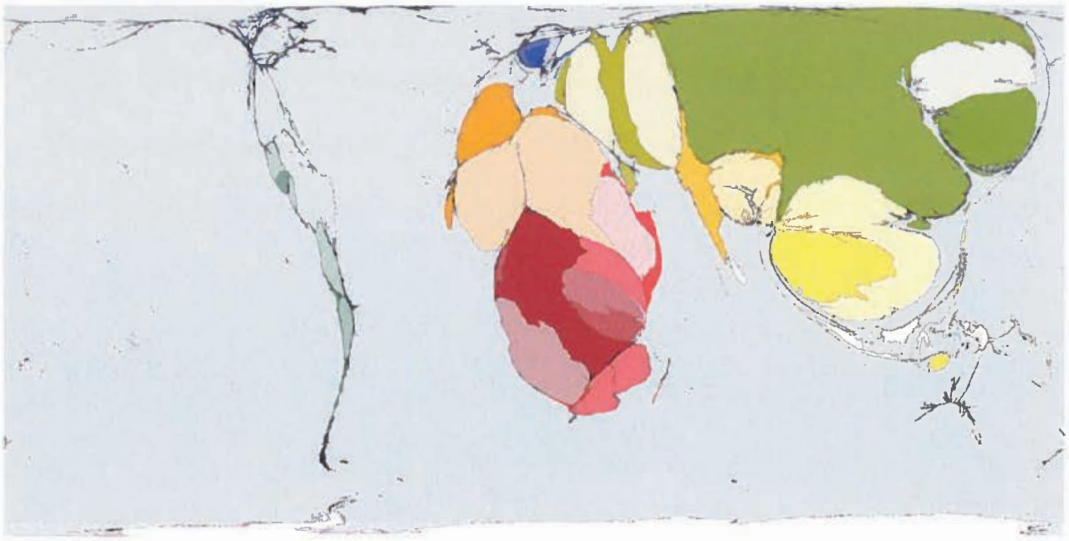


Figure 16
Worldmapper map 287: War Deaths 1945–2000.

Figure 17
Worldmapper map 288: War Deaths 2002.

can have a far more immediate effect than others. There is evidence that government influences suicide rates [22]. Homicide rates also vary dramatically between nations and, most obviously, policy makers are the makers of war. Consider the worldwide distributions of suicides, homicides, war deaths from 1945–2000, and war deaths in 2002 (Figures 14, 15, 16 and 17). With colleagues we have tried to ensure that these images appear in a wide variety of media; they will have greater weight if they are familiar forms. This is particularly the case if they can be instrumental in the formation of public opinion and can effect what we request from our politicians. Examples of these maps appearing in the printed press are available on the Internet [23]. One way in which images such as this may come to be used more widely is if they are employed in teaching. To help in this we have provided all the data our maps are based on as freely downloaded spreadsheets from the website and many lecturers are currently using these resources in schools and universities.

Acknowledgements

Other researchers working on the Worldmapper project are John Pritchard (University of Sheffield), Mark Newman (University of Michigan), and David Dorling. We are also grateful to the anonymous referees. Daniel Dorling is currently supported by a British Academy Research Leave Fellowship. The Leverhulme Trust provided financial support for this work [18].

References

1. Wallace JW: **Population map for health officers.** *American Journal of Public Health* 1926, **16(10)**:1023.
2. Taylor I: **An epidemiological map.** *The Monthly Bulletin of the Ministry of Health* 1955, **14**:200-201.
3. Howe GM, (Ed): **National atlas of disease mortality in the United Kingdom.** London: Thomas Nelson and sons; 1970.
4. Levison ME, Haddon W: **The area adjusted map: an epidemiological device.** *Public Health Reports* 1965, **80(1)**:55-59.
5. Hunter JM, Young JC: **Diffusion of influenza in England and Wales.** *Annals of the Association of American Geographers* 1971, **61(4)**:637-653.
6. Selvin S, Merrill D, Sacks S, Wong L, Bedell L, Schulman J: **Transformations of maps to investigate clusters of disease.** *Lawrence Berkeley Lab Report, LBL-18550* 1984.
7. Selvin S, Shaw G, Schulman J, Merrill DW: **Spatial distribution of disease: three case studies.** *JNCI* 1987, **79(3)**:417-423.
8. Selvin S, Merrill DW, Schulman J, Sacks S, Bedell L, Wong L: **Transformations of maps to investigate clusters of disease.** *Social Science in Medicine* 1988, **26(2)**:215-221.
9. Schulman J, Selvin S, Merrill DW: **Density equalized map projections: a method for analysing clustering around a fixed point.** *Statistics in Medicine* 1988, **7**:491-505.
10. Dorling D: *A New Social Atlas of Britain* Chichester: John Wiley and Sons; 1995.
11. Dorling D: **New Maps of the World, its people and their lives.** *Society of Cartographers Bulletin* 2006, **39(1 and 2**:35-40 [http://sasi.group.shef.ac.uk/publications/2006/dorling_new_maps.pdf].
12. Barford A, Dorling D: **A new approach to mapping the world: visualizing facets of international health.** *The National Medical Journal of India* 2006, **19(4)**:234-235.
13. Dorling D: **Worldmapper: the human anatomy of a small planet.** *PLoS Med* 2007, **4(1)**:e1. e1 doi:10.1371/journal.pmed.0040001
14. Dorling D: **Anamorphosis: The geography of physicians, and mortality.** *Int J Epidemiol* 2007, **36(4)**:745-750. doi: 10.1093/ije/dym017
15. Dorling D, Barford A, Newman M: **Worldmapper: the world as you have never seen it before.** *IEEE Transactions on Visualization and Computer Graphics* 2006:757-764. 12, 5, September/October
16. **Gapminder** [http://www.gapminder.org]
17. Lopez A, Ahmad O, Guillot M, Inoue M, Ferguson B: **Life tables for 191 countries for 2000: data, methods, results.** In *GPE Discussion Paper No. 40* Geneva: World Health Organization; 2001.
18. **Worldmapper** [http://www.worldmapper.org]
19. Mathers CD, Bernard C, Iburg K, Inoue M, Ma Fat D, Shibuya K, Stein C, Tomijima N: **The Global Burden of Disease in 2002: data sources, methods and results.** *GPE Discussion Paper No. 54* 2003 [http://www.who.int/evidence]. Geneva, World Health Organization
20. Mathers CD, Lopez AD, Murray CJL: **The burden of disease and mortality by condition: data, methods and results for 2001.** In *Global burden of disease and risk factors* Edited by: Lopez AD, Mathers CD, Ezzati M, Murray CJL, Jamison DT. New York: Oxford University Press; 2006:45-240.
21. Lopez AD, Mathers CD, Ezzati M, Jamison DT, Murray CJL: **Global and regional burden of disease and risk factors, 2001: systematic analysis of population health data.** *Lancet* 2006, **367**:1747-1757.
22. Shaw M, Dorling D, Davey-Smith G: **Editorial: Mortality and political climate: how suicide rates have risen during periods of Conservative government, 1901–2000.** *Journal of Epidemiology and Community Health* 2000, **56(10)**:722-7.
23. **Media articles about Worldmapper** [http://www.worldmapper.org/articles.html]

