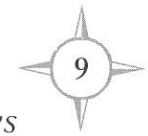
In a 1978 article for *Photogrammetric Engineering and Remote Sensing*—renamed to recognize the revolutionary implications of space imagery—Snyder offered a general description of the projection's geometry and development. An example (fig. 8.6) spanning one and a half orbits illustrates the progressive westward migration of the ground track, noticeably displaced for the second orbit. With the static oblique Mercator projection as a starting point, his derivation introduces the complexity of the precessing orbit and the need to consider the rotating earth's effect on the scan lines, which are not fully perpendicular to the gently curving ground track. Although scale errors remain less than one part in ten thousand within the ground swath—the cartographic standard adopted in the 1930s for the State Plane Coordinate system—distortion increases with distance from the ground track. Because many of the formulas are amenable only to iterative, trial-and-error solutions, whereby the computer converges bit by bit on an acceptable result, the projection is "not . . . exactly conformal." Hardly a problem, though, because the added precision of an exact solution would be useless.

Like most customized map projections devised in the late twentieth century, the Space Oblique Mercator projection is partly a consequence of electronic computing. Snyder's acknowledgments, at the end of his article, underscore the equally important role of camaraderie and self-confidence. After thanking Colvocoresses, Junkins, and the three USGS programmers who validated his formulas, he confessed he "would not have undertaken this derivation . . . without the initial encouragement of Prof. Waldo R. Tobler and the technology available in hand calculators."



Wall Maps and Worldviews

Persistent misuse of the equatorial Mercator projection, especially for world maps having nothing to do with navigation, taunts cartographically savvy geographers. Bad enough when we spot one decorating a nightly newscast or hanging in a small shop struggling to look cosmopolitan. Worse yet when we find a blatant example near home, as I did in the mid-1990s, during parents' night at my daughter's middle school. But there it was, hanging from a spring roller in Jo's social studies classroom: a huge wall map with bright blue oceans, richly colored countries, and a Greenland bigger than China. The teacher, who saw nothing amiss, shrugged when I asked who ordered it and from where. We rely on educators' supplies catalogs, she replied, and since the map came from a reputable dealer, it must be right. *Right?*

Tempted to write the principal or school board, I heeded Jo's advice that parents ought not mimic the self-appointed morality police who condemn public libraries for stocking Judy Blume or J. D. Salinger. Besides, she argued, the teachers rarely refer to the map, even in "global studies," the New York State Education Department's naive

strategy for reintroducing geography without requiring teacher certification in the subject. Another ax to grind.

I don't know whether the map is still there, subtly reinforcing misperceptions of an India smaller than Scandinavia, but Mercator reference maps are alive and well in teachers' supplies catalogs, online as well as in print. (The prodigious Google search engine turned up several Web sites offering Mercator wall maps, but only one, oddly, identified the projection by name.) I don't mean to imply that all or most schools are misrepresenting the world—broad availability, after all, does not demonstrate widespread use—but ill-informed retailers fronting for vendors who should know better can easily dupe unaware buyers. Although most wall-map catalogs offer world maps on other projections, the equatorial Mercator world map is pervasively entrenched in the wall-map trade (fig. 9.1).

We can trace the roots of this persistence to the eighteenth century, when navigators and explorers belatedly adopted the Mercator worldview. Revered by mariners and readily at hand, the projection provided a convenient if inappropriate framework for land-focused maps, on which rhumb lines are pointless. A prominent example is Henry Popple's 1733 map of British possessions in North America, printed in twenty sheets that could, as an option, be pasted on linen, equipped with rollers, and hung as a wall map, eight feet wide and eight and a half feet tall. Sold by subscription—two Guineas down, two more on delivery—it was advertised in London's *Daily Post* as "laid down according to Mercator's Projection, to be engraved by the best Masters, and printed upon the best Paper." Although the original version sold poorly, Popple's successors cut the price in 1739 and enjoyed comparatively brisk sales during a three-year war with Spain over what is now Florida and Georgia. Acclaimed by map historians as one of the two most significant large-scale maps of colonial North America, Popple's map was not only copied more than a dozen times but also served as a source for smaller-scale maps in atlases and textbooks.

With name recognition and a distinctive appearance, the equatorial Mercator projection became the standard world map for nineteenth-

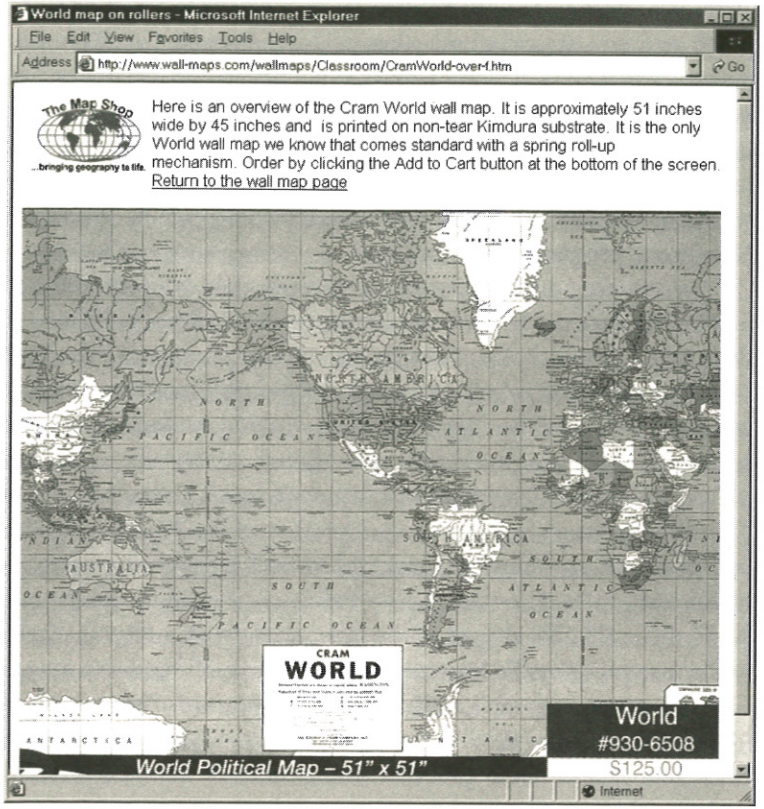


Figure 9.1 This Web advertisement for a Mercator wall map does not identify the projection.

century atlases and wall maps. Not immediately, though: some atlas publishers preferred a pair of globular views, with separate spotlights on the eastern and western hemispheres, while others complemented the equatorial Mercator perspective with these twin hemispheres. By contrast, wall-map publishers readily embraced the Mercator map's rectangular format, which conveniently matched the straight lines and right angles of the typical wall space. Schoolbooks and classroom atlases also promoted the Mercator worldview. Jedidiah Morse (1761–

1826), a prolific author of popular school geographies, used only one world map, on a Mercator projection, in his *Compendium and Complete System of Modern Geography,* published in Boston in 1814. His son, Sidney Edwards Morse (1794–1871), who took over the family business, inherited Jedidiah's affinity for the Mercator map. Sidney's development of wax engraving, an efficient method for enriching maps with small but legible place and feature names, helped promote Morse and Mercator as geographic brand names.

An emerging preference for the Mercator worldview is apparent in John Snyder's cursory survey of thirteen world atlases published in the United States, Britain, France, or Germany between 1820 and 1897. To explore the relative popularity of specific projections, Snyder tabulated the projections used for whole-world maps and for separate maps of eleven major world regions. Although all thirteen atlases employed a variety of cartographic frameworks, most favored a specific projection for each region. For example, ten of the atlases cast their map of Africa on a sinusoidal grid, while nine framed their twin maps of the eastern and western hemispheres on a globular projection. Amid this mild diversity, all of the nine atlases with a second whole-world map relied on the Mercator grid. Moreover, of the eleven atlases with a separate map of Oceania, nine had a Mercator framework, an inappropriate choice despite the region's broad expanse of water. Because few buyers would ever plot rhumb lines or estimate bearings with a world atlas, this distorted picture of the Pacific was a disservice to anyone interested in the relative separations of ports and islands.

A similar tabulation, based on sixteen world atlases published in the United States, Britain, Germany, or Russia between 1916 and 1990, documents the decline of the Mercator projection in the latter half of the twentieth century. Of the six atlases with a whole-world Mercator projection, the most recent was published in 1966. And among these six, only the three earliest, issued between 1916 and 1941, used only a Mercator framework for their world maps. By contrast, the three more recent atlases, in addition to a casting a world map on the Mercator grid, included world maps on at least one other projection, such as the polar azimuthal equidistant or the sinusoidal. At the regional level,

the Mercator projection framed maps of Oceania as late as 1941 and survived into the twenty-first century in National Geographic atlases that use it for separate treatments of the Atlantic, Indian, and Pacific Oceans.

Two additional surveys attest to the Mercator's decline. Arthur Hinks, in his 1912 textbook on map projection, examined ten general reference atlases published in Britain, France, or Germany between 1894 and 1912. In addition to noting that two of the six atlases with maps of Oceania employed the Mercator projection, he observed that the "Mercator, Globular, and Mollweide are used by nearly all of the atlases." A half-century later Syracuse University master's student Frank Wong examined thirty-eight world atlases published in the United States between 1940 and 1960. Although the Mercator projection dominated whole-world atlas maps before 1940, a spate of new projections precipitated its decline, but not demise, during the 1940s. Distribution maps focusing on population and economic activity were the first to be revised. Some publishers substituted an equal-area map while others compromised with projections that were neither equal area nor conformal. Political maps focusing on boundaries and place names held out a bit longer. So strong was the Mercator worldview that initially, during the early 1940s, most atlas makers cautiously added another world map to supplement, rather than replace, the familiar framework. Even so, the transition was nearly complete by 1951, when all American atlas publishers but the C. S. Hammond Company had substituted another projection for their world political maps.

There's little evidence that atlas publishers, in largely abandoning the Mercator projection during the 1940s, were finally heeding the admonitions of scholarly critics. As early as 1912 the influential cartographic educator Arthur Hinks had railed against "the great distortion in the north and south [that] makes Mercator's projection altogether unsuitable for a land map." Nine years later U.S. Coast and Geodetic Survey projection experts Charles Deetz and Oscar Adams held the Mercator "responsible for many false impressions of the relative size of countries differing in latitude." These objections had no more impact than Erwin Raisz's 1938 explanation, in the first edition of his

classic textbook *General Cartography,* that "the Mercator world map enjoys an unmerited popularity," perhaps because its areal exaggeration at higher latitudes helps mapmakers "represent the small countries of Europe on a world map." Must be able to locate Luxembourg and Liechtenstein, eh? However logical and strident, academic cartographers wrote for a small audience and had little influence on atlas publishers, textbook authors, or schoolteachers. According to Wong, the Mercator projection was so well established in the 1930s that most geographers considered other maps "unfamiliar and unconventional."

A stronger impetus for the Mercator map's decline was the war with Germany and Japan, which heightened public awareness of relative distance and cartographic perspective. Media critics mounted a pointed attack on the projection's scale distortions and exaggerated separation of the United States from Europe and Asia. Particularly influential was *Life* magazine's August 1942 illustrated essay "Maps: Global War Teaches Global Geography." Focusing on scale distortions and the relative advantages of conic and azimuthal representations, the nine-page exposé condemned the Mercator worldview as a "mental hazard in a war that is plotted on great circles across the land and sea and through the air." The following February a *New York Times* editorial declared that "the time has come to discard it for something that represents continents and directions less deceptively." Historian Susan Schulten, who chronicled the anti-Mercator campaign, discovered similar denunciations in periodicals as diverse as *Reader's Digest, Consumer Reports,* and the *American Scholar.*

Schulten attributed the Mercator's prewar preeminence to a "map industry [that] consciously chose to meet consumer expectations about the look and shape of the world." Hammond, Rand McNally, and their competitors believed they knew what the public wanted, while consumers conditioned by decades of "overexposure" to the Mercator framework trusted the publishers' expert judgment. The bland continued to lead the blind—or was it the reverse?—until the widening war encouraged radically different perspectives like the dramatic global snapshots drawn for *Fortune* by Richard Edes Harrison (1901–94). Trained as an architect, Harrison was a master of pictorial illustration and self-promotion. His 1944 atlas *Look at the World,* printed on cheap wartime paper, challenged conventional misrepresentations of the separation of Europe and North America with dramatic earth-from-space perspectives (fig. 9.2). In highlighting the disadvantages of mapping the globe onto a standardized north-up cylinder, Harrison cleared the way for fresh cartographic viewpoints. Enlightened by the media, clued-in consumers forced atlas makers to revise and retool.

To assess the endurance of Harrison's legacy, I checked out the world reference atlases on sale at my local Borders and Barnes & Noble. Although both stores offer a broad selection of atlases, hardbound and paperback, many of the books are reconfigured or abridged versions of an earlier, larger edition. In reporting the principal projection used for whole-world maps—a few atlases employ more than one—I list only the most recent version (table 9.1). As my table implies, none of the atlases exploited the Mercator framework for a world political or distribution map. What's more, the only instance of a Mercator whole-world reference map was the time-zone map in the otherwise progressive *Rand McNally Atlas of the World.* I can say this with confidence, even though nearly half the atlases failed to identify their projections by

Figure 9.2 A two-page spread (52–53) in Richard Edes Harrison's *Look at the World* juxtaposed eight global views, two of which (shown here) boldly assert that the isolation of the United States (left) "is more seeming than real" and that Europe (right) has "more close neighbors than any other continent."

Table 9.1 Projections for whole-world maps in selected atlases

Atlas	World Projection
Barnes & Noble Essential Atlas of the World (2001)	[? (rectangular)]
Dorling-Kindersley Millennium World Atlas (1999)	Wagner VII
Hammond Citation World Atlas (2000)	Breisemeister
Hammond Compact Peters World Atlas (2002)	Gall-Peters
Hammond Concise World Atlas (2000)	Robinson
National Geographic Family Reference Atlas (2002)	Winkel tripel
Oxford Essential World Atlas (2001)	Hammer equal-area
Planet Earth Macmillan World Atlas (1997)	[Eckert IV?]
Rand McNally Atlas of the World (2001)	Robinson
Reader's Digest/Bartholomew Illustrated Atlas of the World (2001)	Eckert IV
Reader's Digest Illustrated Great World Atlas (1997)	Robinson
The Times Atlas of the World: Family Edition (1998)	Eckert IV

name, because the Mercator graticule is readily recognizable. Not so for the two projections listed in brackets, which I can only guess or describe vaguely. (Arthur Hinks also complained of unidentified projections in 1912.) Clearly, atlas publishers no longer see a need to cast world maps on a Mercator projection. Equally apparent is the diversity of world-map projections from which they can choose.

As my tabulation suggests, an abundance of more suitable world maps contributed to the Mercator's ouster. Of the projections listed, all but the Robinson and the Winkel tripel are equal area. But these two exceptions are compromise projections, designed to balance distortions of shape and area; neither misrepresents area as flagrantly as the Mercator. What's more, an atlas employing a compromise framework for large two-page reference maps often uses an equal-area projection for smaller whole-world distribution maps. Equally revealing, none of the replacements was available when the Mercator map became preeminent in the early nineteenth century.

A prominent compromise from the World War II era is the Miller cylindrical projection, designed by Osborn Maitland Miller (1897–1979), the American Geographical Society's projection expert, at

the request of Samuel Wittmore Boggs, chief cartographer at the State Department. Concerned about public misinterpretation of shape distortion on equal-area world maps as well as area distortion on the Mercator projection, Boggs asked Miller to compare widely used cylindrical projections and recommend improvements. Constrained by Boggs's preference for a cylindrical framework, Miller reduced the Mercator's areal exaggeration by modifying map distance from the equator to the parallels. I call this the 80 percent solution because, for each parallel, he applied the standard Mercator formula to a latitude only 80 percent as large, and then divided the result by 0.8. A simple example clarifies the process. For the North Pole (90° N), located an infinite distance away from the equator on a Mercator map—and thus never shown—the adjusted calculation consists of finding the projected position for 72° N (80 percent of 90°) on the Mercator grid and then dividing by 0.8. As Tissot's indicatrix illustrates, the Miller cylindrical projection (fig. 9.3), although neither conformal nor equal area,

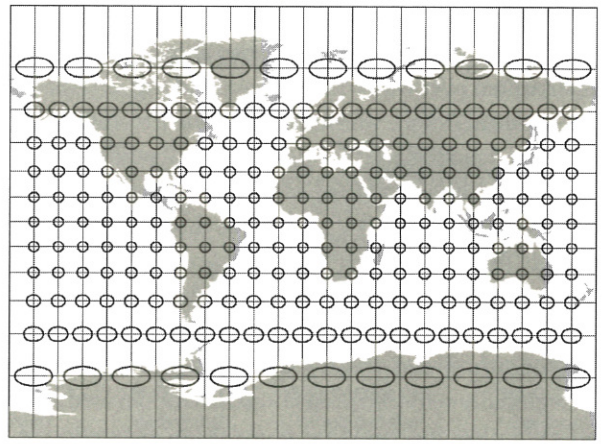


Figure 9.3 Modest angular distortion below 60° lets the Miller cylindrical projection show the poles and provide a Mercator-like treatment of equatorial and temperate regions. Miller's map found little use in Britain, where atlas publishers preferred an older, somewhat similar homegrown compromise projection, the rectangular Gall stereographic.

significantly lowers areal distortion for high latitudes. Although encompassing the whole world, including the poles, it mimics the Mercator map's familiar rendering of temperate and tropical regions.

Endorsed by the State Department and the American military, the Miller cylindrical projection made a modest contribution to the Mercator's decline. According to Frank Wong, the most significant inroads occurred in 1949, when the Miller map replaced the Mercator framework on the world political map in Rand McNally's *Cosmopolitan World Atlas,* and in 1951, when it displaced the familiar Mercator worldview in the *Encyclopaedia Britannica World Atlas.* A more lasting conquest was Rand McNally's adoption of the Miller grid for several climate maps in *Goode's School Atlas.* Substituted for the Mercator in 1949, it's still there in the most recent edition (2000).

Goode's World Atlas (as it is now called) is famous for another cartographic perspective: Goode's homolosine equal-area projection, developed in 1923 by University of Chicago geography professor J. Paul Goode (1862–1932), who moonlighted as Rand McNally's key cartographic consultant (fig. 9.4). Eager to preserve relative area but leery of the severe distortion of angles and shape on equal-area world maps, Goode divided the globe into six lobes, two above the equator and four below, interrupted over water to focus on land (fig. 9.5). Each lobe has its own central meridian, carefully positioned to minimize angular distortion over landmasses. To more faithfully imitate shapes portrayed on a globe, he subdivided each lobe into polar and equatorial zones, depicted respectively by Mollweide (homolographic) and sinusoidal projections that share the lobe's central meridian, around which distortion is minimal. Only in northeast Asia, well removed from both the equator and its lobe's central meridian, is a continent affected by pronounced shearing. By carefully tailoring his twelve zones and their regionally centered projections, Goode devised a remarkably realistic foundation for mapping population, vegetation, and other land-based distributions. And to further illustrate the benefits of interruption, he presented a second composite worldview with its continents split to reduce distortion over the oceans.

Cartographic textbooks treat the Mollweide and sinusoidal projections (fig. 9.6) as "pseudocylindrical" modifications of the plane chart's spartan rectangular framework. All pseudocylindrical projections preserve relative area by bending meridians inward toward a central meridian. Some treat the poles as lines shorter than the equator, while others, like the Mollweide and the sinusoidal, map the pole as points.

Figure 9.4 J. Paul Goode. Courtesy of Robert B. McMaster.

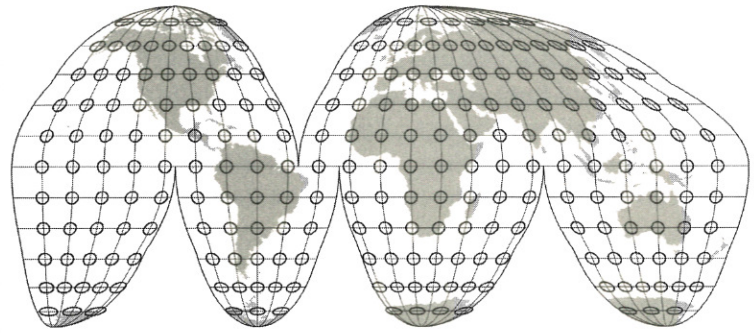


Figure 9.5 Goode's homolosine equal-area projection is a composite of twelve regionally centered projections. Knick points at 40° 44′ N and S mark the boundary between polar and equatorial zones. Its overall shape suggests the skin of an orange, peeled back and flattened.

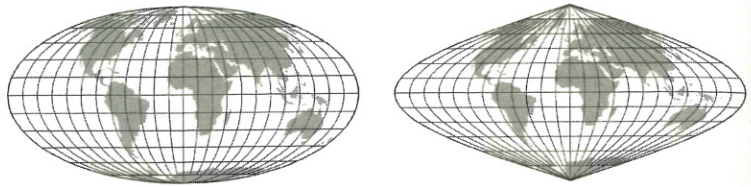


Figure 9.6 The Mollweide (left) and sinusoidal (right) projections minimize angular distortion in polar and equatorial zones, respectively, on Goode's homolosine equal-area projection.

Further adjustment in the spacing of parallels on the Mollweide reduces angular distortion around the poles and provided Goode with a low-shear solution for polar areas. By contrast, evenly spaced parallels on the sinusoidal afford a truer depiction of distance near the equator. The two projections form a seamless lobe by blending perfectly at 40° 44′ 11.98″ N and S, the latitudes at which their east–west scales are equal.

Goode's new world map did not grace his school atlas until 1932, when it replaced an interrupted Mollweide projection used since the atlas's debut in 1923. Educators eagerly accepted these segmented worldviews, perhaps because Goode not only integrated several more familiar projections, including the Mercator, but explained his strategy in the preface to the first edition: "It is quite impossible to transform the surface of a globe into a plane surface without the sacrifice of some elements of truth. It is not possible to have truth of angle, shape, area, and scale all in one map. . . . For geographic use, truth of area is of prime importance, and close to this is truth of form." To justify interrupted distribution maps, he cited four advantages:

> (1) It presents the entire earth's surface, which Mercator's projection cannot do. (2) It is an equal area projection; there is no distortion of area. (3) Parallels of latitude are represented by straight lines trending with the equator, just as in the Mercator, a fine advantage in the study of comparative latitudes. (4) By the method of interruption of the grill [graticule], each continent in turn is given the advantage of having a mid-meridian of its own; in this way better shapes are given the continents than is possible with other projections.

Goode justified each of the atlas's other five projections, including one incorporated largely to prove a point: "Only one Mercator projection is used in this atlas, and this is introduced so that its qualities may be compared with the interrupted homolographic, the newer and better projection for a world map." After acknowledging that the Mercator's value to mariners "is so great that there seems to be no prospect that any other projection will ever take its place for purposes of navigation," Goode vigorously attacked its misuse:

> In all previous atlases Mercator's projection has been used almost exclusively for world distributions, and this in spite of the fact that (1) it is impossible with it to show the earth's surface entire, the north and south poles being at infinity; and (2) distances and areas grow rapidly larger with increase in latitude, becoming enormous in the higher latitudes. On a Mercator's map North America is much larger than Africa, although in fact North America is only seven-tenths the size of Africa. On a Mercator's map Greenland is larger than South America, when in reality it is only one-ninth as large as South America. This distortion of area is so bad that it becomes pedagogically a crime to use Mercator's maps for studies of the relative sizes of continents and oceans, or for areal distribution of any kind. Population density, density of existing forests, annual rainfall, comparison in size of states and empires, all are untrue and inexcusable as shown upon a Mercator chart.

I doubt that Rand McNally would have published a revolutionary school atlas so unlike the firm's other products had Goode not earned management's confidence through two decades of astute advice on cartographic issues. Many employees disliked the diversity of projections and doubted the general public would appreciate an interrupted world map. Resistance softened because of the school atlas's success as a textbook and the cartographic turmoil of World War II, and the

homolosine projection quietly infiltrated the company's mass-market reference atlases. Even so, Rand McNally executives were still wary of interrupted world maps in 1961, when they asked America's leading academic cartographer, Arthur Robinson, to design a new projection. A key requirement was that the map not be interrupted.

Robinson's answer was a compromise projection that, like Miller's, blended distortions of angles and area but without the severe shear imposed by straight-line meridians. Keen to avoid "inducing lasting erroneous impressions, such as might result, for example, from the marked variation in area [on] Mercator's projection," he first canvassed existing projections for an acceptable solution. Finding none, he constructed a list of specifications that included relegating the inevitable exaggeration of area to polar areas, "even though this, unhappily, would greatly enlarge Antarctica." Relying on his sense of aesthetics—as an undergraduate he had studied both art and geography—Robinson employed the computer as a design tool in a trial-and-error search for a world map with a realistic look. After repeated rounds of plotting, appraising, and adjusting the world's shorelines, typically by tweaking the spacing and relative length of the map's parallels, he settled on a design initially named the orthophanic (right-appearing) projection. As Tissot's indicatrix shows in figure 9.7, the trade-off of areal and angular distortion, chiefly apparent in upper latitudes, is less pronounced than on projections that present the poles as points or stretch them to lines as long as the equator. Like other pseudocylindrical transformations, the Robinson projection favors landmasses close to its central meridian but affords a comparatively convincing treatment of Australia, central Asia, and most of North America. Its prominently rounded ends remind viewers that the only true world map is a globe.

Rand McNally unveiled the new map in 1965 as a wall map and in several mass-market atlases. Public response was discouraging—consumers apparently preferred the Mercator map—and Robinson's compromise was relegated to school atlases and similar educational products. At least that's the story circulating among academic cartographers. I've seen no evidence that the company assertively pitched its new projection to a general audience, and whatever market research it

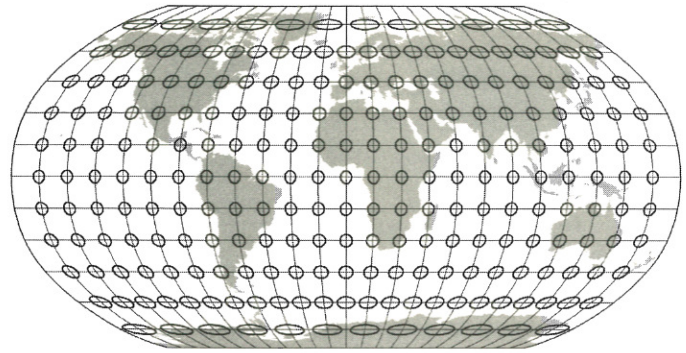


Figure 9.7 The Robinson projection, the product of computer-assisted trial-and-error refinement, reflects Arthur Robinson's effort to create a "realistic," uninterrupted map of the world.

carried out was never fully disclosed. But I also discovered the four-decades-old projection alive and well in recent Rand McNally world atlases as well as in similar products from several competitors. What gives?

What happened reminds me of a pair of three-year-olds in a playgroup: one discards a toy, the other picks it up, and the first wants it back. In this parable the first kid is Rand, the second has the initials NGS, and the toy is Robinson's map, which the National Geographic Society gleefully picked up in 1988, touted in a flurry of press releases, and discarded a decade later for the Winkel tripel (or Winkel III) projection, a modified azimuthal map introduced in Germany in 1921 by Oswald Winkel (1873–1953) but rarely used. Like the Robinson map and the Van der Grinten projection (fig. 9.8, left), which framed the official NGS world map between 1922 and 1988, the Winkel tripel is a compromise perspective, neither equal area nor conformal (fig. 9.8, right). Its quiet introduction in fall 1998 was subliminal in comparison to the Robinson's hyped debut ten years earlier: although the Society mailed a free, 4 by 6 foot laminated world map to every public and private school in the United States and Canada, few news stories mentioned the map's Winkel tripel framework, named but not described in the eighth paragraph of a thirteen-paragraph press release.

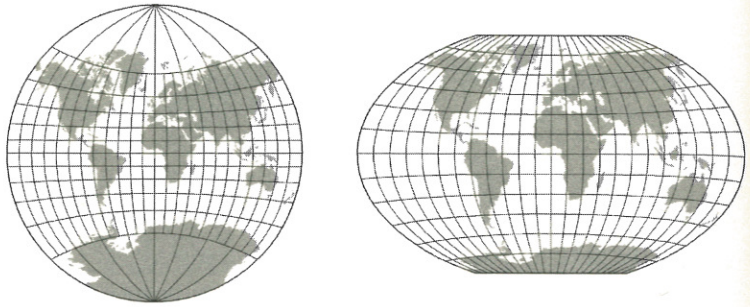


Figure 9.8 The Van der Grinten projection (left) framed the National Geographic Society's official world map from 1922 to 1988, when it was supplanted by the Robinson projection, itself replaced in 1998 by the Winkel tripel projection (right).

Am I suggesting that major map publishers have the attention span of a three-year-old? Perhaps, but the Society's 1988 adoption of the Robinson map was hardly impulsive. I know because I participated in the December 16–17, 1987, seminar convened at NGS headquarters in Washington, D.C., to help chief cartographer John Garver select the best projection for its world reference map. In addition to Garver and six other NGS officials, the discussion included John Snyder, me, and two other academic cartographers, Judy Olson and Dick Dahlberg. After dissecting numerous contenders, we unanimously endorsed the Robinson projection. A year later—designing and printing millions of map supplements doesn't happen overnight—*National Geographic* magazine hit the streets with a large folded freebie. Garver's accompanying article, "New Perspective on the World," praised the new map's "different and more realistic view of the world," judged it "better still" than "the trusty Van der Grinten," and "hope[d] that its main legacy will be a generation of map readers more critical of all flat maps." Inspired by an NGS press release, more than 550 newspapers and magazines with a total circulation greater than 51 million reported the changeover. Eat your heart out, Rand McNally.

National Geographic publications used other global perspectives but flaunted the Robinson projection as the Society's signature world map. In 1990, for example, the newly revised sixth edition of the *National Geographic Atlas of the World* featured a large foldout with back-to-back world political and world physical maps, both cast on Robinson's projection. The lower right corner of the political map reported the projection's adoption in 1988 and claimed that it "presents a more realistic view of the world." This begged the question, "more realistic" than what?

Realism lost its luster in less than a decade. In 1999 the atlas's seventh edition examined map distortion in an impressive two-page treatment titled "Round Earth, Flat Paper." Conveniently ignoring the Mercator projection's role in framing *National Geographic* magazine's first world map supplement, inserted in the February 1905 issue, an illustrated sidebar on the "Evolution of a Better World" chronicled the Society's successive use of azimuthal equidistant, Van der Grinten, Robinson, and Winkel tripel perspectives. The Robinson map, we're told, shows "more than 75 percent of the Earth's surface . . . with less than a 20 percent departure from its true size and scale," while its replacement "avoids the congestion and compression of higher latitude areas and lessens distortion of scale and shape." Readers baffled by this verbal geometry—no, you're not alone—can rely on the not-so-subtle Darwinian analogy, which leaves little doubt about the Winkel tripel's representational superiority.

If nothing else, a new cartographic signature is an occasion for proclaiming a publisher's commitment to progress, much like the laundry detergent proud to be "new and improved" or the retailer obsessed with reconfiguring aisles, shelves, and signage. I call this the Monty Python Effect, after the comic troupe's famed transition line, "And now for something completely different." National Geographic does it, Rand McNally does it, and eventually they all do it, at least partly because the trade-offs inherent in map projection make doing it easy and effective.

A new mathematical formula is not the only way to radically alter a world map. Where the mapmaker centers a projection can enhance a map's distinctive look as well as privilege some places by making them less peripheral, and thus more obvious if not more important than places near the edge or, worse yet, split in two. Until 1975, when

it recentered its world map on the Greenwich meridian (0°), the National Geographic Society copied nineteenth-century United States atlas publishers who favored the ninetieth meridian, a fraction of a degree west of Chicago and especially convenient for its rival Rand McNally, headquartered in the Windy City. Although the America-centric tradition is alive and well in Mercatorized world wall maps advertised on the Internet (as in fig. 9.1), most United States atlas makers now center their world maps on Greenwich, probably because splitting Tibet and severing Siberia from the rest of Russia are aesthetically awkward if not geopolitically inappropriate. Far better to interrupt the cylinder at the 180th meridian and show North America and Asia as whole continents by repeating small amounts of Alaska and Siberia in the empty upper corners of a pseudocylindrical projection. Clever redundancy can improve the look and help the user.

Some projections invite cropping. For example, National Geographic cartographers found it necessary to sever upper and lower portions of the Van der Grinten projection (fig. 9.8, left), which mapped the entire world into a circle but squandered space on polar areas with few features worth naming. Cropping was seldom perfectly symmetric: when a label near the top required additional room, they'd lop a bit more off the bottom.

Mercator's projection makes cropping mandatory. As figure 9.9 illustrates, a Mercator map truncated at 89° N and S portrays Antarctica as larger than all other continents combined. Some of the southern continent must go, of course, but how much? Barring a need to show specific features in polar zones, cartographers are influenced largely by the ratio of width to height, which determines whether a map looks good and fits the page. In opting for an aesthetically acceptable format, they pass up a dramatic demonstration of the Mercator's outrageous areal exaggeration. Less artistic motives might also be at work: cutting the bottom of the map off at the tip of South America while showing most of Greenland puts western Europe closer to center stage—a worldview now widely condemned as "Eurocentric." But un-

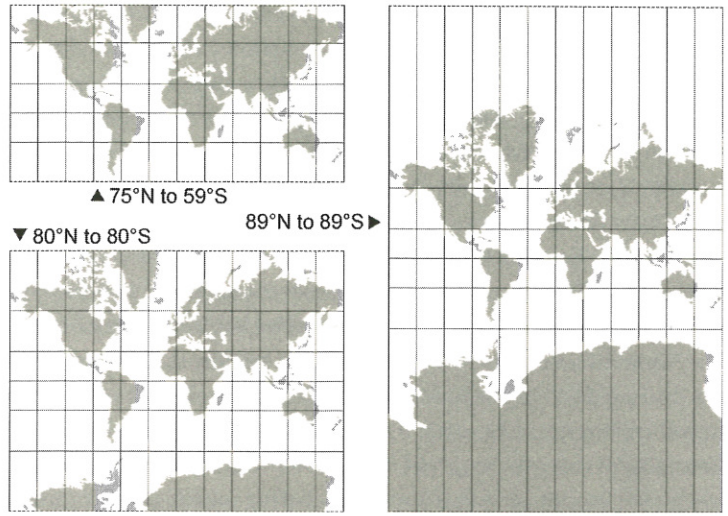


Figure 9.9 How a Mercator map is cropped can greatly affect its worldview and aspect (width/height) ratio.

less coverage extends well north of Greenland, the map's center typically winds up in north or central Africa.

Is a Europe-centered map subliminally malevolent or merely a natural accommodation of European readers? In some situations centering a map near the viewer's location is good design. But if you're a humanist well versed in European imperialism's harsh imprint on the Third World, the traditional Greenwich-anchored world map becomes a clear example of Western cultural hegemony, and all the more so when a Mercator projection inflates the size of western Europe. Outraged humanists must, of course, overlook the greater (but imperially irrelevant) prominence of Siberia, northern Canada, Greenland, and perhaps a lot of Antarctica. More clearly problematic is the historical atlas that largely ignores Asian or Islamic civilizations or the world atlas with ostensibly racist overtones in its themes, regional groupings, and categories. Eurocentric cartography can be far more shameful than a Greenwich-anchored world map.

An easy target is the early-twentieth-century world map that repeats Australia in its lower left and lower right corners. London journalist Simon Jenkins recently recalled such a map from his boyhood, in a 1926 textbook "long used in British schools after the war." Centered on 40° W, its Mercator projection "made Canada look far bigger than the United States and depicted in red the huge British claims in Antarctica." This arrangement clearly exaggerates the size and extent of the British Empire, but its role in promoting a sense of superiority is debatable. (If the colonial Brits' self-esteem required a cartographic recharge, they're hardly as arrogant as we're led to believe.) Although two Australias reinforced the now-quaint notion that the sun never sets on England's possessions, this redundancy also affords uninterrupted treatment of Oceania to the left and South Asia to the right. Both interpretations (cultural hegemony and effective design) are valid, and I'm not certain it's worth debating which one is more fundamental.

It's surprisingly easy to read unintended meaning into an otherwise innocuous world map. Consider the George F. Cram Co.'s *Map of the World* that I picked up recently at a cartographic meeting. Anchored on 90° W, the asymmetrically cropped map is centered vertically in northern Mississippi or western Tennessee, perhaps on Memphis, which would make it an Elvis-centered world map and thus a clever symbol of American cultural imperialism. OK, Elvis centering is a straw man. I'm not denying American hegemony—cultural or otherwise—or its sometimes sinister implications, but I doubt this map has anything to do with Americans' views of where we can peddle schlock or bomb with impunity. Centering a map midway between Greenwich and the International Date Line might be more no more meaningful than a cultural preference for rounded numbers like 50 and 100.

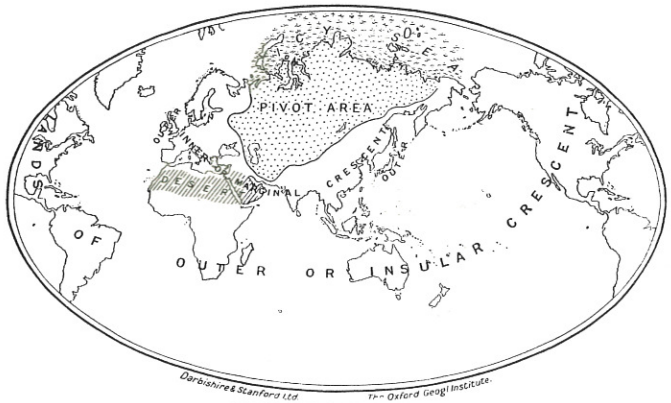
If cartographic scholars want to puff up the importance of the artifacts we study, and raise our profile in the process, cultural hegemony clearly makes an attractive explanation. How tempting to claim, as the distinguished cartographic historian Brian Harley once did, that "the simple fact that Europe is at the center of the world . . . must

have contributed much to a European sense of superiority." But can this argument and its intellectual kinfolk survive the "So what?" test? It's a question we seldom ask.

Similar "maps matter" explanations are equally suspect. A Chicago-anchored Mercator map could have reinforced Americans' sense of isolation from Europe in the late 1930s and early 1940s, but did a map in any measurable way delay our country's entry into World War II? And even though a map with Japan and Hawaii on opposite sides of the world argued against a Japanese attack on Pearl Harbor, is there any evidence, archival or otherwise, that an America-centered projection either stifled military intelligence in early December 1941 or deterred strategic planning in the months before? If so, it's a well-kept secret.

Blind faith in the power of maps comes easy when a projection suggests or magnifies a threat. Because a naive public accepts maps as facts, the John Birch Society speaker delivering an anti-Communist diatribe in the 1960s and 1970s often shared the stage with a large Mercator display, with the Soviet Union, China, and assorted client states colored a brilliant, threatening red. Proponents of air power and missile defense found the markedly different viewpoint of an azimuthal projection useful in dramatizing the possibility of an over-the-pole attack from the Soviet Union. And after the Communist Bloc disintegrated in the late 1980s, the Robinson projection, as Ben Wattenberg observed, "out-perestroika[ed] perestroika." Map historians who gleefully celebrate these alleged cartographic contributions to the Cold War might usefully ask whether the map's role is a matter of intrinsic power or merely the convenient availability of diverse designs.

Some maps might matter. A classic case is Sir Halford Mackinder's (1861–1947) theory of the Heartland, unveiled in 1904 at a meeting of the Royal Geographical Society. An academic geographer with political ambitions, Mackinder believed that technology would soon make ships less important than railways in controlling energy and food resources. A "pivot area" extending from eastern Europe into Russia and south into the Middle East enjoyed a natural advantage, he argued, and "its expansion over the marginal lands of Euro-Asia would permit



THE NATURAL SEATS OF POWER.
Pivot area—wholly continental. Outer crescent—wholly oceanic. Inner crescent—partly continental, partly oceanic.

Figure 9.10 Sir Halford Mackinder promoted his Heartland theory with this geopolitically suggestive oval framing of a Mercator map. From Mackinder, "Geographical Pivot," 435.

the use of vast continental resources for fleet-building [and] the empire of the world would then be in sight"—an imminent threat "if Germany were to ally herself with Russia." To dramatize his argument, Mackinder devised a Mercator map (fig. 9.10) on which duplicate Americas and an oval frame imply an invincible "heart-land" surrounded by an inner crescent of partly continental states and an outer crescent of "wholly oceanic" states, disadvantaged by the emerging importance of land transportation. Mackinder's map is important because Karl Haushofer, a German political geographer who advised Adolf Hitler, bought the idea that control of Eastern Europe was the key to world domination.

However influential Mackinder's elliptical map, its projection merely reflected public perception of how continents should look on a world map. Areal exaggeration was not an asset: Eurasia was a natural Heartland, and Mackinder needed an oval frame to downplay the artificial inflation of the theoretically peripheral Canada and Greenland. The equal-area Mollweide framework would have worked just as well, if not better, had it been the established ideal. What the Mercator worldview offered was nothing more (or less) than authenticity. Through the mid-1940s, it was the undisputed standard, which Miller and Van der Grinten felt compelled to partly replicate. In the absence of another powerful "master image," as Peter Vujakovic notes, the Mercator projection remains more widely used than its unique navigational qualities warrant.

Size Matters

High school debating coaches frown on misrepresenting an opponent's position as a straw man argument, easily knocked over like a dummy filled with straw. Instantly recognized by debaters and judges alike, this rhetorical tactic is common in advertising and political debate, where audiences are less likely to recognize logical flaws, and in the news media, where reporters eager for a lively controversy accord both sides equal time in the guise of fairness. It works especially well when your opponent's counterargument is too technical for general readers. Because any attempt to sort out the facts might be interpreted as taking sides, journalists typically treat both positions as equally valid, as they did when advocates of the Peters projection promoted their "revolutionary" world map as an antidote for the Mercator projection's dastardly "Eurocentric" worldview.

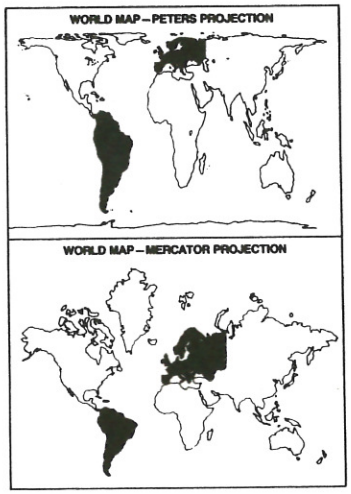
Battle lines were clearly drawn, with the Mercator map on one side and the Peters map on the other. In condemning the former as detrimental to Third World nations, which are largely in the tropics and thus downsized relative to Western Europe, the United States, and the

developed world in general, Peters's proponents ignored decades of pointed criticism of the Mercator map by academic cartographers and its wholesale abandonment by map publishers in the 1940s. Their simplistic scenario linked the Mercator map to an unsympathetic cartographic establishment and aligned the Peters map with pro–Third World organizations like Oxfam and UNESCO—credible allies, even if their expertise has no bearing on the issue. Not content with mere endorsement, the World Council of Churches and similar organizations implied that to oppose the Peters projection was to support intolerance and economic exploitation. To help their readers understand the controversy, newspapers and magazines juxtaposed examples of the Mercator and Peters world maps (fig. 10.1)—as if these were the only choices—and used visual propaganda to put professional cartographers on the defensive.

rect sizes. To do so, it enlarges and elongates most Third World countries at the expense of the northern hemisphere, particularly Europe. That's exactly what Peters, a historian from Bremen, West Germany, had in mind when he drew the map.

Another German, Gerhard Kramer, first drew the more familiar Mercator map in 1569. (Kramer Latinized his last name to "Mercator.") His map produced severe size distortions in some countries because he located his own homeland, Germany, in the center of the map. It although it distorts shapes in order to preserve accurate geographical relationships.

"In our epoch, relatively young nations of the world have cast off the colonial dependencies and now fight for equal rights," he says. "It seems important to me that the developed nations are no longer placed at the center of the world, but are plotted according to their true size." His work is perhaps more of a contribution to world politics than it is to cartography, since its shape distortion renders it unsuitable for use in navigation. *(cont.)*



The Peters projection, top, reflects the actual sizes of land masses. The Mercator map, bottom, makes Europe appear larger than South America. It is actually smaller.

Figure 10.1 *Christianity Today* illustrated a pro-Peters story with this pointed comparison of the Peters and Mercator portrayals of Europe and South America. From "A New View of the World," 39.

Who was Arno Peters? According to an obituary that appeared in the *Times* of London shortly after his death at age eighty-six on December 2, 2002, he was a German historian recognized as a staunch "advocate of equality in all things." In addition to his map projection, Peters and his first wife, Anneliese, authored the *Synchronoptische Weltgeschichte* (Synchronoptic World History), an elaborate book-length, year-by-year timeline that runs from 1000 BC to AD 1952 and devotes equal space to all years—a bafflingly obsessive strategy in light of the vast differences between earlier and later years in numbers of inhabitants, inventions, and noteworthy events. Other Peters innovations include a system of musical notation that distinguishes notes by color as well as position on the scale and a postcolonial global coordinate system based on decimal degrees and a prime meridian aligned with the International Date Line. Noting that the Greenwich meridian became the global standard in 1884, "when Britain was the strongest European colonial power and ruled over a quarter of the world," he argued that with "the ending of colonialism and the closure of Greenwich Observatory, there is no reason other than custom for retaining this zero meridian."

Peters came to cartography late in life. Born in Berlin in 1916, he studied journalism, history, art, and film production. After receiving a doctorate in 1945 from Berlin's Friedrich-Wilhelm University—his dissertation, "Film as a Means of Public Leadership," seems especially timely—he secured various grants, including one from the American government, for a world history textbook suitable for use in both East and West Germany, neither of which was particularly pleased with the result. After writing for a socialist magazine from 1958 to 1964, he cofounded the Institute for Universal History in Bremen and became its director in 1975. Although Peters discussed his world map as early as 1967, at a meeting of the Hungarian Academy of Science, he didn't actively promote it until May 1973, at a press conference in Bonn. Reporters received copies of his *Orthogonal Map of the World* and a brochure, *The Europe-Centered Nature of Our Geographical Picture of*

GALL'S ORTHOGRAPHIC PROJECTION.

EQUAL AREA. PERFECT.

For Physical Maps, chiefly Statistical.

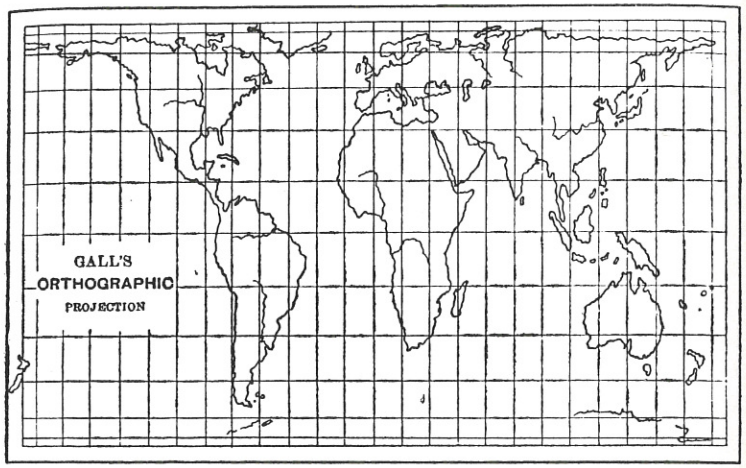


Figure 10.2 Gall's Orthographic projection, a forerunner of the Peters projection and prototype for the Gall-Peters projection. From Gall, "Use of Cylindrical Projections," 121.

torted for nineteenth-century atlas publishers, who typically turned to a sinusoidal or Mollweide projection whenever they needed an equal-area map.

Could Peters have discovered his projection independently? Sure. Is it likely? Yes, but only if Peters naively ignored the existing literature on map projection, including a 1910 German-language article by Walter Behrmann, who pointed out that giving a cylindrical equal-area projection two standard parallels, rather than one (the equator), reduced the pronounced east–west stretching of polar areas on the original rectangular equal-area map, presented by J. H. Lambert in 1772. Curious about the overall effect on shape, Behrmann examined angular deformation for rectangular projections secant at latitudes between 10° and 60°, at a ten-degree interval, and concluded that standard parallels at 30° yielded "the best of all known equal-area projections of the whole world."

"All known," it turns out, is a very large group (fig. 10.3) insofar as every marginally distinct pair of standard parallels produces a slightly different world map. It helps, though, to assert broad benefits like those claimed by British architect Trystan Edwards for a version secant at 37° 24′, presented in 1953. Edwards promoted his projection "as a 'general service' map to supercede Mercator's for all purposes except navigation and as the standard world map for the study of political geography." A *Times* of London editorial titled "Mercator Disci-

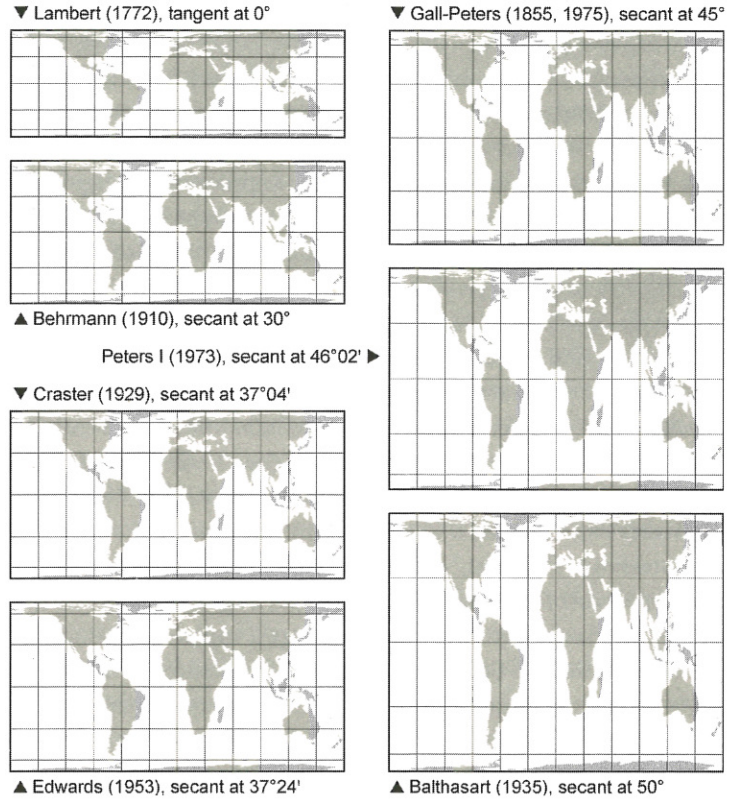


Figure 10.3 A few members of the family of cylindrical equal-area projections, a very large group insofar as every plausibly distinct pair of standard parallels defines a new member.

plined" puts him a couple of decades ahead of Peters in media-savvy Mercator bashing. Optimistic but myopic, Edwards patented his projection, thereby assuring its obscurity—why pay a royalty, mapmakers ask, when equally sensible options are free for the taking? Other named members of the cylindrical equal-area family are the Craster rectangular equal-area projection (secant at 37° 04′), mentioned fleetingly in a 1929 article by Colonel J. E. E. Craster, who much preferred its pseudocylindrical modification, and the equally obscure Balthasart projection (secant at 50°), introduced in 1935 in a Belgian geographic journal by the otherwise unknown M. Balthasart. Jeremy Crampton, an academic cartographer eager to give Peters the benefit of the doubt, would also include the German historian's admittedly flawed 1973 map (secant at 46° 02′).

Although Peters was probably unaware of the Gall Orthographic projection in the mid-1970s, he should have done a bit more homework before touting its advantages in an impressively designed, generously illustrated book, *The New Cartography,* published in 1983. Not content with "fidelity of area," he made claims that were either false (like "fidelity of scale," possible only on a globe) or trivial (like "totality," which describes a map's ability to show the entire world). Sure, the Mercator and a handful of other projections can't cover the entire sphere, but no equal-area projection lacks totality. A few of his "attainable map qualities" seem contrived to exclude interrupted composite equal-area projections like Goode's (see fig. 9.5), which lacks "fidelity of axis" because its meridians curve, "supplementability" because the mapmaker can't "detach a [small] section from the left hand side and . . . reattach it to the right," and "proportionality," which demands "longitudinal distortion along [the map's] upper edge as great (or as small) as along its lower edge." Eager to disparage a superior alternative, Peters unfairly denied Goode's map "fidelity of position," whereby "all points which exist at an equal distance from the equator are portrayed as lying on a line parallel to the equator." Goode's parallels might be interrupted, but they're consistently parallel to the equator.

Three additional qualities round out Peters's list of ten. Willingly conceding that Goode's, Mercator's, and Van der Grinten's projections (among others) possess "clarity," whereby a map "does not deform by

extreme distortion any of the countries, continents and seas portrayed," Peters boldly claimed this attribute for his own map. And technically he's right: its strung-out continents are not "extreme" insofar as their distortions could, technically, always be worse. The two remaining qualities are vague and baffling. The Peters projection has "universality" because it "permits the construction of grid systems for maps of each section of the earth's surface as well as for a global map . . . and permits the portrayal of all contents of a map for all applications." Huh? And because of "adaptability" it "can cope with specialist requirements of general map contents." According to these enigmatic definitions, no projection other than Peters's is universal or adaptable.

To the chagrin of the German Cartographic Society, which challenged Peters's claims as early as 1973, the assertive historian won the support of former German chancellor and Nobel laureate Willy Brandt, who chaired the Independent Commission on International Development Issues. To advertise disparities between developed and less developed nations, the latter largely in the tropics, the Brandt Commission put Peters's map on the front covers of its 1980 report *North–South: A Programme for Survival* and a 1983 sequel, *Common Crisis North–South: Cooperation for World Recovery.* Identical acknowledgments note the projection's use "rather than the more familiar Mercator projection," mention its "several innovative characteristics," and praise it for "represent[ing] an important step away from the prevailing Eurocentric geographical and cultural concept of the world." Prominently endorsed, the map that promised equality and fairness became an icon of social consciousness.

Relief organizations and other pro–Third World groups worldwide began using the Peters map in their own publications or giving huge numbers of wall-size copies to schools and churches. According to the *Economist,* by 1989 UNICEF and kindred agencies had distributed over 60 million copies. Prominent adopters include the United Nations Educational, Scientific and Cultural Organization (UNESCO) on the international scene and the National Council of Churches of Christ in the United States. In Britain there's Action Aid, Oxfam, and the Third World Foundation.

Why the Peters map? In 1986 geographer Peter Vujakovic surveyed British groups committed to Third World development and found that twenty-five of forty-two respondents (69 percent) had adopted the Peters projection for one or more publications. Asked to explain their decision, adopters cited a variety of reasons, including areal equality (48 percent), a distinctive look that commands attention and provokes thought (36 percent), elimination of Eurocentric bias (32 percent), and improved recognition of Third World countries (24 percent). Despite its distortion, the map's unusual appearance was clearly an asset. As one respondent noted, "use of the Peters projection is a statement in itself."

In framing his map as the only effective antidote to a venomous Eurocentric cartography, Peters appealed to adopters' wariness of Western values. The enemy was not just Eurocentric maps, he argued, but the professional mapmakers who foisted them on an unwitting public. Calling for a revolution in mapmaking, he attacked cartographers' authority, ethics, and relevance.

> Philosophers, astronomers, historians, popes and mathematicians have all drawn global maps long before cartographers as such existed. Cartographers appeared in the "Age of Discovery," which developed into the Age of European Conquest and Exploitation and took over the task of making maps.
>
> By the authority of their profession they have hindered its development. Since Mercator produced his global map over four hundred years ago for the age of European world domination, cartographers have clung to it despite its having been long outdated by events. They have sought to render it topical by cosmetic corrections.
>
> . . . The Eurocentric world concept, as the last expression of a subjective global view of primitive peoples, must give way to an objective global concept.
>
> The cartographic profession is, by its retention of old precepts based on the Eurocentric global concept, incapable of developing this egalitarian world map which alone can demonstrate the parity of all the peoples of the earth.

Academic cartographers who might have been mildly amused by Peters's 1973 posturing were outraged and embarrassed by his assault on their credibility. Particularly offensive was the 1977 republication, apparently verbatim, of a West German government press release in the *Bulletin* of the American Congress on Surveying and Mapping (ACSM), a broad professional society in which land surveyors greatly outnumber cartographers. The *Bulletin*'s editor, a communications professional with no cartographic training, apparently welcomed the short piece, engaging and well illustrated, as a bone to throw members clamoring for cartographic content.

It's easy to see why a reader unfamiliar with map projection would find the item intriguing and convincing. Its two-part headline sets up the straw man with a plea for fairness:

> FOUR CENTURIES AFTER MERCATOR:
> Peters Projection—to Each Country Its Due on the World Map

A catchy lead sentence alludes to a pervasive problem:

> The picture of the world we still use today originated in the world of yesterday.

Ignoring the great mapmaker's original depiction, centered slightly off the west coast of Africa (see fig. 4.2), a single short paragraph claims Mercator's genius for Germany while declaring his wall map Eurocentric:

> Mercator had put his chosen homeland, Germany, lying in the northern quarter of the globe, in the center of the map together with all of Europe.

Areal distortion, the reader learns, makes the map racist:

> The regions of the globe inhabited by white people were depicted much larger than the others. Countries and continents inhab-

> ited by colored people appeared a great deal smaller by comparison than they actually were.

Fortunately, another German discovered a solution a few years ago:

> Dr. Peters presented his new map to the world in 1973. It shows all countries and continents in their correct relative proportions. This absolutely area-factual Peters Projection furthermore keeps the unavoidable distortions of forms, distances, and angles so minimal that a world picture of great faithfulness to reality came into being.

Whatever credibility the piece gained among savvy readers by acknowledging the "unavoidable distortions of . . . distances and angles" was lost a few paragraphs later with unattainable claims that Peters's equal-area map "achieves absolute angle conformality" and "is totally distance-factual." Equal-area maps are never conformal.

American cartographers fired back in the next issue. Arthur Robinson, a professor at the University of Wisconsin and the author of a popular cartography textbook as well as his own world map projection (see fig. 9.7), questioned Peters's originality and common sense: "Map projections are fascinating for many reasons, not the least of which is the way people, such as Dr. Arno Peters, who know little of the subject, regularly devise something new and wonderful. Some of these 'discoveries' pass into oblivion because the originators have the good sense to check out the idea with the cartographer knowledgeable about projections. Others don't have such good sense, don't realize what they don't know, put it forward, and end up looking ridiculous. 'Peters' Projection' is a good example. Let me analyze it." Robinson, who would become the historian's fiercest critic, regarded Peters's map as nothing more than a useless modification of the cylindrical equal-area projection with two standard parallels. Behrmann's version, secant at 30°, had some merit, but not Peters's. "Most forms," he noted, "will appear either to squash the land areas N-S or stretch them." Robinson called some of Peters's claims "ridiculous" and argued that "only one who is blind could say that [his map] 'has no extreme distortion of form.'"

Following Robinson's commentary, projection expert John Snyder contended that the *Bulletin* article "reads much more like an exaggerated advertisement than like a professional presentation." Snyder noted that Lambert had presented a cylindrical equal-area map in 1772 and that the Edwards and Behrmann variants "were also advanced as revolutionary." Citing Maling's analysis in *Geographical Magazine,* he questioned whether the Peters projection was, as claimed, an equal-area map. His parting shot reflected frustration over what seemed an obstinate ignorance of map history: "For Peters' promoters to declare that this is the first world map projection of consequence since Mercator is ridiculous and insulting to dozens of other inventors over the years who have done a much better job with much more innovation and much less fanfare." The *Bulletin*'s editor washed her hands of the flap with an optimistic note of closure: "The Dr. Arno Peters' projection was acclaimed by an F.R.G. Government release as having 'radically changed' the world map. Our eminent cartographers have debunked the projection and seem to have 'laid it to rest' forever in no uncertain terms!"

Laid to rest? Hardly. A decade later ACSM and Peters's supporters were at loggerheads over a forty-two-page Friendship Press booklet that misconstrued the *Bulletin*'s republication of the West German press release as an endorsement of Peters's map. Friendship Press is the publishing arm of the National Council of Churches of Christ in the USA, and its executive director at that time was Ward Kaiser, an ordained minister in the United Church of Canada. In 1987 the Press published Kaiser's *A New View of the World,* subtitled *A Handbook to the World Map, the Peters Projection.* The contested passage, below, followed a brief listing of supporting organizations.

> Support for Professor Peters' map has been forthcoming from a number of professional communities. Geographers and cartographers among these. Thus the American Congress on Surveying and Mapping could say: "[Dr. Peters' map] shows all countries and continents in their correct relative proportions. This absolutely area-factual Peters Projection furthermore keeps the unavoidable distortions

> of forms, distances, and angles so minimal that a world picture of great faithfulness to reality came into being."

An endnote attributed the quote to the November 1977 issue of the *Bulletin* but omitted its origin as part of the FRG press release. Twenty pages later Kaiser concluded a discussion of the map's alleged qualities by emphasizing, "Thus the mathematical or scientific superiority of this projection becomes apparent. You may wish to quote statements that recognize this breakthrough, such as those by the American Congress on Surveying and Mapping."

ACSM objected vehemently and demanded a retraction. Clearly embarrassed, Friendship Press responded by pasting a short note on the contents page of unsold copies:

> CORRECTION
>
> The statement attributed to the American Congress on Surveying and Mapping on page 10, also referred to on page 31, was originally made in a bulletin of the Press and Information Office of the Government of the Federal Republic of Germany. The ACSM reprinted the material in its Bulletin No. 50 in November 1977 but has not made an official statement of its own on the Peters Projection.

As Peters's chief North American apologist, Kaiser had sparred with Robinson, Snyder, and other leading cartographers in countless articles and interviews. "Every teacher who really wants to help his or her students understand the real world ought to have this map," Kaiser told *USA Today*. Reiterating the Peters straw man for *Mother Jones,* he asserted that the Mercator map "makes the predominantly white-dominated areas of the world seem more important than they are." The same article includes John Snyder's observation that "no flat map will do perfect justice to a globe." Like other cartographers who rejected Peters's claim of priority, Snyder referred to the historian's creation as the "Gall-Peters projection."

Snyder considered both shape and area important. In an article for *Christian Century,* he recalled a radio interview in which the host had

pressed Kaiser on Peters's distorted rendering of Africa. The minister's reply suggested ignorance of globes and space imagery: "Well, one needs to ask what is the normal shape of Africa? Without having seen Africa from outer space, I'm not really in a very good position, nor perhaps [is] any of us, to say how it actually looks." Phooey, Snyder retorted, "We know very well how Africa looks from space!" And "Peters' distortion of Africa seem[s] excessive." How excessive? In a "views and opinions" essay for *The American Cartographer,* Arthur Robinson likened the map's distorted landmasses to "wet, ragged, long, winter underwear hung out to dry on the Arctic Circle."

Robinson and Snyder felt the profession should take a stand. In 1985 the American Cartographic Association, the cartographers' wing of ACSM, formed a Committee on Map Projections, which examined the issue of distortion on world maps and produced three booklets explaining options to a lay audience. The committee, which Snyder chaired, concluded that neither the Gall-Peters map nor any other rectangular cylindrical projection—plane chart, Mercator's, Lambert's, Behrmann's, Miller's, whatever—was worthwhile. As the first booklet, *Which Map Is Best?* observed, "To force the spherical globe into a rectangle produces extreme shape distortion, but surprisingly most people don't complain." Robinson, who wrote the text, posited an explanation: "To a designer a rectangle is neat: It fits nicely on a rectangular page or wall, and it doesn't leave awkward, empty corners as oval projections do." Even so, he also blamed public familiarity with the rectangular Mercator grid.

Rather than engage Peters's supporters in yet another hissing match, the committee drafted a resolution "strongly urg[ing] book and map publishers, the media, and government agencies to cease using rectangular world maps for general purposes or artistic displays." Severe distortion is inherent in the "straight edges and sharp corners" of any rectangular map, which not only "represent[s] most distances and direct routes incorrectly" but "portray[s] the circular coordinate system as a squared grid." Frequent sightings of a severely distorted world map, the resolution claimed, made it "look right" and contributed to "serious, erroneous conceptions [of] large sections of the

world." Borrowing from the Peters playbook, the committee attacked only one map by name—in the resolution's concluding sentence: "The most widely displayed rectangular world map is the Mercator (in fact a navigational diagram devised for nautical charts), but other rectangular world maps proposed as replacements for the Mercator also display a greatly distorted image of the spherical earth." The implication was clear: Mercator's map provides an inappropriate worldview but Peters's projection, though different, was no solution.

Professional cartographers and geographers (or at least the organization leaders who approved resolutions on their behalf) were impressed. In addition to the American Cartographic Association, the antirectangular resolution won endorsements from the American Geographical Society, the Association of American Geographers, the Canadian Cartographic Association, the National Council for Geographic Education, the National Geographic Society, and the Geography and Map Division of the Special Libraries Association. A May 1989 mailing to three hundred news organizations and media officials attracted modest attention. The *Wall Street Journal* ran a short item on its front page, and the *Washington Post* included snapshots of the Mercator and Robinson projections with a brief report in its "Science Notebook" column. Otherwise, the resolution got very little play in the press. Either the map flap was stale news, or the Committee on Map Projections lacked the charisma of Peters's supporters.

Not all academics dismissed Peters's arguments. J. B. Harley (1931–91), one of the world's most respected map historians, saw the Peters controversy as an effort to deny the map's ideological role and ridiculed "the hysteria among leading cartographers at the popularity of the Peters projection." The "real issue," he argued, was a power struggle between Peters, whose "agenda was the empowerment of those nations of the world he felt had suffered a historic cartographic discrimination," and professional cartographers, including most academics, "whose power and 'truth claims' . . . were at stake." In a seminal 1991 essay "Can There Be a Cartographic Ethics?" he charged that cartographers, obsessed with accuracy and willfully ignoring societal consequences, were "still closing ranks." Harley wrote from experience: ACSM had asked him to submit the piece to the *Bulletin* but declined to publish it because his interpretation conflicted with the organization's official position on the Peters map.

Harley echoed Peters's indictment of Eurocentric cartography. "The scientific Renaissance in Europe," he argued, "gave modern cartography coordinate systems, Euclid, scale maps, and accurate measurement, but it also helped to confirm a new myth of Europe's ideological centrality through projections such as those of Mercator." The legacy of a colonial Europe-centered world can be found on all inhabited continents, according to research by Thomas Saarinen, a cognitive geographer who analyzed 3,863 sketch maps by students in forty-nine countries. Although evident on all continents, the myth of European centrality is neither pervasive nor strictly Europe-centered. Participants in Africa and Europe typically drew a north-up map centered around the Greenwich meridian but with Africa clearly in the middle. By contrast, most students in East Asia and Oceania sketched a Sinocentric world, and more than one-fifth of Anglo-American students made their maps Americentric. Surely some of the so-called Eurocentric images merely reflect a natural tendency to position oneself near the center.

Willing to credit Peters with highlighting the problem, neither Harley nor Saarinen was eager to recommend a single solution or put all of the blame on the Mercator projection. John Pickles, another geographic scholar who saw value in the Peters map, questioned the impact of Europe-centered displays. "Cartography shares and reproduces the values of the age," Pickles argued, but the map is more a reflection than a source of power.

Harley, Pickles, and Saarinen have a point. A map can be an ideological statement, as the Peters projection clearly is, and anyone who denies the possibility of an ideological role is clearly wrong. That said, a map's effectiveness as an ideological statement does not make it a reliable device for representing area, shape, or relative importance. Favor one role or attribute, and you're likely to slight others.

John Snyder offered an ironic take on ideology and relative size. At age twenty he developed an equal-area map in the shape of an hour-

glass (fig. 10.4). I reproduced his map in *How to Lie with Maps* to make the point that area fidelity need not confer shape fidelity. Snyder mentioned the map tongue-in-cheek at the closing paragraph of a letter to Arthur Robinson.

> Enclosed is an *equal-area* pseudocylindrical-type projection I devised around 1946, and drew by hand then. I felt it should remain buried in my notes. Now, it seems the time to arrange a big press conference to unveil it because of the way it shows how so much of the world is choking off the Third World economically. It also draws attention to the center—the Third World areas—and it is *finally* equal-area. Besides Peters, this may be the only equal-area projection ever devised, to go by some published statements. If you will lend your name to its promotion, I'll give you a substantial part of the profits. Or maybe our committee should scrap the pamphlet and promote this instead. Sorry, I have to stop to get into my straitjacket.

Don't misread the sarcasm. A fervently antiracist Quaker convert who once resigned from a church because of the minister's insensitive remarks about African Americans, Snyder resented Peters's exploitation of Third World causes.

I'm continually puzzled by assertions that the Peters projection promotes "fairness to all peoples." What does areal equivalence have to do with population, which varies widely in density throughout the developed and less developed worlds? A better solution, I'm convinced, is the area cartogram, also known as a demographic base map when it distorts map area to portray relative population.

I made one myself once, for a population geography textbook. As shown in fig. 10.5, my map is not without flaws, and it's not particularly original. I borrowed the armadillo graticule from a 1953 cartogram whose authors apparently borrowed it from Erwin Raisz's (1893–1968) clever projection of the world onto a torus. I used 1980 headcounts and tried to draw more readily recognizable geographic caricatures, but only for countries with more than five million people. Thus Africa is set off from Europe and Asia, and Ireland is lumped

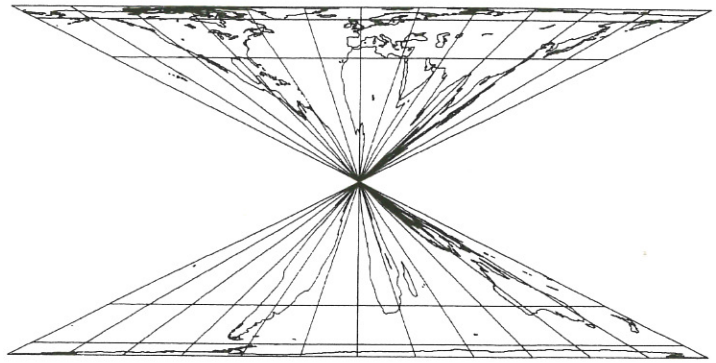


Figure 10.4 John Snyder's hourglass projection, an equal-area map, demonstrates that fidelity of area need not confer fidelity of shape. From Monmonier, *How to Lie with Maps,* 98.

with England, Scotland, and Wales. A larger scale could accommodate additional countries, but not small nations like Djibouti and Luxembourg. Even so, my map not only highlights the numerical prominence of China and India, which look much smaller than Canada on an equal-area projection, but also points out the demographic significance of Indonesia, the world's fourth most populous country but easily overlooked on most maps. For readers curious about smaller

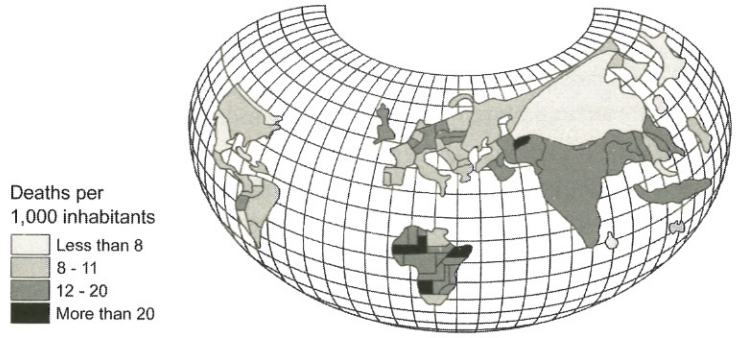


Figure 10.5 World-on-a-Torus population cartogram used as a base map. From Schnell and Monmonier, *Study of Population,* 204.

nations, my coauthor and I included an appendix listing population size and vital rates for all countries, large and small. For precise comparisons, tables of numbers are always more reliable than maps.

A population cartogram can make a strong ideological statement, especially if fairness to all people is more important than fairness to all acres. Even so, demographic base maps don't quite look like maps, and in the international arena they have the added drawback of privileging the more populous nations of Asia over the more numerous but less densely settled countries of Africa. According to historian Jeremy Black, geometric accuracy and even demographic accuracy mattered far less to Third World advocates than the Peters map's distinctive appearance. "Peters struck a chord with a receptive international audience that cared little about cartography, but sought maps to demonstrate the need for a new world order freed from Western conceptions."

Not all Third World supporters agreed. In the early 1980s left-leaning British political scientists Michael Kidron and Ronald Segal used several cartograms in their startlingly innovative *State of the World Atlas*. Only one is based on population; other cartograms use map area to dramatize contrasts in armaments, food supply, and government income. Rather than risk distracting readers with unusual map projections, the authors plotted most of their "angry facts" on the Winkel tripel projection (see the right side of fig. 9.8), a compromise projection adopted two decades later by the comparatively staid National Geographic Society. A note in the corner of the atlas's first map indicates that Kidron and Segal had rejected the Peters map as needlessly distorted and potentially confusing:

> Since the world is virtually spherical it is geometrically impossible to produce a completely accurate world map, on a flat sheet of paper, without some distortion or modification.
>
> The Mercator projection of 1569 and the Peters Projection of 1977 display two extremes of such distortions. However, Winkel's "Tripel" is used throughout this atlas as a familiar and relatively fair, "equal area" projection.

Small insets of the Peters and Mercator maps illustrate these "extremes," while quote marks around "equal area" acknowledge that Oswald Winkel avoided extreme distortions of shape by allowing small distortions of area. Because readers need to focus on the maps' symbols and distribution, a "familiar" projection is an asset.

Peters tested the relative merits of familiarity and visual ideology with his own world atlas, published in 1989. In addition to 246 world maps addressing economic, social, and political topics similar to those in the *State of the World Atlas*, the *Peters Atlas of the World* has a topographic section in which each of 43 two-page maps covers one-sixtieth of the earth's surface at more or less the same scale. In extending the Peters doctrine of areal fairness to relatively detailed region maps, the topographic section grossly overemphasizes sparsely settled areas in Saharan Africa, Greenland, and Antarctica at the expense of India, Indonesia, and other densely populated countries. To avoid extreme stretching on his topographic maps, Peters abandoned his signature projection, secant at 45° N and S, in favor of locally centered cylindrical projections. And in polar zones, where a cylindrical graticule would cause pronounced east–west stretching, an azimuthal projection lets the meridians converge (realistically) to a point. Additional compromise is apparent in the understandable suppression of maps that would cover large expanses of ocean in order to afford equal treatment to the Seychelles, the Cape Verde islands, and other outposts inconveniently distant from a continent. They're present, but only as tiny specks on a very small-scale world map. Fairness suffers further as some places disappear into the gutter between facing pages while others show up on more than one regional map.

Academic cartographers found much to criticize. Many of the color symbols are unnecessarily garish, for instance, and place names are difficult to read on world maps printed eight to a page. Looking beyond design flaws, several reviewers ridiculed the hype-filled promotional material. Russell King and Peter Vujakovic, writing in the British journal *Geography*, validated their title "Peters Atlas: A New Era of Cartography or Publisher's Con-Trick?" by quoting the claim, "This Atlas represents the greatest single advance in map-making in over 400 years."

In the *Bulletin* of the Society of University Cartographers, Vujakovic applauded the "interesting and varied" content of the thematic section but questioned the assertion, in the atlas's two-page introduction, that " 'no interpretation or evaluation of information has been undertaken . . .' in order not to detract from the user forming '. . . an objective and unprejudiced personal picture.' " While interpretative descriptions afford an opportunity for bias, few cartographic decisions are as subjective as the selection of themes and data. Equally deplorable was the atlas's lack of dates and source notes for individual maps.

Peters's more strident claims were toned down in 2002, when the Hammond World Atlas Corporation published the *Hammond Compact Peters World Atlas,* printed in Germany and subtitled *The Earth in True Proportion.* Hammond's 2003 college catalog (fig. 10.6) touts the book as "a distinct alternative and enhancement to all other atlases . . . the first atlas ever to depict countries, continents, regions and their relationships to each other according to true land mass." Insofar as no other world atlas I know of relies exclusively on equal-area projections, the claim seems valid. What's more, the offer of a Peters Combo Pack that includes the more conventional *Hammond New Comparative World Atlas* reflects a new marketing strategy that emphasizes complementarity.

In linking two well-known cartographic brands, Hammond and Peters, the new pitch portrays the Peters atlas as an essential supplement. "Which map projection is 'better,' one that shows true land mass but distorts shape, distance and direction, or vice versa?" Clever phrasing insofar as "vice versa" implies that world maps in the second atlas don't distort shape, distance, or direction. Hype aside, the two volumes are fitting complements because continental maps in the *Comparative* atlas are cast on the innovative "optimal conformal" projection designed by physicist Mitchell Feigenbaum to minimize distortions of large and small shapes as well as distance. To accommodate more reactionary tastes, Hammond's catalog offers a Mercator world map as either a "designer edition" wall map or a page-size laminated version bundled with the company's *Scholastic New Headline World Atlas.*

Figure 10.6 The Hammond 2003 college catalog devoted a full page to the *Hammond Compact Peters World Atlas.*

In the 1990s the Peters map became an emblem of diversity awareness, marketed as the cornerstone of a catholic cartography in which dissimilar images of the world promote cultural sensitivity. An influential advocate is HR Press, which claims "the largest selection of cultural diversity training materials for the workplace." Its Web site offers the Peters Map Seminar Pack, which includes Peters and Mercator maps as well as an "Upside Down World Map" formed by casting the Van der Grinten projection (see the left side of fig. 9.8) with the South Pole at the top. ODT, Inc., another diversity-awareness publisher, sells three different south-up maps as well as the conventional Peters projection, the Peters atlas, and *Seeing through Maps,* a book based on the notion that any map (but particularly a world map) reflects a point of view. The authors, Ward Kaiser and Denis Wood, discuss the advantages and disadvantages of more than twenty world maps, including population cartograms, and acknowledge criticisms of Peters's map, including its pronounced stretching near the poles and equator. They reject Peters's claims of priority, but they argue that his projection "has shaken up cartography and been of enormous value in getting people to critique and understand the images they are presented with."

ODT's success in marketing the Peters map includes the February 28, 2001, episode of the NBC political drama *The West Wing,* in which the fictional Organization of Cartographers for Social Equality lobbies presidential staff to put the Peters map in every public school. Presidential press secretary C. J. Cregg overcomes her initial shock of seeing the strangely stretched continents and becomes a supporter. Inquiries and sales leaped. Pro-Peters organizations seized the opportunity to promote the Peters message, and on its Friendship Press Web site the National Council of Churches resurrected a familiar straw man: "The Mercator was designed for navigation and is still valuable for that purpose, but it gives a wildly distorted sense of size and position. The Peters shows how large, and where, each country is."

A more recent ODT product suggests that the Peters map, as an icon of cultural diversity, might be a bit stale. In August 2002 ODT announced the Hobo-Dyer projection, a cylindrical equal-area map secant at 37° 30′, midway between the standard parallels of the Behrmann and Gall-Peters projections and only slightly different from Trystan Edwards's worldview, secant at 37° 24′. The projection's name reflects the collaboration of ODT principals *Ho*ward Bronstein and *Bo*b Abramms with Mick Dyer, a designer at Oxford Cartographers, the British firm that produced the artwork for the *Hammond Compact Peters World Atlas.* Particularly striking is the projection's presentation as two maps, printed back to back (fig. 10.7). On one side a conventional north-up view reflects a notable lessening of the north–south stretching that undermined Peters's portrayal of tropical nations. On the other side a south-up map centered on 150° E moves Australia from a peripheral position to center stage. Although south-up maps, particularly popular in Australia, are not new, the two-sides-of-a-coin presentation was sufficiently dramatic to capture the endorsement of Nobel laureate Jimmy Carter. According to a December 6, 2002, ODT press release, "When President Jimmy Carter receives the Nobel Peace Prize on December 10th in Oslo, Norway he will take a map developed and published in Amherst, Massachusetts. The Carter Center chose ODT's new Hobo-Dyer map to display the 68 countries around the world in which the Center has worked since 1982." The endorsement

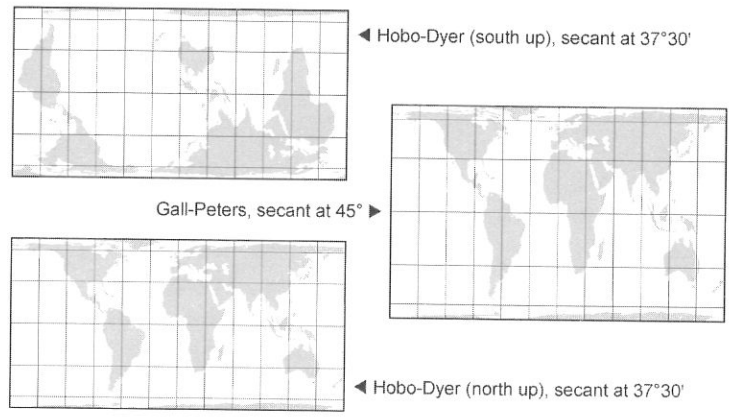


Figure 10.7 A comparison of the Gall-Peters projection with complementary orientations of the Hobo-Dyer projection. Note that the south-up view is centered on 150° E to place Australia near the center.

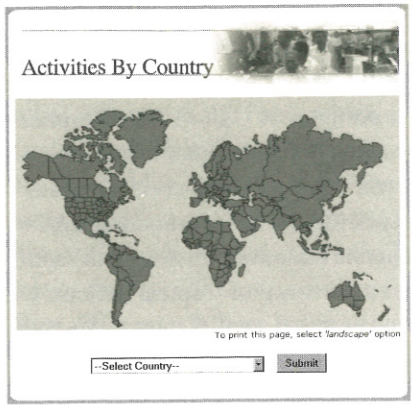


Figure 10.8 A world map on the Carter Center Web site decorates a menu for retrieving descriptions, by country, of the organization's humanitarian activities. From http://www .cartercenter.org/activities/activities.asp?submenu=activities/.

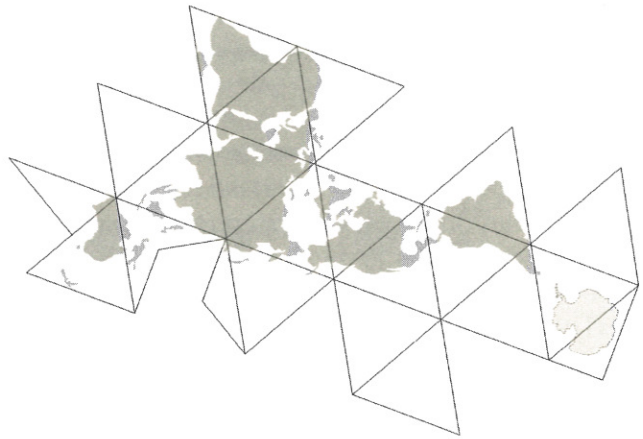


Figure 10.9 Geographers Paul Knox and Sallie Marston used this orientation of R. Buckminster Fuller's innovative "Dymaxion" map in *Places and Regions in Global Context,* an elementary textbook in human geography. For simplicity they removed the triangular framework and Antarctica. The word *Dymaxion* and the horizontal version of the projection are trademarks of the Buckminster Fuller Institute.

seems genuine, but a search of newspaper databases failed to confirm Carter's use of this post-Peters perspective. And three months after his trip to Oslo the Carter Center Web site decorated its activities menu with a world map on what obviously is not an equal-area projection (fig. 10.8).

I compared the Carter map to some well-known rectangular projections but couldn't find a match. Someone apparently compiled an ad hoc world map from diverse sources—perhaps a Mercator map was one of them—and moved Africa and Australia away from Eurasia to make them stand out. Note the gaping Strait of Gibraltar and the partition of New Guinea. Despite these liberties, the map is innocuous. Carter Center officials and their Web designer obviously consider humanitarian good works far more important than relative size, which must be distorted slightly if a world map is not to mangle shape.

If one wants a more eye-catching low-distortion world map, there are numerous options. A good example can be found in a textbook on world region geography by Paul Knox and Sallie Marston, who invoked an innovative map projection developed a half-century earlier by famed architect-inventor R. Buckminster Fuller. To make distortions of area and angles essentially invisible, Fuller mapped the globe onto an icosahedron, a three-dimensional solid consisting of twenty equilateral triangles (fig. 10.9). Yes, there's distortion, but because the triangles nicely mimic small sections of the globe's surface, stretching is largely negligible on small-scale maps. The Buckminster Fuller Institute uses a version with the main band of triangles aligned horizontally as its trademark. By contrast, Knox and Marston rotated the image clockwise about twenty-one degrees, stripped away the triangular framework, and zapped Antarctica, which contributed nothing to their demographic and economic maps. The awkward orientations of Australia and the Americas underscore the trade-offs inherent in map projection.

Points of View

Arno Peters made it difficult to view the Mercator projection as merely another navigation tool. Overseas conquests by the Spanish, the Portuguese, and the Dutch, to name a few, depended on sea power, and a map that helped colonial navies reach distant shores seems at first glance a worthy scapegoat for European exploits in Africa and Asia. Equally problematic are questions raised by the projection's more general uses. Are its inappropriate adoption for nineteenth-century reference atlases and its persistence on post–World War II wall maps merely reflections of its role in navigation, or might sinister political motives be at work?

Maybe, but probably not. The Mercator projection's formidable societal momentum demands multiple explanations, which include collective memory, brand-name recognition, and institutional inertia. Both the map and its author are well known, to be sure, and their coastlines look right to many people. Commercial mapmakers are understandably reluctant to snub buyers eager for a time-tested product, and designers seeking a traditional tone can readily exploit its famil-

iar authority. Cartographic educators have railed against its misuse for at least a century but cannot stamp out ill-advised Mercator worldviews. And for all their pleas for fairness, neither can Peters and his disciples.

Despite its cachet, the Mercator projection is greatly overrated as a symbol of Western imperialism. Functional maps were essential for efficient navigation but not uniquely so. Straight rhumb lines helped naval commanders, merchant captains, and slave traders go about their business, but so did the caulking for their hulls, the timber for their masts, and the canvas for their sails. Equally questionable is the Mercator map's influence on social thought and world politics. Did Europe's rulers and merchants need wall maps or world atlases to justify their actions? Did maps that inflated the size of the British Empire stifle whatever remorse nineteenth-century Britons might have had about racism and economic slavery in Africa or India? More to the point, did anyone ever die because of the Mercator projection?

I feel like a heretic to say it, but cartographic scholars engrossed in ideology and empowerment have vastly inflated the importance of maps, and with it the significance of their scholarship. While maps can be influential in contemporary disputes over boundaries or environmental impact, broader geopolitical impacts are more difficult to gauge. Seduced by the "power of maps" as an intellectual agenda, self-proclaimed theorists demand little evidence for innovative monocausal arguments (like Peters's) that might seem sensible were their proponents not aggressively trouncing equally plausible explanations.

A case in point is Brian Harley's endorsement of Arno Peters's effort to promote "fairness" to Third World nations without questioning how the Peters projection, or any other map for that matter, might achieve this worthy goal. While Harley merits praise for his eloquent analysis of "cartographic silences," a concept based on maps' ability to manipulate opinion by omitting or suppressing information, his willingness to excuse the "silences" of Peters's proponents, who blatantly ignore existing equal-area maps, is puzzling.

Need for verification doesn't stop there. In questioning the motives of Peters's critics, Harley overlooked an opportunity to challenge

academic cartography's untested assumption that the Peters map can seriously impair public understanding of geography. Although superior projections abound, the evils of the Peters map are easily exaggerated. Do its users really think Africa looks that way? Do they never look at a globe, or at other maps? Are map users complete idiots?

An abundance of dysfunctional designs in news publications and academic journals suggests that maps as a whole are remarkably robust. By this I mean that a map need not be well designed or user friendly to be informative, at least among conscientious users who know their geography and read maps carefully. We live with distorted maps—we have no choice—and a map that clobbers the shapes or sizes of continents is not intellectually poisonous, especially for users acquainted with other frameworks. For these viewers, there is ample room for both the Peters and the Mercator. The real problem is broader ignorance of maps, geography, and geometry. Among a map-savvy public, the Peters projection would have few adherents.

A persistent concern is the Mercator map's areal distortion, especially troublesome when uniform dots representing a fixed number of people, hogs, or apple trees portray variations in density. As every mapmaker knows, or should know, an equal-area projection is essential if a dot-distribution map is to reveal reliable contrasts between high-density and low-density regions. For other types of map the cartographer must weigh distortion of area against distortions of angles, distances, and directions. Also relevant are the gross shapes of continents, faithfully represented only on a globe. As Goode's equal-area map (see fig. 9.5) demonstrates, interruptions over water can minimize shape distortion by allowing each region its own, locally centered map projection. As Robinson's compromise projection (see fig. 9.7) shows, modest concessions to area distortion toward the poles can foster relatively realistic continents without ripping apart the oceans. And when true angles are important on meteorological maps covering tropical and temperate latitudes, the conformal cylindrical projection pioneered by Gerard Mercator is peculiarly appropriate.

Although Peters's supporters treat areal distortion like a crime

against humanity, modest distortions of relative area can be highly useful on compromise projections like Robinson's and Winkel's tripel (see the right side of fig. 9.8). Truth be told, exact area equivalence is often wasted on world maps intended to foster comparisons of relative size. Precise visual comparison is impossible because map generalization precludes an exact portrayal of coastlines and national boundaries, and because irregular shapes interfere with perception of shape. If you don't believe me, show a friend an equal-area map of the United States and ask whether Florida is larger than Georgia. The Sunshine State's panhandle and greater north–south extent trick most people into thinking, incorrectly, that it's bigger than its more compact neighbor. A similar L-shaped outline suggests that Africa on an equal-area map might look slightly larger than it should.

If any projection is worth denouncing, it's the vaguely named "geographical projection" popular among users of geographic information system (GIS) software. Used occasionally for maps of the conterminous United States (fig. 11.1), it's a nonprojection that treats longitude and latitude as rectangular (x, y) coordinates—an undisguised throwback to the plane chart of pre-Mercator sailing. Because meridians cannot converge, the map inflates the areas of Montana, North Dakota, and other northern states.

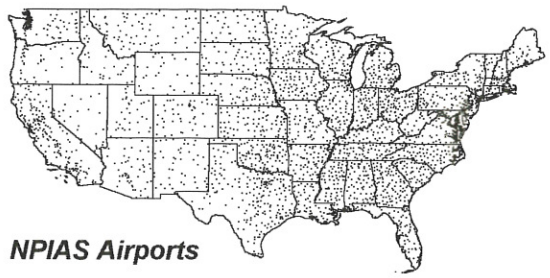


Figure 11.1 GIS software encourages use of the "geographical projection," which enlarges the relative area of northern states by using longitude and latitude as rectangular coordinates. From U.S. Department of Transportation, Federal Aviation Administration, *National Plan of Integrated Airport Systems,* appendix B.

Peters's complaint that the Mercator projection favors northern countries at the expense of the Third World finds favor among postcolonial deconstructionists poised to slay dead dragons. Critical theorists suspicious of government mapmaking see topographic and other maps as biased representations, subverted to whatever questionable agenda "the state" might promote. Although a potential for bias exists, broad assumptions of conscious or subliminal malevolence trivialize commonsense notions of bias and agenda. In my experience, the bias of ignorance, the bias of sloppiness, and the bias of tradition, individually or collectively, are far more prevalent than the bias of political ideology.

Mistrust of the Mercator map is not new, as historian Susan Schulten discovered in her examination of American geography textbooks from the 1940s. Controversy over the centering of world maps before and after the Japanese bombed Pearl Harbor is particularly revealing. While some geopolitical strategists attacked the traditional Greenwich-centered world for downplaying the strategic significance of the Pacific Ocean, others condemned world maps centered on 90° W (roughly the longitude of Chicago) for promoting a sense of "psychological isolation" among Americans by showing the Atlantic and Pacific Oceans as "a sort of 'Maginot Line' around the Western Hemisphere." Postwar anxiety about a possible over-the-pole attack from the Soviet Union led to "replac[ement of] the massive ocean buffers of the Atlantic and the Pacific on the Mercator projection with the relatively insubstantial Arctic, a 'new mediterranean' surrounded by the two political superpowers." Although Schulten mentions the Mercator projection by name, she's more concerned with how maps were centered than with their treatment of relative area. In this sense "Mercator" refers more generally to any equatorially centered cylindrical map projection in much the same way "Coke" sometimes means Pepsi.

The most trumped-up charge against the Mercator map is its alleged Eurocentrism. Horizontally, any projection centered on the Greenwich meridian is also centered on Africa. Vertically, any cylindrical projection on which the poles lie an infinite distance from the equator can be configured with Europe at the center. Insist on show-

Figure 11.2 A pro-Peters rendering of the Mercator projection, framed as a Europe-centered straw man. From Kaiser and Wood, *Seeing through Maps*, 7.

ing all of Greenland and not a hint of Antarctica, and a Mercator map becomes Eurocentric (fig. 11.2). Whatever social or political consequences this configuration might have, the only examples I've seen are straw man renderings designed to promote the Peters map.

Repeat an inaccurate statement assertively, and uncritical readers accept it as fact. This aphorism might explain Simon Winchester's catty complaint about fellow British writer Nicholas Crane's recent biography of Gerard Mercator. In a review for the *New York Times,* Winchester chides Crane for "not linger[ing] on the social and political implications of Mercator's map" and not "tr[ying] to undo the wrongs that Mercator perpetrated more than four centuries ago." In addition to famously inflating northern lands, the great mapmaker "chose to set his equator two-thirds of the way down his sheet, the better to give his native Flanders a more suitably dignified position on the chart." Had that been Mercator's motive, I doubt that Crane would have missed it. True, the 1569 map's equator is a bit below the map's center, but a look at the original chart (or the tracing in fig. 4.1) indicates that "two-thirds of the way down" is an exaggeration.

Empower yourself by confronting the myth of Mercator's Eurocentrism. The next time you see a Mercator map—assuming it's not there just to prove Peters's point—take a tape measure or piece of

string and find its real center. What you find will probably not be greatly different from the Mercator wall map hanging decoratively outside the map room at the Syracuse University's Bird Library. Bisected vertically by the 33rd parallel, the map is clearly centered on North Africa. Yes, its equator is pushed southward, more so than on Gerard Mercator's original, but Europe is definitely not at the center. I have no idea who purchased the map or when it arrived. Rand McNally copyrighted it in 1993, and its faded colors indicate a decade's exposure to light. While another Mercator map would not be my choice for a replacement, the one that's there is harming no one.

Peters's attack is neither the first nor the most serious threat to the Mercator projection. As noted in chapter 6, replacement of the Mercator on aeronautical charts by the Lambert conformal conic attests to the diminished importance of rhumb lines. John Q. Stewart highlighted the latter's advantages in a 1943 *Geographical Review* essay: "The civilian flyer over a country well mapped and abounding in easy navigational marks (rivers, large bridges, railroads, race tracks) and provided with radio aids and lighted airways does not trouble to engage in pin-point plotting. For him the relative constancy of scale of the Lambert outweighs everything else; and it is important to give him what he needs." That year Consolidated Vultee Aircraft Corporation touted another air-age tool, the azimuthal equidistant projection, in a booklet on maps and air supremacy: "[A]lthough a Mercator map of the world shows Greenland many times its actual size, it is nevertheless ideal for surface navigation because it shows true compass directions. And . . . the Azimuthal Equidistant projection, while it may show some areas sadly out of shape, provides an ideal chart on which the aviator can plot a true course and measure his distance from a given point." Nowadays plotting the route is less important than entering the right coordinates into an electronic system that uses satellite positioning, radar, and radio beacons to stay on course. Computers that can fly the plane and display any map the pilot wants have redefined the role of the paper aviation chart. And similar electronic aids for mariners have diminished the significance of the Mercator sailing chart.

Despite these inroads, Mercator's map still decorates walls and page layouts. On commercial wall maps in settings that invite close inspection, the projection's conformality is an asset for viewers concerned more with local geography than global comparisons. Only when the viewer steps back from the display does area exaggeration intrude. As artistic flourishes, small-scale Mercator maps bear little trace of their Cold War role in John Birch Society propaganda, designed to inflate the size, and hence the threat, of China and Russia. Despite the potential for more contemporary political protest, I have yet to see one used in spite to denounce pro-Peters political correctness. As far as I can judge, artists who invoke the Mercator worldview are merely exploiting the visual equivalent of a classic style like the penny loafer. Surely the *Atlantic Monthly,* in laying out a Mercator framework for The World in Numbers features examining global issues (fig. 11.3), is not thumbing its nose at the Third World. Nor is the

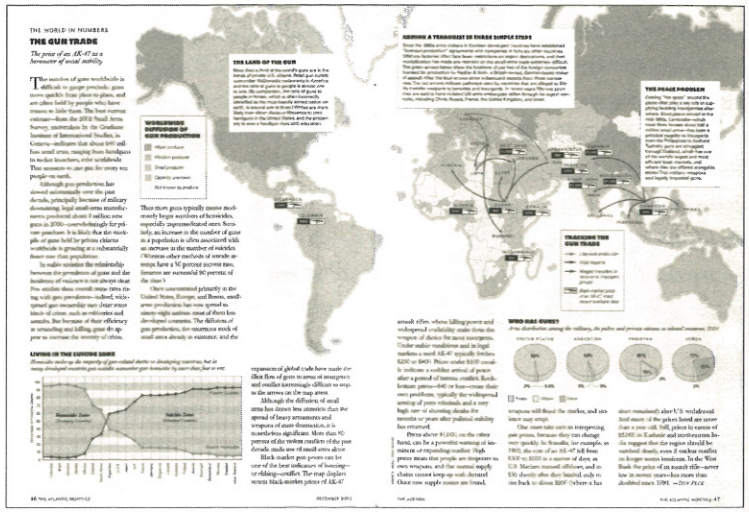


Figure 11.3 Demonstrating that maps can decorate as well as inform, the *Atlantic Monthly* embeds a Mercator projection in the standard two-page layout used when its The World in Numbers feature addresses global patterns. From Peck, "Gun Trade."

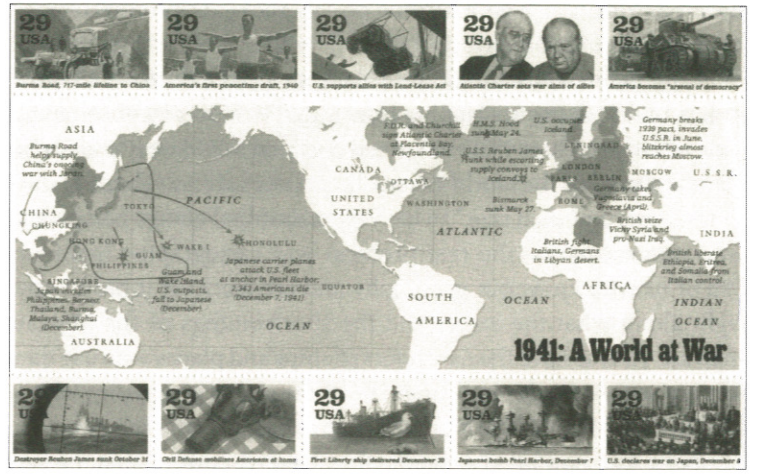


Figure 11.4 A Mercator map centered on 90° W dominates the stamp sheet issued by the U.S. Post Office in September 1991 to commemorate the fiftieth anniversary of World War II.

U.S. Postal Service, in placing a Mercator map at the center of a stamp sheet commemorating American involvement in World War II (fig. 11.4), using artistic ambiance as an excuse for geopolitical propaganda. As in other formal displays, Mercator's rectangular framework aligns nicely with the stamp sheet's edges and perforations.

Like any popular icon under attack, the Mercator map has its defenders. Among its earliest and more moderate supporters were Charles Deetz and Oscar Adams, the leading federal experts on map projection during the 1920s and 1930s. Their 1921 treatise *Elements of Map Projection* interprets exaggerated areas in higher latitudes as an asset because "in the consideration of the various evils of world maps, the polar regions are, after all, the best places to put the maximum distortion." Favoring rectangular frameworks over curved parallels and converging meridians, Deetz and Adams denounced "charts having correct areas with cardinal directions running every possible way [as] undesirable." Articulating an opinion rarely heard these days, the pair maintained that "the Mercator projection not only is a fixture for nau-

tical charts, but . . . plays a definite part in giving us a continuous conformal mapping of the world."

Later defenders were more strident. In a 1943 *Harper's Magazine* article titled "Those Misleading New Maps," University of Minnesota astronomy professor Willem Luyten declared the Mercator chart "the standard map of the world to date" and asserted that "shape is much more important than size." In his view, azimuthal air-age perspectives were unnecessary—the real problem was cartographic ignorance: "All of us who know our geography and are teaching it have known right along what the errors and the shortcomings of the Mercator map are. And so have the navigators of ships and planes who use them. But not so the uninformed amateurs of the global geography, who appear to have accepted the Mercator map as gospel truth: they were Flat-Earthers. And now all of a sudden they have discovered that the earth is round." Readers eager to follow the war and prepare for a wider use of aviation were told to get a detailed Mercator map and a globe.

While Luyten comes across as a fuddy-duddy, Hoover Institution economist Thomas Sowell personifies conservative resistance to leftist "moral preening." His 1995 book *The Vision of the Anointed,* which emphatically rejects the Mercator map's alleged Eurocentrism and Western arrogance, is less caustic than his 1990 *Washington Times* oped, which paints a sarcastic picture of political correctness in which "deep thinkers find [Mercator's map] sinister, if not racist." Rhetoric aside, Sowell's appreciation for the Mercator map is more personal than ideological. He had an early interest in map projections and found a Mercator wall map a convenient prop for a hastily improvised but well-received speech in a ninth-grade English class. "Don't mess with the Mercator projection," he warned. "It rescued me when I needed it, and now it's time to return the favor."

In addition to exposing the ideological roles of map projections, the Peters controversy revealed once again the ignorance of map projection, and geometry in general, among the public, the media, and even some academic geographers. Anyone who teaches geography or craves an appreciation of the environment and world affairs needs a basic understanding of how map projections work, how they can be

manipulated, and how narratives of their misuse and alleged misuse are readily distorted. Rather than banish the Mercator map, an enlightened society needs to appreciate the limitations of globes and the marvelous flexibility of map projection. With "virtual globes" and inexpensive, highly interactive cartographic multimedia so widely available, mapmakers and teachers have little excuse for inappropriate choices and uninspired pedagogy.