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—Stewart Clegg and Chris Carter

Maps

Maps are both tools and artifacts. As tools of knowledge and power, they have played an important role in the globalization of the planet; as historical artifacts, they can tell the story of globalization. Mental maps, which guided hundreds of thousands of years of hunting and gathering, helped early humans as much as their Paleolithic hand axes. Thus, mapping the environment is an old human (and even pre-human) capacity. The production of material maps, however, is a historical novelty arising after the Neolithic Revolution and somewhat before the invention of writing. A nine-foot-long picture map in Catal Hüyük, Turkey, from around 6200 BCE may be the oldest map to date; it shows a settlement of some 80 buildings in front of an erupting volcano (see image below).

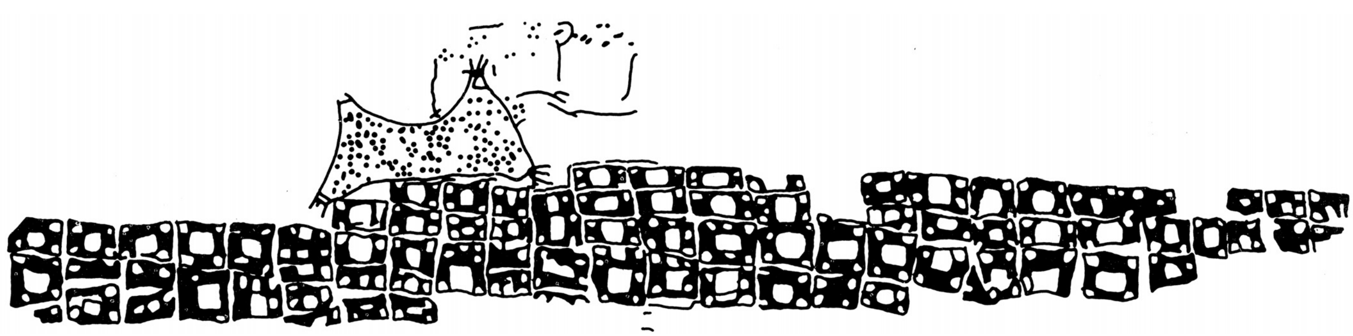
Today, electronic maps are guiding drivers as well as cruise missiles via navigation devices based on Global Positioning Systems (GPS). These virtual maps, typically not meant for human eyes but available on computer screens, indicate that the period dominated by material maps is ending and that high-technology mapping on demand is coming to the fore. This change does not mean the end of maps, to be sure, yet all tangible maps are now either historical (collectors' items) or consumable (printouts). Map servers and Geographical Information Systems (GIS) have become the leading mapmakers.

Mapping has jumped from animals to humans and then to machines, an evolution that classifies the last eight millennia as the period of material maps. Starting slowly, as befits the imperceptibly growing world population of the pre-Columbian era, the emerging literate urban cultures began to create tangible maps of their particular worlds and worldviews. Eventually, the enormously rich and diverse, but still only partly researched and documented, world heritage of maps was brought into existence.

Mental mapping continued in the tribal worlds, where it was hidden until Western explorers saw tribal people manifesting their mental maps in sand or on bark. Yet stumbling upon the universal human aptitude for mapping did not change the elitist assumption that oral cultures are "primitive" in comparison with literate cultures. Native mapping and speaking were viewed as low-level skills and looked down upon from the heights of the "civilized" skills of writing and mapmaking.

Maps as Artifacts—Anything Goes

Material maps are time- and culture-bound artifacts. Far from being simply objective and objectifying, they are essays about the world that allow and require multiple "readings." Cosmological, philosophical, theological, scientific and political, imaginary and rhetorical, treacherous and ideological, experimental and playful, maps challenge their readers in many ways. They are historical documents full of local knowledge, circumstances, and assumptions. Even global



This picture map—a Neolithic wall painting—was found at the site of an ancient settlement at Catal Hüyük in Turkey and is considered by many to be the oldest extant map found on Earth.

maps are situated in a local time frame and cannot hide the traits of the societies and cultures that produced them. The *mappaemundi* (maps of the world) of the European Middle Ages combined Christian doctrine with clues about the geography of Asia, Europe, and Africa. Now, space-based photos of the globe and countless modern world maps on the Web pay tribute to the globalism of the present time and the interdependent relationship of global society with the physical geobody.

The history of cartography shows that "anything goes," and that it is not a history of straight progress from geographic ignorance to ever more accurate spatial representations of the geobody. As in the history of art, there is too much diversity to shoehorn the wealth of map images into a single scheme. From ancient Babylonian clay map-tablets to current New York bus and subway diagrams, the great variety of social and cultural constructions of maps does not call for a narrowing of the focus to one viewpoint only. The "View of the World from 9th Avenue," Saul Steinberg's ironic map of the local perspective of Manhattanites, is as precise as any large-scale topographical map of the Ninth Avenue area from the U.S. Geological Survey (USGS). From the contemporary point of view of global history and theory, however, the world corpus of maps is a valuable source for the student of globalization.

Historical maps can be queried to reconstruct the globalization of the planet as the tortuous unveiling of the face of the Earth. Among the many processes of globalization, this one is basic. Without full knowledge of the globe, the processes of globalization are blind.

The globalization of the planet has proceeded in a fragmented, unconscious, and meandering way. The extant historical maps tell the story of a planet that was not known in its entirety. Until very recently, geographical mapping was reliable only locally and, indeed, blind and erroneous globally. Imperial Roman road and itinerary maps, for example, encompassed a much larger section of the Earth than the comparatively small local knowledge-maps that African hunter-gatherers carried around in their heads. Yet the bulk of Africa remained unknown to the Romans, whereas the unmanifested tribal maps covered virtually all parts of it.

The production of maps was not teleological in the sense that it was geared from the beginning toward the final goal of full disclosure of the geobody. Nevertheless, one can sort the world archive of maps according to this eventual outcome and design a new periodization of mapping that can illuminate this result and the major turning points leading to it. A straightforward way of setting up this periodization would be to distinguish among preglobal, protoglobal, and global mapping.

Preglobal mapping. Reaching far back in time, the preglobal period of mapping includes all mental and physical maps that humans have produced in complete ignorance of the global geography of the planet.

Protoglobal mapping. Beginning with the voyages of exploration in the 15th century, the protoglobal period of mapping took a decisive geographical turn. Fueled by Gutenberg's printing press and accelerated by the concurrent rediscovery of Ptolemy's *Geography*, mapmaking became a high priority in Portugal, Spain, and elsewhere. Individual fortune hunters as well as geographical entrepreneurs took to it and scientists embraced it. For reasons of politics, power, and privilege, the spatial exploration of the whole planet became an overriding goal of Western culture and nation-states for over 500 years. This period ended in the second half of the 20th century with the mapping of the ocean floors.

Global mapping. Based on complete spatial knowledge of the earth, the global period of mapping is now taking shape. Global geography is no longer a challenge but a starting point. Every structure and spot on the planet is located in its proper context and can be mapped instantly, automatically, and with high and increasing accuracy. Scalable from local to global, digital mapping technology provides whatever mapping service is requested from the myriad clients of mapping. To the earlier domestications of fire, animals, and plants, global mapping is adding the domestication of space.

Maps as Tools—Restrictions Apply

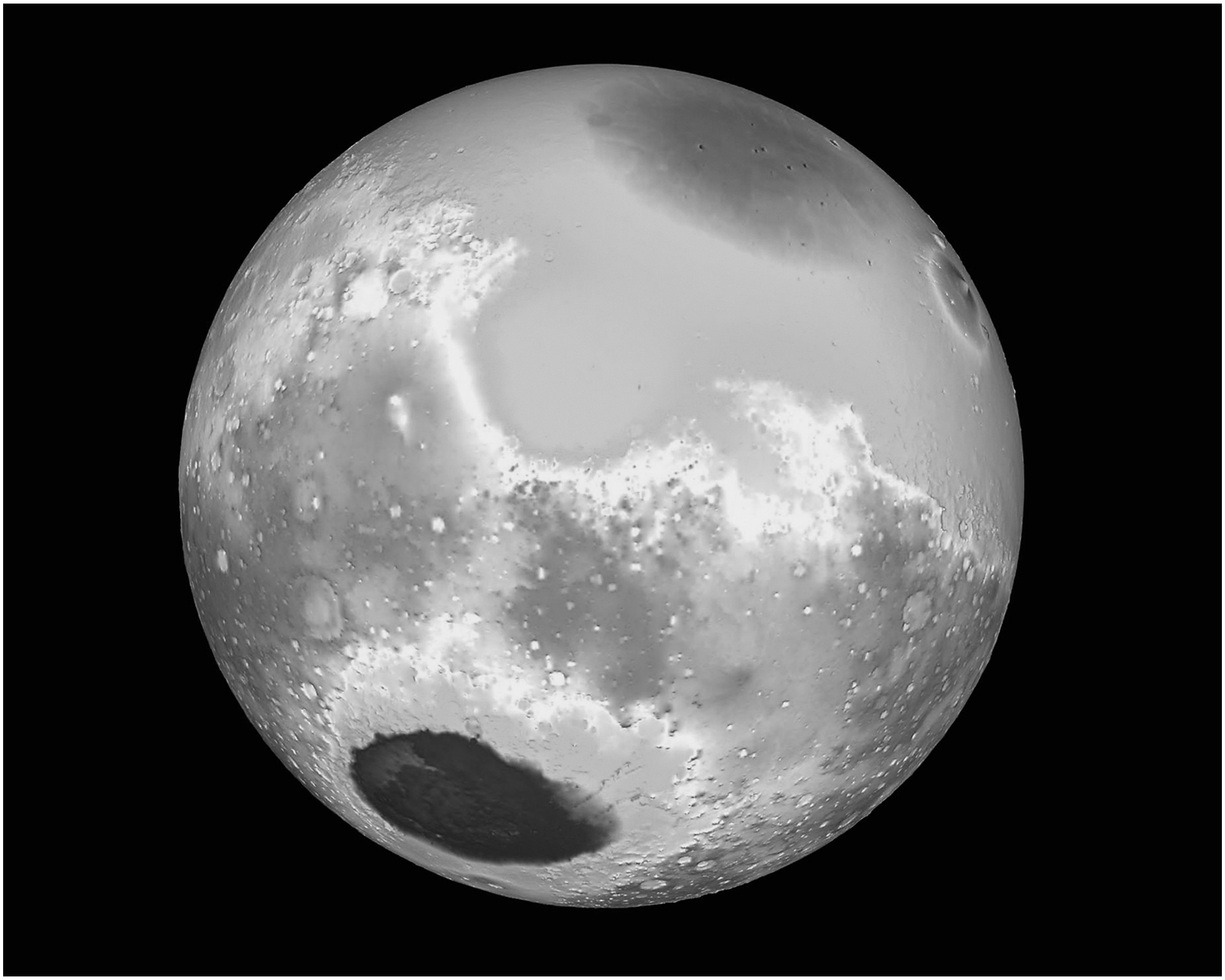
The ever-present, but not always dominant, use of maps as tools was responsible for the rapid accumulation of geographical knowledge during the protoglobal mapping period. Putting a premium on rigorous spatial exploration and accurate determination of location, this period optimized the use of maps as tools and constrained the freedom of anything-goes mapping. A costly affair in many ways, modern mapping has turned the enjoyment of maps into "graphicacy" (graphic literacy) and "map appreciation," competences that are not innate and must be learned. Basic map literacy requires an understanding of the most important technical features of cartography: graticule, projection, and scale.

Graticule. Derived from Latin *craticula* (fine latticework), this term stands for the lines of latitude and longitude. The Earth's shape and rotation about its axis define the North and South Poles as reference points for the equator, the one and only equidistant *great circle* that is perpendicular to the axis of the Earth. Measured in angular degrees north or south of the equator (from 0º to 90º), the *parallels of latitude,* which are parallel to the equator and perpendicular to the axis of the planet's rotation, form increasingly smaller circles toward the poles. Longitude, however, is not based on a natural but on a conventional feature, the *prime meridian* (half a great circle running from pole to pole). Since 1884 this central meridian has run through the Royal Observatory at Greenwich in southeast London. Meridians are noon lines (A.M. and P.M. stand for *ante meridiem* and *post meridiem*); they are measured in angular degrees east or west of Greenwich (from 0º to 180º) and intersect all parallels of latitude at right angles on the surface of the globe. Thus, the global net of space-lines (parallels) and time-lines (meridians) captures each point on the planet and determines terrestrial locations precisely, which is crucial for long-distance travel, the construction of globes and the drawing of maps.

Projection. As long as the spherical shape and large size of the earth were unknown, projection was not an issue. The problems of projecting the round geobody onto a flat surface emerged once the notion of a "global" earth had gained acceptance (around 350 BCE) and Eratosthenes had computed its meridional circumference (around 250 BCE). If a flat sheet of paper could be rolled into a sphere, projection would be unnecessary. However, the mathematical procedures of projection are unavoidable because flat maps are desired and a sphere cannot be unrolled without stretching or ripping.

Map projection reduces the Earth to a small sphere and then throws parallels, meridians, outlines of oceans, continents, and so forth from that sphere onto a developable surface. Three such surfaces—plane, cylinder, and cone—can be used to receive the data from the scaled-down globe. This operation inevitably distorts some of the information inherent in geographical shapes, areas, distances, angles, and directions. Various projections inevitably distort some of the information on the sphere (e.g., geographical shapes, areas, distances, angles, and directions) and various projections with different properties are possible. A cone touching or piercing the globe and contacting one or two parallels provides a *conic projection* (good for mid-latitude countries); a cylinder wrapped around the equator results in an *equatorial cylindrical projection* (good for world maps); and a plane touching one of the poles makes a *polar azimuthal projection* (good for polar areas). Infinitely more points or lines of contact are possible, yet the general rule that distortion increases with distance from the point or line of contact applies to all. Cartographers and map users must therefore try to find the best match between the intended use of a particular map and the numerous possibilities of projection and distortion.

Scale. The scale of a map controls what a map can or cannot show. Covering small areas, large-scale maps have room for some detail. Yet small-scale maps, which cover large areas, cannot fill their precious space with details. Even a city with millions of people can be too much of "a detail." Huge urban agglomerations like Mexico City are a mere dot on a small-scale map. Conversely, the drawing of an ancient burial chamber showing graves, walls, and entrances requires a large-scale map. The common confusion of "large" and "small" scale misunderstands the mathematical message of the two numbers that constitute the scale of a map. The scale of 1:100,000, for example, brings the map and the ground into a specific fractional relationship: the numerator "1" (which always refers to the map) and the denominator "100,000" (which always refers to the ground) tell the map-literate that one unit on such a map (an inch or a centimeter) represents 100,000-times that unit in reality. The "Representative Fraction" (RF) of 1:100,000 indicates furthermore that this is also a comparatively large-scale map. As ½ is larger than ¼, a one-to-one-hundred-thousand map is much larger in scale than a one-to-one-billion map (which can put the whole world in a logo). A 1:100,000 map can still show the major roads of a city, because one centimeter on this map represents only one kilometer on the ground.



This NASA topographic map of Mars, released May 27, 1999, was created by pulses of laser light beamed at millions of points around the planet from the orbiting Mars Global Surveyor spacecraft.

In preglobal times, the wider world was unknown and the local worlds were familiar. Thus, large-scale maps showed what people actually knew, whereas small-scale maps emphasized what people believed in terms of religion, politics, and philosophy. Now, with the entire geobody revealed and a correct "global worldview" enthroned, the glut of small-scale representations of the Earth has shifted the burden of ideology from the global to the local. The global worldview, which used to be geographically incorrect, is now so "realistic" that it can easily create its own false consciousness of the global whole and its local parts. The global citizen who is map-literate knows about the give-and-take of small-scale mapping (it gives the global and takes the local); but the map-illiterate consumer of global maps is induced to think that the blue planet contains a perfectly smooth and "flat" world that is clearly delineated and neither fragmented nor torn apart by enormous local differences.

Outlook

What is on the horizon of global mapping? As a proven technology in geography and other earth sciences, global mapping has a bright extraterrestrial future. The 1997 satellite spacecraft of NASA's Mars Global Surveyor mission began mapping the red planet in 1999, and the Mars Exploration Rovers—Spirit and Opportunity—began their mission of robotic Mars mapping and geology in 2004. The expanding electronic frontiers of cyberspace have drawn cartographers into the mapping of technoscientific landscapes. Globalizations and glocalizations are beckoning to be mapped, and successful ventures like the mapping of the human genome are suggesting new areas of cartography altogether. However, the truly global future of global mapping seems to lie on the earth in the management of the planet's human and nonhuman resources. From the protection of endangered species to the administration of global cities, and from the pursuit of global capitalism to the organization of earth's ecosystems, the knowledge and power tool of global mapping is ready for a dangerous voyage.

See Also

Global History; Globalism; Globalization; Glocalization; Technology; Territoriality; Voyages of Discovery

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—*Wolf Schäfer*

Marine Pollution

As shipping and land-based economic activity accelerated in the latter half of the 20th century, concern grew among scientists and the public about the effects of pollution on marine and coastal organisms and habitats. Public perceptions (and many policymaker responses) have often been driven by high-profile disasters such as the oil spills from the tankers *Torrey Canyon* in 1967 and the *Exxon Valdez* in 1989. While such accidents may cause severe local environmental damage, they constitute a small fraction of the pollution discharged into the world ocean. Nevertheless, nongovernmental organizations (NGOs) and governments have often used high-profile accidents and events to raise awareness about marine pollution.