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Rasmus Winther’s *When Maps Become the World* is a general philosophy (part 1) of science (part 2) by means of the particular lens that he calls “map thinking” or “cartology.” Map thinking entails much more than the map analogy, long deployed by philosophers of science, that scientific theories are rather like maps. Winther seeks to unpack the analogy: *why* is it that maps and scientific theories can be analogized with respect to each other? Even more generally, Winther explores how mapping is implicated in the very concept of *representation*. The first part of the book explains map thinking and those mapping practices that are exemplary of the processes of scientific inquiry; the second part then elaborates on these processes in a series of case studies of how scientists engage in mapping processes and how they make maps.

This is a difficult book to review for H-Net, and for H-Maps in particular. Despite Winther’s suggestion (repeated by one of the blurbs) that the book is in part a historical overview of mapmaking in the West, it is not actually about history, and certainly not really about the history of maps and mapping. Although published by the University of Chicago Press, which is well known for its extensive list of map history books, the book has been managed by a different set of editors and does not appear on the press’s sales website under “cartography.” This is a work of exposition, not critique. Ideas are developed or presented to construct a grand, logical system, rather than being examined and assessed in detail in order to sustain an argument. In this respect the book is staccato in its structure. It proceeds rapidly in very small chunks that often deal with very big subjects. The treatment seems consistently cursory; the ideas do eventually come together, but in the meantime the reader is left to juggle many disparate thoughts.

The tone, consistently light and breezy, is set by the manner in which each little chunk in part 1—at times no more than six lines—is accompanied by one of three little icons indicating the difficulty of concepts: a sunbathing figure, to flag “easy reading”; a figure swimming just below the water surface, for “philosophical snorkeling”; and a plunging figure, for “philosophical deep diving.” There is little logic to which icons are prefaced to which sections. Their presence suggests that the book is intended for philosophical neophytes, yet there are many chatty asides and extraneous details that are clearly addressed to more knowledgeable readers. As popular philosophy, I am not sure it succeeds.
It certainly does not succeed in its treatment of maps and map history. Winther remains committed to outmoded and deeply flawed concepts of the nature of "the map" that, to be honest, call into question the entire project. Before I can get into this argument, I need first to summarize the book's goals and content, at least as I understand them.

**Map Thinking**

The conceptual weight of the volume lies in part 1. Maps work, Winther argues, because, at root, they are analogous to the world. He does not quote, but could easily have done so, my own favorite definition of a map along such lines: maps are "depleted homologues" of the world.[1] But analogy functions in different ways, so there are different kinds of maps. The literal map is the foundation of Winther's entire edifice: "a map at geographic scales containing at least some geographic objects" (p. 38). From the literal map there derives both the "spatial map analogy," which sustains extreme-scale maps and state-space maps, and the "general map analogy," which sustains the analogous map and (yoking the two analogies) the causal map. Extreme-scale maps operate at non-geographical scales, as in mapping the cosmos, but "still represent physical objects or causal processes in actual physical space." A state-space map is a representation of non-physical space, such as a three-dimensional mathematical surface. A causal map is a diagram that uses spatial placement or flow to visualize non-spatial phenomena, such as the chemical Krebs cycle, a part of a cell's respiration process. An analogous map is a theory or model that, even when not spatial, guides the user. Examples of each of these different kinds of map are later discussed and explicated in the case studies that constitute part 2 of the book.[2]

With these analogies and map types in place, Winther then explores the processes of literal map making and map using. Map making is a process of abstraction, map using of ontologizing. Abstraction is the process by which the map maker/scientist turns the world into a map: calibrating units of linear and temporal measure; collecting data measured with those units; generalizing the data (selecting the kinds of information to be mapped and choice of metric framework; simplifying the collected data; classifying the data into types for symbolization); and exaggerating some elements as needed for the purpose of the map.

Map using is a process of ontologizing, which is to say the process of "map thinking" by which the map user reads the map to construct an understanding of the world. This is Winther's fundamental concern and explains his title: ontologizing is how maps (generically, analogously) are turned into the (user's understanding) of the world. This is, Winther posits, a multistage process. At a naive level of map use, users read the map and take the map to be equivalent to the world. This state he calls "pernicious reification." Less naively, Winther argues, it is possible to attain "contextual objectivity" through "integration platforms" by which multiple maps/models/representations of the same phenomenon are provided and appreciated. Ontologizing rests on the user imbibing the map as a representation, which rests on both isomorphism and similarity (icons and mimesis). Ontologizing further entails naive "seeing merely as" (limited, leading to pernicious reification) or "pluralistic ontologizing" (expansive, leading to contextual objectivity). In part 2, Winther works through a series of case studies to show how the provision of integration platforms allows individuals to rise above personal, subjective, and perniciously naive understandings to attain contextual objectivity. All told, Winther addresses profoundly important themes in the natural sciences and philosophy: epistemology, ontology, subjectivity, objectivity, achieving communal consensus. This is an ambitious project, indeed!

Winther gives a first explanation of integration platforms by means of a history of the famous Mercator map projection. First of all, the projection was itself an integration platform, combining
as it did different ways of mapping the world. On the one hand, there was the projection of the earth's surface as a system of latitude and longitude, as explained by Claudius Ptolemy in his second-century CE *Geography*, as adopted in Renaissance Europe. On the other, there were the portolan charts of the Mediterranean Sea that were extended to the Atlantic coastlines of Africa and Europe; these were structured around rhumb lines and did not account for the curvature of the earth's surface. The map projection that Gerhard Mercator used for his large world map of 1569 combined these two geometrical structures in a single map. The price, of course, was that the earth's geography rapidly distorted in size away from the equator; each pole, famously, is located at an infinite distance from the equator. This map became the European worldview—and was perniciously reified—until challenged in the second half of the twentieth century, notably by Richard Edes Harrison and Arno Peters. Winther mentions the proliferation of map projections designed in the twentieth century and suggests that a clear exposition of the different ways of mapping the world—different map projections, non-Western mapping strategies—would constitute a further integration platform to ensure that people in the present know that the Mercator projection is just one way, not the only way, to map the earth.

**Map Problems**

Given the huge intellectual stakes involved, it is a shame that this foundational example is wrong. That Mercator sought to overturn all other previous kinds of mapping system is quite uncertain, and all of Winther's claims concerning what Mercator generally thought and wanted to do are not supported by any references to Mercator's writings. The argument rests solely on inadequate secondary sources. The idea that Mercator's map projection was widely and rapidly adopted to become the Western world map (Winther states that it "soon became ubiquitous and ironclad in its perceived authority," p. 100) is in fact a myth created by nineteenth-century historians enamored with the Renaissance as the literal rebirth of rational thought; Peters and his partisans exploited this myth in order to promote his own world map projection. Sailors loathed Mercator's projection because it was unusable with their navigational technology; sea charts were consistently drawn on the projection only after 1800, with the implementation of two methods for readily determining longitude at sea (lunar distances as well as the chronometer, the latter of which Winther implies was the sole technology) and with the rise of modern hydrography and the complete reexamination of coastal waters. The most common geographical world map before 1800 was the transverse (equatorial) stereographic in two hemispheres; in the nineteenth century there were as many double-hemisphere world maps (although now on the so-called globular projection) as there were on Mercator's projection, and geographers increasingly created and advocated other map projections for mapping the world and especially for mapping global distributions of physical and human phenomena. The period of Mercator's dominance was basically only 1917 through 1945, and it was rapidly challenged by many during and after World War II, who distributed many guides to the general public about the merits of competing map projections. All this is to say, the history is much more complex and less applicable to his philosophical principles than Winther can allow. Winther himself rehearses a well-worn "history" grounded in assertion, myth, and cliché.

Indeed, Winther's whole philosophical edifice rests on a cursory understanding of the nature of literal maps, map making, and map using. Winther, in effect, suffers from his own pernicious reification.

Specifically, Winther presents an understanding of the "literal map" that was defined only in the nineteenth century, that held sway in the twentieth, but that has been resoundingly challenged since 1980. The processes of map making
began to be idealized as a singular and universal endeavor in the early nineteenth century, as marked by the acceptance in the 1820s of the neologism of cartography and by the first forays into the “history of cartography” after 1840. The ideal comprises a web of preconceptions and convictions about what maps are and how maps are made, a hegemonic belief system to which all analysis of how and why maps are made must conform.[3] In other words, even as humans have engaged in a wide variety of practices by which to comprehend and communicate their understandings of spatial complexity, academic and lay commentators alike have forced them into a conceptual straitjacket. Those preconceptions are still largely unrecognized. The ideal has manifested in particular in the presumption that it is meaningful to talk about “the map” as a coherent and unambiguous category of things: this is a map, that is not.

The ideal’s preconceptions are rampant in When Maps Become the World, but remain unrecognized and unexamined. The idea of the analogous map rests, for example, on the preconception of efficacy, which maintains that all maps are somehow about navigation and guidance. Winther is able to suggest that all maps are so efficacious because his discussion focuses on high-resolution topographical mapping (especially a US Geological Survey topographical quadrangle of San Francisco Bay) and on world maps that are characterized by the Mercator projection, which is presented as a solution to navigation. Winther pays lip service to other kinds of map, but barely thinks through what they entail; they are all guides to physical space or to social space (as in the case of the few other literal maps, such as those of the former Levant that he does discuss). As with the rest of the ideal, the preconception of efficacy is a strictly modern development, stemming from the rise of technologies of personal mobility in the later nineteenth and early twentieth centuries.

Topographical plans and world maps exist at the two spatial poles of most mapping practices—the detailed and the global—and all other literal maps exist in between on a continuum of scale reduction. Winther also rehearses the “Powers of 10” schtick, of zooming in and out from a couple on a lawn (p. 73), making the human couple the anthropic midpoint between the entire universe and the atom and insisting that all literal maps are measured and scaled reductions of reality.

The two kinds of map sustain crucial claims for Winther’s philosophical system. The world maps permit Winther to talk about projections and the interchangeability of graphics and mathematics. The analogy of maps to scientific theories is bolstered by the manner in which “map projections can be represented geometrically or visually” (p. 113), which is to say as both some mathematical functions \( x = f(\lambda, \phi), y = g(\lambda, \phi) \) and as a plot of meridians and parallels; the formulae and the plot express the same concept (i.e., mapping). This conceptual unity is essential for both the “general” and the “spatial” map analogies, but the unity is historically contingent rather than a logical or philosophical axiom; its ontological veritude of the map as a mathematical model rests on C. F. Gauss’s geometry and, later in the nineteenth century, set theory (as Winther does recognize, pp. 169–74).[4] At the same time, the existence of different map projections suggests the multiplicity of mappings, within and between cultures, of “worldviews.”

Topographical maps permit Winther to demonstrate the observational basis of all maps. Winther accepts without question that the literal map is necessarily based on observation, and especially on observation from above. Indeed, he starts a couple of chapters with short vignettes about a plane trip and how the world looks from close up, on the ground, and from up in the air (esp. p. 59). If a work is not a scaled reduction from surveyed information, then it is not a map.

In addition, Winther seems to rely on the ideal’s individualistic preconception: maps might
be made for social reasons, but they are made and read by individuals. A key fallacy of the ideal is that maps are direct externalizations of the individual map maker's internal cognitive spatial schema. There has accordingly been much confusion between the two, enabled by the sloppy use of "mental map" to mean: a) internal, neurological concept, also known as "cognitive map" (with the understanding that this is only a metaphor); b) the sketch map drawn by an individual; and c) a researcher's visualization of spatial conceptions held by a discrete population. Although "b" is heavily mediated by socioculturally defined practices, it is held to be the same as "a" (so that one can judge the quality of an individual's cognitive development according to the maps that the individual makes). Winther, too, insists that maps, literal and scientific, are about human experience and the externalization of the individual's deep mapping (p. 30).

Winther allows his "literal map" to be defined by commonsense notions of what maps are by refusing to define them. In his first chapter, he chats about the various ways one might define a map and about the various aspects that maps present, but he does not actually define "map." When he does suddenly advance a definition, he does so without flagging that he is changing the terms of the discussion. He basically throws up his hands at the idea of defining "map" and instead defines mapping (p. 14). I can see, having read the rest of the book, why he made this change, but for such a rhetorical move to be made by a philosopher is, frankly, frustrating. And without defining his terms, the idea of "map" is un/underdefined and all the ambiguities and presumptions of the ideal of cartography flood right back in to muddy the intellectual waters.

Winther thus remains "caught within the metaphysics of presence which presupposes some foundational object against which the distortions and interpretations can be measured: that some interpretation-free image could be produced that does not distort the world."[5] He embraces "the odd faith in the 'miracle of mapping.'"[6] In this perspective, literal maps are necessarily reductions of the environment. They are made or updated when the environment changes (pp. 84, 87). Their production is algorithmic, reducing the world according to map scale. And they are read algorithmically. They are not human documents to be actively interpreted by their consumer. Rather they are statements that determine the user's ontologizing.

The distinction between abstraction (making) and ontologizing (using) manifests the ideal's material preconception: map making is a practice that leads to the creation of a material thing, the map, which is then acquired by the user, who reads it. That is, all cartographic actions fall into two grand epochs, before the map and after the map, and they are violently divided by the map. The relationship is thus all one-way. The map maker invests the map with semantic potential, determines the map's meaning, gives the map agency. The map is then imbibed by the user, who is directed by the map (and apparently nothing else) to understand the world. The map user is a passive consumer of the map's content. This model says absolutely nothing about how map users actively engage with maps, and is quite antithetical to the actual manner in which map makers and map users are in fact part of the same discursive communities.

Winther sustains this idealized perspective by relying on literature from academic cartography that hews close to the ideal. In one of the few sociocultural critiques that Winther cites, Brian Harley argued that map historians had been misled by believing what academic and practicing map makers had said maps were.[7] Harley's criticism applies to Winther. He uses older literature and relies heavily on undergraduate textbooks, all of which are products of the ideal. He does make extensive use of Denis Wood's work, yet it must be acknowledged that Wood is as committed to the
specialness of modern maps as the established academic cartographers that Wood has railed against.[8]

At times, Winther states that map thinking is not algorithmic (as p. 6), but the needs of his philosophy of science requires that they be so. He seems to bend even the academic literature that he does use to ensure that his understanding of mapping practices aligns properly with his understanding of the natural sciences. He misuses “cognitive map” for sketch maps, conflating the neurological schema with a thoroughly mediated externalization. He bungles how his cartographic authorities use “iconic” and “mimetic” symbols. His broader understanding of semiology and Charles Saunders Peirce’s differentiation of icon, index, and symbol seems confused; he seems not to appreciate that there is a deep divide in the cartographic literature between dyadic (Saussurean) and triadic (Peircean) sign models, with Wood on one side and Alan MacEachren on the other.[9] He makes a revealing statement on p. 79, that “the most abstract map would have few or no signs,” a statement that makes absolutely no sense, however one defines “sign.” Again, even if one accepts the textbook definition of “cartographic generalization,” as Winther elaborates, one must also accept that he warps the idea by including issues of metrical structure (pp. 74–77) and by mangling “selection” (p. 70).

And, to wrap up this litany before it becomes too extensive, I have to observe that Winther’s deployment of map history is shallow. As the example of the “history” of the Mercator projection suggests, he has relied more on common knowledge than a careful review of the recent literature. A few examples will suffice. The Cassinis’ surveys of France in the eighteenth century did not entail trilateration (p. 63). It was all triangulation, the measurement of angles between sightlines forming triangles across the landscape; trilateration means that only the distances from tower top to tower top would have been measured, an act that was impossible in the 1700s. Ptolemy did not describe the orthographic projection in his Geography (p. 99); nor was his second projection an equal-area projection (p. 76).

From where I sit in the humanities, I find Winther’s description of maps and map making to be not just stilted and limited, but parodically ahistorical and acartographic. His simplification seems required by his larger exercise in the philosophy of science, which sees “science” as a strict practice rather than a messy and contested arena. The logic is, at root, circular. Regardless of what philosophers of science might think of this ambitious exercise in grand thinking, I cannot recommend it as making any new contribution to ideas about maps and mapping or to any discussion of map history.

Notes
[2]. In many respects, the examples that Winther provides in the case studies of part 2—extreme-scale maps of cosmology and genes; literal maps of geological space; state-space maps in physics and physical chemistry, analogous maps in mathematics, and causal maps in neurology and migration, etc.—make this a more philosophically structured exploration than Stephen S. Hall’s popular Mapping the Next Millenium (New York: Random House, 1992).


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