or to refresh my memory of the mathematical development of Snyder's complex polynomials. While nothing replaces original sources, the consolidation is genuinely helpful.

I would choose this title for many reasons if I were to teach a course in map projections. For one, the pedantic text relieves a student's common frustration: what does the author mean by this term? Is it specialty nomenclature, and if so, what is its definition? Or is it meant in a more general sense? That same pedantry relieves the teacher of having to grant students leniency when they wheedle for credit based on an incorrect but (barely) plausible interpretation of the text. If the student did not get it, you can't blame the author. For another reason, the sequential development of the mathematics offers a natural curriculum for the course. For yet another, the tutorials sprinkled around the text assist the student in practical ways, ridding them of the need for a companion text on mathematics. And last, the book's execution is good on all counts: written well, designed intelligently, methodical, paced evenly, indexed and referenced well, and otherwise considerate of the reader's needs.

While one must be wary of treating any text uncritically — and the Compendium does not come without errors — I welcome Dr. Fenna's contribution to my library. I hope it wears my red annotations with honor.

The Natures of Maps: Cartographic Constructions of the Natural World
Denis Wood and John Fels
Chicago: University of Chicago Press, 2008.
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Reviewer's note: This review was based on page proofs received in August 2007 from ESRI Press. Minor changes that typically occur in the final preparation of the book make it likely any page assignments to quotes included in this review might change slightly. Precise attribution of quotes from the proofs have therefore not been included in this review.

Maps of Nature / The Natures of Maps

In 1986 Wood and Fels disassembled the map, describing ten codes through which its signs create meaning. Their argument was subsequently enfolded into Wood's *The Power of Maps*, one of the best selling books on mapping in recent decades. Twenty-one years later, Wood and Fels have put the map back together again "by replacing the whole idea of the map as a representation with that of the map as a system of propositions." In their new text, Wood and Fels insist that "The map is not a picture." Instead, they assert, "[i]t is an argument [; …] everything about a map, from top to bottom, is an argument."

The argument that maps are systems of propositions is made in two brief introductory chapters and then applied across nine subsequent chapters whose subject is nature and the natural world as constructed in more than fifty maps, typically a *National Geographic Magazine* supplement to a USGS map. Chapter titles, often echoing map titles, reflect the way the maps construct nature: "Threatened Nature," "Threatening Nature," "Nature as Cornucopia," "Possessable Nature," "Nature as Science," "Nature as Mystery," or "Nature as Park."

Each chapter proposes a view of nature that is instantiated in the maps. Because maps are *objects* in which the *subject* of nature is explored, the power of the argument is lodged in the maps whose unpacking reveals nature as "something drawn not from the world but from the minds of men and women; for maps are made not of wildlife, earthquakes, hurricanes, mountains, canyons, birds, but of signs–these themselves composed of marks and concepts. The map: a field of concepts." In that field two perspectives contend: Nature is not simply the maps' subject, but the maps are objects within which different conceptions of nature contend. This is elegant and subtle, a conjunction of subject and object that argues the nature of maps through maps of nature. Both the argument and its form are unique. Nothing like this has been attempted in cartography before.

To say it is unique is not to suggest its ideas are new but that they have never been applied in this way before to maps. The authors bring to their study a perspective that has been well articulated in the sociology of scientific knowledge by scholars that include, in a partial list: Ian Hacking (*The Social Construction of What?*), Bruno Latour (*We Have Never Been Modern*), Andrew Pickering (*The Mangle of Practice: Time, Agency and Science*), John V. Pickstone (*Ways of Knowing: A New History of Science, Technology, and Medicine*), Hans-Jörg Rheinberger (*Toward a History of Epistemic Things*), and especially Steven Shapin and Simon Schaffer (*Leviathan and the Air-Pump*).

Wood and Fels' goal is not, as David N. Livingstone's book title had it, *Putting Science in its Place: Geographies of Scientific Knowledge*, but putting mapping *into* science as a tool not of illustration, but of substantive argument, a tool of what the history of science folks call "knowledge creation." The map becomes the workbench on which ideas about nature are hammered out, not a frame in which the inhuman world is displayed. Nature is human, Wood and Fels argue, and so are the maps that present its many faces.

The core idea of the book is an axiom asserting that maps are constituted of fundamental propositions that take the form, "this is there." Such propositions make the dual claim that some thing (person, Koala bear, ocean current, tree) or quality (disease, health, drought, rain) exists and, secondly, that it can be located on a map. This fundamental "posting" as Wood and Fels call it, gives the map its ability to establish relationships between things in the map: "To claim that *this is there* is to make a powerful claim precisely because it implies the ability to perform an existence test: *you can go there and check it out*." This "map logic" is unfolded in a "spatial/meaning calculus." The conclusion is that maps assert a reality that is observable, a reality that is testable, but a reality that, at the same time, remains a construct we self-consciously create.

In this fashion the authors transpose the map from a medium apart from science to one that is inherently scientific. Argument, proposition, and testing have been the principal procedure of science since the seventeenth century: the world is known through observations and tests. These observations and tests constitute arguments submitted to knowledgeable outsiders whose confirmation establishes them as facts. Insisting that this is also the *modus operandi* of maps transforms mapping into an active intellectual enterprise, into a science that creates knowledge.

Whether the map subject is endangered species in Australia or the fracture lines of the earth's tectonic plates, mapping establishes the subject as real: *this thing* (a Koala bear, the Pacific plate, a storm track) *is there* (in Australia, on the U.S. coast, moving across the Midwestern states).

The semiotic codes first described by Wood and Fells in their 1986 paper now serve to instantiate their postings ("a 'this' is 'there'"). The authors use, but do not dwell on, cognitive linguistics as an interpretive tool. They propose a "cognitive cartographics" in which "mental maps" are replaced by cognitive, mental spaces as a flexible frame within which meaning is constructed. That construction is played out in the layout of the map itself. As Wood and Fels argue, "The principles underlying the graphic design of maps, far from being essentially aesthetic, are wholly at the service of the map's construction of knowledge, a construction built in real time by the map readers and typically validated on the spot (as evidenced by its use)." Within this framework it is impossible to say, as generations of cartographers have, that, "A map is a graphic representation of spatial relations (or relationships in/across/through space)" (Vasiliev 2006). Instead, maps by Wood and Fels' definition present arguments in which relationships are proposed, creating a world that results from the mapmaker's decisions rather than merely reflecting one outside the mapmaker's control.

Finally, Wood and Fels argue that the map image itself cannot be understood except as embedded in a *paramap* "that surrounds and extends a map in order to present it." The paramap consists of the *peri*map (elements of which include ancillary maps, legends, scales, and so on) and a broadly conceived *epi*map including the article within which a map may be embedded. For example, John Snow's famous map of Broad Street cannot be understood outside the context not only of its design but also of the publication in which it was embedded. The map at once confirms the reality of the subject (cholera) as it draws authority from the text with which it is associated (Snow 1855). Again, Wood and Fels borrowed the idea, this time from the literary critic Gerard Genette (1997), but its use with maps is novel and powerful.

The Natures of Maps demands first-rate maps as exhibits because the argument about the nature of maps is made through close readings. As noted, most came from the National Geographic or the USGS, and they're spectacular. *The Natures of Maps* was developed under contract with ESRI Press, which, fortunately, was willing to present the maps in this oversize book in full color and glorious detail. ESRI also provided a talented designer, Savitri Brant, who is almost a third author. Her layout advantages the maps, and so the text as well. As a result, the book is intelligent *and* drop-dead gorgeous; turning the project into an art book as well as a theoretical study of maps and nature.

Last October, however, ESRI Press was reorganized and over a dozen books under contract were dropped. This occurred weeks before Wood and Fels' project was scheduled for production. Four different presses almost immediately expressed interest in picking up and publishing this volume, and the University of Chicago won the contest for its publication. *The Natures of Maps* fits nicely within its catalogue of works on the history of cartography and cartographic applications to different disciplines.

Many will be grateful for, though I regret, the failure to expand on the transposition of cognitive linguistics into the cognitive cartographics promised but never really developed. The idea, as presented in early chapters, is a way around the problem of "mental maps" filed in the brain and the limitations of the Piaget-based developmental psychology with which they have in the past been argued. The idea is so potentially useful that its promise needs exploration and could perhaps have been better expanded in an additional chapter.

I also wished for a chapter on some of the ramifications of this concept of maps as self-conscious constructs arguing elements of the world. Perhaps the most critical lesson for the professional mapmaker is the degree to which Wood and Fels' argument insists that mapmakers are responsible for the way in which

their maps *build* worldview rather than simply "reflect" the world. *The Natures of Maps* underscores but does not discuss the disconnect between the map and the mapmaker's responsibility for it (Koch 2006). With the idea of maps as representation it was easy to disassociate the mapmaker from the map ("It's just the way the world is"). If maps are arguments, then mapmakers are more than illustrators and are, in fact, responsible for the conclusions their work promotes.

No one book can say everything. It may be a strength of this one that the ramifications are lightly sketched and the theoretical deftly articulated but not hammered in on every page. Wood and Fels let the maps make their argument, creating the reality they propose. It's a beautiful book and one whose propositions will be the source of ideas, articles, and books for years to come.

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