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Janet VERTESI, *Seeing Like a Rover: How Robots, Teams and Images Craft Knowledge of Mars* (Chicago, University of Chicago Press, 2015)

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Janet Vertesi's *Seeing Like a Rover* is a phenomenological *tour de force*. It analyzes in great empirical detail and theoretical sophistication the work of the Mars Exploration Rover team, which carried out NASA's epic mission to find water (and possibly life) on Mars. Vertesi spent over two years in multiple sites, documenting team members' work, observing videoconferences and meetings, interviewing scientists and engineers, and working as an image calibrator. She was present when scientists gradually came to the conclusion that they had found signs of past water on the planet, and her account analyzes how this and other conclusions emerged from the team's practices of producing, processing, and interpreting images from *Spirit* and *Opportunity*—two robots ("Rovers") that NASA launched to the planet.

The book represents the 40-year-old genre of *Laboratory Studies* at its best. It not only shows that human agency is a core constituent of scientific representations, but also illustrates how collective practices of seeing and knowing bond a scientific community together and condition its members' cognition. As Vertesi argues, Rover scientists can create infinite images of the same Martian terrain by using different combinations of camera filters, assembling images in false, true, or partially true color, and manipulating images' color and contrast digitally. Rather than studying Mars as passive onlookers, who merely observe the photographs that their cameras capture, scientists actively draw and redraw the planet in ways that disclose new features in it and conceal others. "There is no one best way of picturing Mars" [78]: how scientists do it depends on their professional interests and needs—what they want to emphasize (e.g. differences in soil color tones) and deemphasize (e.g. blur from dust). The limits of what scientists can legitimately do with an image are set by scientific communities' conventions, the technical properties of the Rovers and their cameras, and the software packages that the team uses.

As a scholar of imaging and imagery, Vertesi conveys these arguments using stunning visual materials. The book could very well be one of the most aesthetic publications in our discipline's history although,

admittedly, it does not have many competitors.<sup>1</sup> Beyond their sheer beauty, the images in the book take readers through an embodied experience of learning how scientists look at Mars. By the time I reached the end of the book, I could detect in the images details I was unable to see when I began reading. Like the Mars Exploration team, I learned how to see like a Rover.

All of these insights have immense analytical potential but, at various points, I felt the book did not push them as far as it could have. Vertesi chose a rather weak target to challenge: “what is at stake,” she wrote in the introduction, “is our understanding of images in science. [...] It is all too easy to assume that scientific images show exactly ‘the things themselves as they appear’ without paying attention to the considerable work it takes for scientists to reproduce such pictures” [8]. The text she quoted is from *Micrographia*—a 1665 monograph by Englishman Robert Hooke, which included lengthy verbal descriptions and multiple images of small items he observed with a microscope. When the argument is formulated in this way, some of *Seeing Like a Rover*’s analytical power is spent refuting naive and outdated seventeenth century empiricism: Vertesi smack a cockroach with a grand piano.

This piano is in fact playing a very elaborate symphony, which is worth discussing and considering. For one thing, it signals a rather unlikely turn toward Durkheim, who has been unpopular in Science Studies during long years of being the *École Des Mines*’ favorite punching-bag [Latour, 2005]<sup>2</sup>. The analysis in *Seeing Like a Rover* shows how much Latour lost when he relinquished Durkheim: Vertesi shows us that the Rovers acquired a totemic status, imbued team members’ cognition and identity, and became the center of a large community of scientists, engineers, and even laypeople who were charmed and inspired by one of NASA’s most romantic scientific excursions to date. Vertesi also shows how shared ways of seeing, knowing, and experiencing—aka collective consciousness—are the building blocks of collectivities, and how analyzing the non-human and material elements of collective consciousness (e.g. camera filters) does not contradict, but enriches Durkheim’s perspective.

More controversially—and also along the Durkheimian line—the book breaks with a long Science Studies tradition of analyzing

<sup>1</sup> Lorraine Daston and Peter Galison’s *Objectivity* (2010, New York, Zone Books) would have been a serious contender had they not been historians.

<sup>2</sup> Latour Bruno, 2005. *Reassembling the Social: An Introduction to Actor-Network Theory*, Oxford, Oxford University Press.

controversies. This theoretical move is of utmost importance; the book acknowledges it, but does not elaborate on its significance. The clashes between Pasteur and Pouchet, Boyle and Hobbes, and Eddington and Miller became cornerstone case-studies (Latour 1988;<sup>3</sup> Shapin and Schaffer 1985;<sup>4</sup> Collins and Pinch 1993,<sup>5</sup> respectively) not only because of their historical significance, but also because they provided researchers with empirical counter-factuals (or rather, factual counter-factuals). Studying controversies had the advantage of taking scholarship back in time to moments when undisputed facts were still disputed and what ended up being wrong was just as real as what ultimately became factual.

Vertesi's account, however, is all but devoid of controversy. The scientists she followed were predisposed to reach agreement about everything, usually before conflict arose, and the team's social organization resembled an anarcho-syndicalist utopia. Besides operating the Rovers, the team also had the goal of "achieving unity of opinion and purpose and maintaining the commitment of contributors." The team "betray[ed] a collectivist orientation consistent with commons-based, participatory, or postcommunitarian systems" and "demonstrate[d] a flattened structure with few levels of management between members" [15-16].

Similar collaborative orientations have been documented in other big science projects (e.g. Knorr-Cetina, 1999<sup>6</sup>), but notice how counter-intuitive it is in Vertesi's field-site. After all, the Mars Exploration Rover team recalls a bizarre Zimbardo-style experiment. 150-some scientists of various disciplines—presumably, all as ambitious as people working on the cutting edge of planetary science can be—have to decide together how to use a very scarce data collection resource. (The Rovers could send and receive limited amounts of data, and every command from the control center—as every image that the Rovers sent back—cost bytes.) Scientists who had an interest in different questions and wanted to take different photographs of different sites had good reasons to be in conflict with each other, especially because the engineers responsible for navigating the Rover between rocks and around cliffs already consumed much of the available data.

<sup>3</sup> Latour Bruno, 1988. *The Pasteurization of France*, Cambridge, Mass., Harvard University Press.

<sup>4</sup> Shapin Steven and Simon Schaffer, 1985, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life*, Princeton, Princeton University Press.

<sup>5</sup> Collins Harry and Trevor Pinch, 1993, *The Golem: What Everyone Should Know About Science*, Cambridge, UK, Cambridge University Press.

<sup>6</sup> Knorr-Cetina Karin, 1999, *Epistemic Cultures: How the Sciences Make Knowledge*, Princeton, Princeton University Press.

Imagine a sociology department where faculty and graduate students had to collect data together and whose data gathering capacities were limited to, say, two surveys of 500 respondents, 30 archival dossiers, and 20 days of participant observations a year. The department's historical sociologists could access additional dossiers only at the expense of its ethnographers' participant observations and its demographers' surveys, all while extensive construction works to strengthen the sociology building's foundations were eating into everybody's datasets. Faculty in this department would kill each other, which leaves one wondering why the Mars Exploration team members did not.

The book mentions several instances where conflict and disagreement did surface, and documents how the team settled them [Chapter 5]. But can't the settlement of conflicts—or their complete absence—itsself be an expression of power and social domination? Vertesi recognizes this possibility, writing that “some individuals dominate conversations while others remain silent; [...] minority voices are effectively silenced as the pressure to agree and not speak out against the group norm becomes coercive.” But at the same time, she insists, “Rover team members have developed their own internal structure, rules, and roles for combating these inefficiencies” [16].

I do not (and cannot) challenge this statement empirically. Clearly, achieving consensus and orienting group dynamics toward agreement was central to the team's work, perhaps because the complete dependence on two robots and the limited data they could collect made collaboration imperative. Indeed, Vertesi's ethnography documents very convincingly how Principle Investigators made it routine to wait until all team members confirmed that they were “happy” with the decisions made. But I am left unsatisfied with the possibility that underneath this consensus lurked an unobservable history, in which discussion was narrowed and certain actors were excluded.

The book mentions several important details that may indicate such a history. First, when NASA launched the mission, it was interested in a very particular goal—finding water—and therefore its engineers installed “instruments to approximate a geologist toolkit” [11]. Data collection tools had a very particular disciplinary affiliation, which was probably the outcome of struggles that NASA's hierarchical system settled before the mission began. Second, scientists who wanted to participate in the mission to Mars had to submit research proposals to NASA's committee—another hierarchical organization, which accepted few and rejected many. Third, the Rover team was international and had sites in four countries and two continents. At the same time, the

continents—North America and Europe—and the countries—the U.S., Canada, Germany, and Denmark—left out the majority of the world’s population—the very same majority that other global projects regularly exclude. Fourth and finally, the three photographs that Vertesi took in a meeting of the mission’s leaders [138–139] show no person of color and only a handful of women. In one endnote, Vertesi acknowledges that some hierarchy did exist within the team: “A single Principal Investigator leads the team: *he* is a charismatic personality who, through *his* work with the Rover team, has become a well-known figure in NASA science and politics” [263, fn 23, emphases mine]. The book does not tell us much about the Principle Investigators’ sociological background—their gender, race, and nationality—but in case the use of male pronouns here is not accidental, it signifies a sociologically meaningful difference. It is possible, for example, that the expectation to collaborate and reach agreement in all circumstances would be applied differently to women and men—and that women who voiced minority or dissenting opinions (e.g. p. 5, p. 38, p. 145) were held to different expectations in relation to the group’s consensus, compared to their male colleagues. It is also possible that men appropriated charismatic qualities more easily and were more likely to bear the power to shape consensus.

Since the book does mention cases of disagreement among researchers, its general focus on consensus appears to derive from a theoretical-methodological decision rather than an empirical finding: “instead of hunting for the moments when consensus breaks down and politics rears its ugly head, then, I chose instead to treat the building and management of consensus” [17]. I suspect that this decision reflects a stance that many Science Studies scholars have embraced over the past decades, replacing epistemological questions with ontological ones. Along this line, Vertesi does not evaluate the relationship between scientific representations and reality, but studies representations *as* realities, which scientists construct just like builders construct roads, houses, or bridges. Within this framework, it is very difficult to analyze disagreement, doubt, conflict, tensions, and clashes among team members as constituents of the representations that were ultimately produced, and much easier to take them as “inefficiencies” (see above)—mere obstacles to research that scientists eventually overcome. Facts (or representations) do not triumph over other facts—they simply evolve, at times in torturous processes, from scientists’ discussions and actions.

When the story we tell is a story of consensus building, we are therefore at risk of forgetting not only the people who challenged

consensus at various points, but also those whose challenges were so incommensurable with the science that ultimately prevailed that they did not survive to be observed by an ethnographer. I do not mean to argue that this book draws conflict as consensus, or domination as social cohesion, but that its analysis may have begun after some of the controversies were already settled, perhaps forcefully. Put differently, when one follows how Rover scientists see and draw images, one self-limits to studying consensus building—because by the time people get to focus on seeing and drawing, challengers have already been eradicated. Studying controversies is not possible not because challengers are silenced, but because they no longer exist.

The fact that this book highlights fundamental conundrums that the entire Science Studies field is facing testifies to the significance of its contribution. Vertesi's powerful ethnography and the clarity of her thinking make *Seeing Like a Rover* a most thought-provoking milestone in the field. It is a thoroughly enjoyable and inspiring read, which shows how powerful sociology can be when it analyzes the production of hard science.

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