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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, pp. 304

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This is a book that I read with pleasure. It captured my imagination. And, I must admit, it wasn't fun when one of the rovers died. Alone. In the Martian desert. By that point, I had become almost convinced that I too could "see like a rover."

"After you've worked with the team for a while," says an informant, "you kind of learn to see like a Rover." The team is the Mars Exploration Rover Team, and this book studies what does it mean to say that a human member of the team can learn to see how a machine. To address this question, Vertesi take us on a step-by-step journey through the image-making practices that produce those familiar reddish Martian landscapes. The outcome is a well-crafted, highly textured ethnographic account of how the team works with the digital images sent back by Martian rovers. The reader learns how these scientists and engineers make sense of the images, manipulate them to make them "more objective," and use them to orient their action at a distance. A very long distance indeed.

Vertesi does a great job in mobilizing relevant work in the history of science and science studies, centering each chapter on a powerful insight. Her story vividly reminds us of the theory-ladenness of observation, the conventional and local nature of objectivity, and of the fact that scientific images, including photographs, are always and necessarily constructed. It reminds us that instrument calibration is an eminently social process, one that is as much about people as it is about machines. On this particular point, Vertesi goes beyond the narrative of alternative kinds of objectivity, to engage with the process of calibration as integrating machine work and human judgment, in a way that gestures interestingly toward recent

STS work on machine learning and the concept of the mechanizable.

A few main themes run through the chapters of the book. One is an understanding of knowing and visualizing as embodied processes. Vertesi engages with notions of embodied skills and priorities in the making of scientific knowledge, and brings them into Martian territory. Hence her interpretation of the team drawing Mars as something that makes sense to them (e.g. constituted by different kinds of surfaces), which builds on Wittgenstein's notion of "seeing as." There is plenty of body talk when it comes to the rovers and their cognitive as well as physical achievements. It is fascinating to see the way members of the team end up identifying themselves with the rover they are following - not just its mechanical eyes, but its mechanical body as well. The rover is truly a member of the team, and when it gets stuck against a rock, or one of its mechanical arms doesn't work properly, its human colleagues would express and discuss the problem through their own bodies, in a natural, unthinking, and very effective way. I have found these ethnographic passages enlightening, and more convincing that, say, yet another ponderous reflection on the non-human.

Another major theme is captured by the iconic image, at p. 180, from Thomas Hobbes' *Leviathan*: the king's body as composed of its subjects' bodies. How not to think immediately to the rover as an air pump of the 21st century? In fact, all chapters grapple, from different vantage points, with a fundamental insight: making technoscientific knowledge about Mars means stabilizing a particular kind of social order. Each single technical choice made by the team is *also* a micropolitical choice - and it has to be so in order to succeed.

One of the most memorable passages, in this respect, is the description of the "happy" ritual in chapter one. At the beginning of each Martian day, the team gathers to go through the activities planned for that day. Resources, including time, are limited, and choices need to be made about how to allocate them. Not all experiments can be performed, and not all routes can be pursued. There might be tensions within the team - for example between scientists, whose priority is to collect information, and engineers, whose priority is the survival of the rover. But even among the different subgroups, say the geologists, one detects different disciplinary agendas that can produce conflicting expectations. The rover will not move until each team member has confirmed that they are "happy" with the plan. There is a precise social mechanism to register consent, and it is also clear how to proceed if someone is "not happy."

Vertesi draws on a venerable tradition of understanding knowledge as a collective phenomenon that has its champions in Wittgenstein and Durkheim. One of the reasons why her case-study is so effective in making this point lies in the nature of the team: it's large, international, disciplinary diverse. These conditions make the work necessary to align interests and perceptions particularly *visible*. The social dynamics of the team are designed to establish consensus and allow goal-oriented action. The

digital images are a site for these negotiations, and the way they are seen it's their final outcome. That these images show something clearly, or tell the team what to do, is indeed the *outcome* of a social process, not its beginning. An image can show something *clearly* only if the alignment has been successful.

Interestingly, Vertesi has not chosen the case of a controversy over digital image making or interpretation. Instead, she describes the mundane operations, the daily rituals that are constitutive of seeing like a rover or, and it's one and the same thing, of being a legitimate and well-behaved member of the team. Rather than focusing on breakdowns and crises, she looks at normal science, the daily routine of making sense of images of Martian things. And it is precisely through the inspection of this routinized, normal procedures that one sees how normativity can only emerge and be sustained by the coordinated activity of concept application carried out by the team, through rituals of perception alignment and mutual symbolic sanctioning.