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Knowing as Distributed Practice: Twenty-first Century Encounters with the Universe

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ABSTRACT
Knowing, Karen Barad argues, is a distributed practice in which humans participate in larger material configurations. This text looks at how humans participate in practices of distributed knowing, starting from a proposal for a twenty-first century planetarium developed by Flemish artist Eric Joris and his company CREW. Joris' planetarium demonstrates the potential of technology to address what Mark N. B. Hansen terms 'the organism's power of imaging': an existential potential of comprehension that is grounded in the embodiment of the organism. The planetarium thus mediates in ways of knowing the universe that are situated (Donna Haraway) in embodied experience with movement and spatiality, and affords humans to participate in an unfolding of articulations of space. This allows for a non-representationalist approach to knowledge transmission that acknowledges the inseparability of observed object and agencies of observation (Barad). Instead of showing the solar system as a stable object of a vision from nowhere, the solar system emerges as what Federica Timeto calls a technospace: a dynamic and contingent formation whose emergence cannot be disjoined from the generativity of the mediations that traverse it.

KEY WORDS
Distributed knowing, situated knowledge, enactment, technology, embodiment, planetarium

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Figure 1: Charlotte Bigg and two CREW members in their studio testing the planetarium. Photo: CREW.

> *Knowing is a distributed practice that includes the larger material arrangement. To the extent that humans participate in scientific or other practices of knowing, they do so as part of the larger material configuration of the world and its ongoing open-ended articulation. (Barad, 2007, p. 379)*

Thus observes Karen Barad in her groundbreaking *Meeting the Universe Halfway* (2007) in which she elaborates an understanding of knowing as distributed practice on the basis of Niels Bohr's quantum physics and theories of performativity from the humanities and social sciences, and with a focus on practices of knowledge production. This brings her to a posthumanist understanding of knowing that acknowledges the active role of instruments in how things come to be known and decenters the human knower. Knowing, she argues, 'is not an ideational affair or a capacity that is the exclusive birthright of the human', nor is it 'a play of ideas within the mind of a Cartesian subject that stands outside the physical world the subject seeks to know'. Rather, '[k]nowing is a material practice, a specific engagement of the world where part of the world becomes differentially intelligible to another part of the world' (Barad, 2007, p. 342). This paper looks at how humans participate in such practices of distributed knowing, starting from a proposal for a twenty-first century planetarium developed by Flemish artist Eric Joris and his company CREW.[1]

A planetarium is an instrument to transmit knowledge about the universe. How the apparatus that is the planetarium does so implies conceptions of what knowledge is and what it means to know. One way of understanding the operations of knowledge transmission is in terms of representations mediating between knower and known. One might think here of the well-known dome shaped type of planetarium in which projections of distant stars and faraway galaxies allow viewers to imaginarily 'boldly go where no man went before' as if to see for themselves what it looks like 'over there'. This is what Barad identifies (and rejects) as representationalism: 'representationalism marks a failure to take account of the practices

1 - See: http://www.crewonline.org/

through which representations are produced. Images or representations are not snapshots or depictions of what awaits us but rather condensations or traces of multiple practices of engagement' (Barad, 2007, p. 53). These practices are, to speak with Donna Haraway (1988), *situated*. How the world, and the universe, come to be known is a correlate of the (organic and inorganic) bodies involved in perceiving and understanding, and their social, cultural, technical, and other specificities. Such situatedness, Haraway observes, is foregrounded by 'the "eyes" made available in modern technological sciences' (Haraway, 1988, p. 583). Modern scientific instruments shatter the idea of passive vision. She points out how technologies like sonography systems, magnetic resonance imaging, artificial intelligence-linked graphic manipulation systems, scanning electron microscopes, computed tomography scanners, color enhancement techniques, satellite surveillance systems, home and office video display terminals—as well as 'cameras for every purpose from filming the mucous membrane lining the gut cavity of a marine worm living in the vent gasses on a fault between continental plates to mapping a planetary hemisphere elsewhere in the solar system' (Haraway, 1988, p. 581)—expand what can be perceived. They do so by means of inorganic perceptual systems that operate in ways radically different from human perceptual systems. 'These prosthetic devices show that all eyes, including our own organic ones are active perceptual systems building on translations and specific *ways* of seeing, that is, ways of life' (Haraway, 1988, p. 583, original italics). These specificities however, Haraway also points out, often get obscured by 'an ideology of direct, devouring, generative, and unrestricted vision, whose technological mediations are simultaneously celebrated and presented as utterly transparent' (Haraway, 1988, p. 582). One of her examples is the chapter 'Space' in the volume celebrating the 100th anniversary of the National Geographic Society that:

> *…recounts the exploits of the space race and displays the color-enhanced 'snapshots' of outer planets reassembled from digital signals transmitted across vast space to let the viewer 'experience' the moment of discovery in immediate vision of the 'object'. These fabulous objects come to us simultaneously as the indubitable recordings of what is simply there and as heroic feats of technoscientific production. (Haraway, 1988, p. 582)*

Non-human modes of seeing of modern technological science make available outer planets—as well as many other things humans cannot perceive directly—yet how these inorganic perceptual systems participate in how the universe comes to be known is also what gets obscured by visualizations that suggest direct availability to human perception. These visualizations erase the differences between the ways in which outer planets become available to the inorganic perceptual systems of scientific technology, and human perception. They thus perform what is actually a double act of erasure. Erased are not only the particularities of the inorganic perceptual systems of technologies probing the depths of space, but these visualizations also obscure how they are designed to meet the particularities of the perceptual systems of human perceivers. These visualizations can appear as transparent windows to what is 'out there' because they

naturalize specific human modes of perceiving. This double act of erasure produces 'immediateness': the illusion of unrestricted availability and access to a disembodied and distant observer.

Haraway's observations point to what Mark Hansen (2015) describes as the 'doubling or splitting of media's operationality' (Hansen, 2015, p. 52). Hansen does not write about scientific instruments but about media technology, in particular about what he calls 'twenty-first century media'. These are media like micro-sensors, data processors, smart technologies, search engines and other digital and networked media that perform operations to which humans have no direct access. Like scientific measuring instruments, they detect intensities, differences, fluctuations and patterns, and like 'the "eyes" made available in modern technological sciences' (Haraway quoted above), their modes of operating do not directly correlate to human sensory capacities the way nineteenth- and twentieth-century media like photography, cinema or sound recording do. Rather, they 'open up an expanded domain of sensibility that can enhance human experience.' To access this domain of sensibility, 'humans must rely on technologies to perform operations to which they have absolutely no direct access whatsoever and that correlate to no already existent human faculty or capacity.' (Hansen, 2015, pp. 4-5) In order for humans to relate to this expanded domain of sensibility, therefore, additional mediation is required to presentify what is not accessible to human perception.[2] Understanding how humans can participate in distributed practices of knowing, therefore, requires not only acknowledging how the specificity of nonhuman ways of perceiving expand the sensible, but also how the larger material arrangement in which humans participate affords them to relate to these expansions of the sensible, and do so from the specificities of their human perceptual systems.

Joris' planetarium is an example of how technologies permit humans to relate to what cannot be perceived directly by them and how, as a result, they are capable of participating in distributed practices of knowing. In his planetarium, knowledge about the universe is not transmitted by postcards from outer space presenting the illusion of a transparent window to what humans cannot perceive, but, in line with Barad's observations, results from how humans participate in the larger material arrangement presented by the planetarium. This larger material arrangement affords them to relate to that what, otherwise, remains imperceptible to them by means of what Hansen (2006, p. 19) terms 'the organism's power of imaging': an existential potential of comprehension that is grounded in the embodiment of the organism. The organism's power of imaging is a primordial operation that is a general condition of phenomenalization—that is, of the world (or the universe) becoming available in relation to an agency of observation. The planetarium demonstrates the potential of technology to address the bodily power of imaging and shows how this allows for a non-representationalist approach to knowledge transmission. In the planetarium, the universe comes to be known as a result of how the apparatus affords humans to participate in an unfolding of articulations of space. This approach to knowledge transmission acknowledges the inseparability of observed object and agencies of observation (Barad). The planetarium demonstrates the potential of technology to not only expand the sensible beyond human perception

2 – I use 'presentify' following Hansen. On page 52 of Feed Forward he observes that

> ...on one hand, twenty-first century media mediate the sensory continuum in which all experience, human included, occurs; on the other, twenty-first century media function as media for humans–as media in its traditional sense–when and insofar as they presentify the data of sensibility in ways that humans can perceive. (original italics)

As I understand it, he uses presentify because he wants to avoid the suggestion that what cannot be perceived by humans can nevertheless be made present in terms of their modes of perceiving. Which would suggest mediation as a kind of window, and this is precisely the understanding of mediation he argues against. The additional layer of mediation offers a way of relating to what cannot be made present in terms of human perception and thus presentifies its existence.

by means of inorganic perceptual systems, but also to afford new ways of knowing in which humans participate in what Federica Timeto (2015) calls technospaces.

STROLLING THROUGH THE SOLAR SYSTEM

Although their work is regularly presented in theatre contexts, Joris' company CREW is quite unlike the usual theatre company and may be better described as a multidisciplinary team of artists, researchers and technicians using live performance and installations as mediums to test, play with, and reflect on the aesthetic possibilities and implications of innovative technologies. For the past fifteen years, they have attracted much attention with high-tech performances in which audience members are partially immersed in virtual worlds. Characteristic of their way of working is their use of various kinds of head-mounted displays that present users with panoramic video images that respond to the user's viewing direction and movements. In early versions of this technology, users, or immersants as CREW refers to them, had to remain in one place or had to be moved around by helpers pushing them around in chairs on wheels. Over the years the system has radically improved, as a result of which immersants are now much freer to move around while carrying the technological equipment in a kind of backpack.[3]

Figure 1 (at the beginning of this text) shows Charlotte Bigg wearing such a head-mounted display and backpack in a test-version of the planetarium in Joris' studio. Bigg and Kurt Vanhoutte (not in the picture) are the project leaders of the international research project *Spectacular astronomy: Historical and experimental explorations into the visual and spatial experience of planetariums, 19th-21st centuries.* Joris' proposal for a twenty-first century planetarium was developed in the context of this project.[4]

The little sensor on Bigg's head—the antenna that makes her look a bit like an alien—is used to synchronize her movements and the direction of her looking with visualizations produced by the system. The screen on her back shows what she is seeing. What she sees depends on where she looks and how she moves about. Moving through Joris' studio, she is moving through visualizations of the solar system. Unlike planetariums that present visions of the universe as if existing independent from viewers, in Joris' immersive planetarium the solar system universe unfolds from the encounter with immersants. This is not merely a matter of technology responding to the movements and direction of the eyes of a viewer in order to support an immersive illusion. Actually, Joris' creative strategies actively subvert such suggestion of transparency of technological mediation and direct attention to how the solar system emerges for a viewer as a result of how this viewer enacts the affordances of the technology. This starts already before the encounter with the universe. The immersant-to-be first meets with a person who assists in putting on the head-mounted display and explains how to move around. After putting on the display, the immersant sees the image of an avatar speaking with the voice of that same person. This avatar introduces herself as a guide. The way in which a connection is thus staged between the avatar encountered in the virtual universe and an actual person in the space within which the immersant finds herself, blurs the boundary

3 – See Sigrid Merx (2015) for a description and analysis of CREW's mode of working as it developed through previous projects.

4 – For more on the Spectacular Astronomy research project, see: http://visualpoetics.be/?action=project&id=36

between these two spaces and highlights how the virtual universe is generated in the here and now. The immersant finds herself in what Hansen (2006), after Monica Fleischmann and Wolfgang Strauss, proposes to term 'mixed reality'. In mixed reality, the virtual is '[n]o longer a wholly distinct, if largely amorphous realm with rules all its own.' Instead, it denotes a 'space full of information' that can be 'activated, revealed, reorganized and recombined, added to and transformed as the user navigates…real space' (Hansen, 2006, p.2). The virtual here manifests itself in how technology opens new realms within reality, realms that:

> *…can be accessed through embodied perception or enaction (Varela). In this way, emphasis falls less on the content of the virtual than on the means of access to it, less on what is perceived in the world than on how it comes to be perceived in the first place. (Hansen, 2006, p.5)*

In Joris' planetarium, the virtual solar system is presented quite literally as a space full of information that is activated and transformed from the space in which the immersant and the guide are materially present. At first, the virtual space is a rather empty space. Visualizations of partial views of the solar system are gradually built up, a process in which the guide plays an active role. The relationship between the virtual world and the space from where it is activated is made present time and again, for example when the guide invites the immersant to touch a football on a string—the movements of which, tracked by motion capture, will be used to create an impression of the sun in orbit in the virtual space (Figure 2).

Figure 2: the actor performing the avatar together with an immersant. Photo: CREW.

Far from immersing immersants in views of 'how it is' with the solar system, the planetarium presents itself as a tool for making sense of what lies beyond human modes of perceiving, and exposes its own modes of operating. The planetarium not only invites users to step inside in the virtual solar system but also to look at how others are similarly moving around in it. Immersants are invited to watch others before and after them going through the experience and are thus stimulated to develop an understanding of how the ways of imagining the universe they have encountered, or are about to encounter, are produced. Figure 3 shows an image of a presentation of the *Spectacular Astronomy* project (in the Imaginarium in Tourcoing, France, December 2015) in which the audience could attend short lectures about various aspects of astronomy and the project while simultaneously watching other people experiencing the planetarium.

Figure 3: Compilation of images showing a demonstration of the planetarium in Tourcoing, December 2015. Photos and compilation: CREW.

The planetarium presents a compelling image of humans feeling themselves around in technologically-triggered imaginations of the solar system, trying to make sense of the relative positions of the planets and the logic of their orbits by means of embodied enactment. Getting what is thus transmitted is not a matter of 'getting the picture' but of grasping an embodied sense of connections, relations, distances, movements. The modes of operating of the planetarium bring to mind that of the orrery, transmitting knowledge about the universe by means of a mechanical model of the solar system that shows the relative positions and motions of the planets and moons. This permits the user to move around it and sometimes (in large-scale orreries) through it, or (in the case of so-called living orreries) by collectively performing the movements of the planets in their respective orbits. Joris' planetarium also continues the practice of the historical orrery to upsize the planets relative to the distances between them. The distance between the planets that are part of our solar system is so big in comparison to the size of the planets that, if the model would be made according to scale, the planets would be too small to be noticed by human perceivers. This concession to scale supports an understanding of knowledge transmission as being about grasping a logic of relationships and relative positions and movements rather than as a suggestion of a mirror image of reality.

ORGANISM'S POWER OF IMAGING

In Joris' planetarium, immersants participate in ways of knowing the solar system as a result of how they enact the affordances of the technological set-up. This set up does include visualizations, yet these do not offer the promise of a transparent window to the universe as if existing independent from the mediations of the technology. Rather, these visualizations are part of how the planetarium stimulates what Hansen (2006) describes as the organism's power of imaging. This power, he observes, is increasingly addressed by technologies that, instead of presenting the illusion of immediate access to another world, afford modes of enacting perception that open realms of the virtual within reality. Understanding what is at stake in these new modes of engaging users requires 'the transition from (external) image to (internal) imaging power, from the observational to the operational perspective' of the body (Hansen, 2006, p. 19). Hansen elaborates such a transition through (among others) Maurice Merleau-Ponty's (1962) notion of the body schema and Shaun Gallagher's (2005) explications of the implications of Merleau-Ponty's ideas.

The body schema is 'a system of sensory motor capacities that function without awareness of the

necessity of perceptual monitoring.' It is distinct from the body image, which is 'a system of perceptions, attitudes and beliefs pertaining to one's own body' (Gallagher, 2005, p. 24). The distinction between body image and body schema is not always clearly made, not even by Merleau-Ponty himself. Nevertheless, Gallagher points out, there are good reasons to make a clear conceptual distinction between the two because they help to address different sets of questions. The concept of the body image helps to address questions about the appearance of the body in the perceptual field, whereas the concept of the body schema helps to answer questions about how the body shapes the perceptual field (Gallagher, 2005, p. 17-18). Or, as Hansen puts it:

> *Whereas the body image characterizes and is generated from a primarily visual apprehension of the body as an external object, the body schema emerges from what, with autopoetic theory we have called the operational perspective of the embodied organism. As such, it encompasses an 'originary', preobjective process of world constitution that, by giving priority to the internal perspective of the organism, paradoxically includes what is outside its body proper, what lies in the interactional domain specified by embodied enaction. (Hansen, 2006, p. 38-39)*

The body schema develops out of the body's interaction with the environment. It evolves from the experience of moving, doing, and touching, and interacting with the environment, and in its turn it shapes our perceptual field in terms of the potential for movement and action. This arousal of potential movement is the basis of our response to what we encounter and how we are able to relate to what we encounter. Furthermore, Merleau-Ponty observes, through this arousal of potential movement we are not only capable of relating to real situations but also to virtual ones:

> *In the case of the normal subject, the body is available not only in real situations into which it is drawn. It can turn aside from the world, apply its activity to stimuli which affect its sensory surfaces, lend itself to experimentation, and generally speaking take its place in the realm of the potential. (Merleau-Ponty, 1962, pp. 108-109)*

This possibility for experimentation and to relate to situations that are not real is, according to Merleau-Ponty, not a matter of the body mistaking what is not real for real, but of the potential of the body to engage with the virtual in ways that build upon the possibilities, habits and patterns that are our body schema and afford us to grasp what is encountered in these terms.

Similarly, Joris' planetarium affords users to come to an understanding of the solar system that is grounded in their body schema. The head-mounted display provides them with a partial perspective on the solar system only. Moving around allows immersants to change their perspective and to explore the relationships between the sun, earth, planets and moons and their movements relative to one another and relative to themselves as observers. The planetarium thus mediates in ways of knowing the universe that are situated in bodies of immersants and their embodied experience with movement and spatiality. This situatedness is foregrounded by how

the planetarium destabilizes the self-evidence of human, earth-based perception as foundation for understanding the universe—for example in how it mediates in a spatial logic that does not necessarily correlate with an earthly sense of gravity and with earthly ways of orienting ourselves in relation to the floor as stable ground.

… in a spatial logic that does not necessarily correlate…

The situated nature of the knowledge transmitted is also addressed by how the planetarium takes the immersant along in visualizations that present the solar system according to different explanations of how to imagine the relationships between the earth, the sun and the planets by Ptolemy (c. AD 100–c. 170), Copernicus (1473–1543) and Tycho Brahe (1546–1601). Joris' planetarium demonstrates how each of them offers different explanations of what invisible parts of the solar system must be like in order for the phenomena that can be observed to make sense, and also how these ways of knowing the universe can equally be made accessible for embodied enactment. Today's understanding of the solar system is thus put in a historical perspective and presented as one step in a history of attempts of making sense of what can and what cannot be perceived. Historical specificity is further underlined by presenting it as the current commonly-accepted model of the solar system. Presenting the different models side by side and by means of the same technology, the planetarium also alerts its users to the difference between the technology used to transmit ways of understanding the solar system and the technologies used to explore it, and to the fact that what they encounter in the planetarium is, to speak with Barad quoted above, 'not snapshots or depictions of what awaits us but rather condensations or traces of multiple practices of engagement' designed to afford human perceivers to relate to what they cannot perceive (Barad, 2007, p. 53).

RE-ARTICULATIONS

> *Galileo's telescope, the* occhiale *or* perspicullum *revealed the earth's status as the third of several planets about the sun; Herschell located the solar system in the Milky Way, expanding the cosmos from solar system to galaxy; twentieth-century radio astronomy multiplied the number of galaxies and the Hubble telescope has introduced us to superclusters. (Peters, 2003, p. 409)*

John Durham Peters makes these observations in a text in which he argues that geology and astronomy form the outer limits of communication theory in how they practice the art of reading records from distant times and faraway places. Technological developments make possible new ways of reading as a result of which the universe expands in time and space. Joris' planetarium suggests we may conceive of such expansions made possible by technology as re-articulations in line with the re-articulations of the solar system from Ptolemy to Copernicus to Brahe. Technological developments from Galileo to Hubble, and beyond, expand the sensible and presentify what humans cannot perceive.

Such presentification, therefore, is not like opening a window onto a new part of the universe but results from how the co-evolution of humans and technology affords the universe to be articulated in new ways.

Joris' planetarium affords immersants to enact an embodied understanding of the logic of such articulations. Instead of showing the solar system as a stable object of a vision from nowhere, the solar system emerges as what Timeto calls a 'technospace'. She defines technospaces as 'dynamic and contingent formations whose emergence cannot be disjoined from the generativity of the mediations that traverse them' (Timeto, 2016, p. 1). In the planetarium, the solar system as technospace emerges from how immersants enact the affordances of the technology and this way re-articulate the ways of knowing the solar system that the planetarium aims to transmit. Given the fact that the solar system itself is largely inaccessible to human perceptual systems and therefore can only be known from how technology presentifies (aspects of) it in ways that humans can relate to, we might also understand the solar system as we know it as itself a technoscape. The solar system as we know it is a phenomenon that cannot be disjoined from the generativity of the human-technology configurations in which the world, and the universe, get articulated in an ongoing, open ended process.

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