

Kevin Buist

Lost Probes and Lonesome Rovers: What Images Produced by Unmanned Spacecraft Can Tell Us About Being an Object

*Short man, Large dream
I send my rockets forth between my ears
Hoping an inch of Good is worth a pound of years
Aching to hear a voice cry back along the universal mall:
We've reached Alpha Centauri!
We're tall, O God, we're tall!*

Ray Bradbury, from *If Only We Had Taller Been*

As I write this, the Voyager 1 spacecraft is a little over twenty billion kilometers from Earth, catching its first whiffs of interstellar space. The probe was launched in 1977, it completed its grand photographic tour of the solar system two and a half decades ago, and is now using only a trickle of electrical power to sense the shifting density of interstellar medium and beam it back to Earth with a faint radio signal. Now blind, it will keep smelling deep space and whispering back to us for a few more years, then its power supply will die, and its inert body will continue hurtling through space for an unknown amount of time, probably billions of years. (Cook 2013)

I want to consider the images created by unmanned space probes and rovers, and what these images can tell us about the experience of traveling in space from the perspective of a machine. The images produced by these machines can provide insight into their firsthand experiences, they're sensing their environments and sharing what they collect. There are two overlapping but distinct ways of thinking about the sensual experiences of unmanned spacecraft. On one hand, they can be seen as technological extensions of human experience, ways of stretching our collective senses billions of miles into space. On the other hand, we can consider these machines as their own objects with their own experiences and inner lives. In this view probes are not extensions of human experience as much as independent actors undergoing an

alien experience that's difficult for us to comprehend. Considering being from the point of view of these machines is possible, because they share their sensory input with us. We can postulate about their firsthand experience of deep space because we can see through their eyes, as long as we accept the metaphor that what they're doing is "seeing." Bradbury ends his verse about the grandeur of space exploration by saying, "We're tall, O God, we're tall!" But is "we" the right word? We've sent something to touch the stars, but it isn't us.

Before we can speculate about a machine's experience of space, it will be helpful to understand how they collect information—and create experiences—for humans back on Earth. An awful lot of translation takes place to make the data collected by probes and rovers into something that is intelligible to us.

Let's start with an image produced by NASA's Mariner 4 unmanned probe produced in 1965. Mariner 4 launched in November 1964, and flew by Mars in July 1965, returning the first ever image of another planet taken from space. Our understanding of the character of the Martian surface up to that point was murky at best, and wildly speculative at worst. A real time data translator returned a stream of pixel brightness information of the first image, but processing this data into a coherent image took the room-sized computer several hours. The impatient scientists at Jet Propulsion Laboratory decided to pick up some pastels at a nearby art supply store, print the brightness readings on strips of paper, then color them by hand to render the first image visible. (Figure 1) (NASA.gov 2015)

The hand-colored image of Mars from Mariner 4 is a convenient beginning point for considering human interaction with images returned from unmanned spacecraft. While this image seems archaic by today's digital imaging standards, it's a helpful reminder that what is returned from these distant machines are not actually images. They're electromagnetic pulses, tapped out in a sophisticated pattern of 1's and 0's that we translate into images. Probes are

experiencing and sensing space, but it takes a lot of work to translate this into a form that's intelligible to humans.

The activity required to operate probes and rovers—and make their data useful to science and the public—is performed by specialized teams. Janet Vertesi is an ethnographer who spent time with the team in charge of the Spirit and Opportunity Mars rovers to learn how their work shapes how we see Mars. She wrote a book called *Seeing Like a Rover: How Robots, Teams, and Images Craft Knowledge of Mars*. Rover cameras are not built to detect just light visible to humans, they sense all sort of light beyond visible spectrum. Scientists must filter this data. Image processing is so complex that it takes a special kind of visual competency, they must learn to “see like a rover”. Digital image processing is very involved. Some things are given emphasis and others are not, so that other scientists can see the same points of interest. Vertesi calls this process “drawing as”. It's the process of revealing different aspects for different purposes. (Vertesi 2015)

For our purposes here, Vertesi's take on how to think about the experience of these machines fits squarely in the first of our two frames: considering probes and rovers as extensions of human experience, rather than independent entities. She makes this clear:

I take as a first-order assumption that the rovers cannot be understood without the complex network of people and software on Earth that animate them. What remains to be explored, however, is exactly how this team is organized, what daily work the members perform, and how their ordering on Earth is implicated in producing order on Mars. (Vertesi 2015)

Vertesi sees rovers as objects that are socially created and socially animated. The rover and the team could be described as two parts of one whole. This way of thinking about robots in space is anthropocentric, human and machine are entangled. Probes and rovers are tools that extend humanity into space, and extend the experience of space back to humanity.

Vertesi explains how complex this entanglement is. Scientists in charge of Opportunity and Spirit's high-res Pancams physically imitate the body of the robot with their own bodies, pantomiming the movements before they write code to accomplish them. Sometimes these gestures are used to communicate to other team members, but more often they're done when scientists are on conference calls or working at computers alone in a room. Team members even improvise with their bodies, leading to new maneuvers beyond what the rover was designed to accomplish. (Vertesi 2015)

Vertesi's focus is on human/machine interaction, but the descriptions of the relationship between the teams and the rovers can begin to give us an insight into what it might be like to be a rover, rather than just control it. She explains that rovers have simple artificial intelligence to avoid hazards, but they only get visual input in intervals. Scientists liken it to walking through a dark room with a cluttered floor using only a flash bulb to see what's in front of you. One flash gives you enough information to move a little, but eventually you need an updated image. Vertesi argues that seeing like a rover is not just a matter of using the information and images provided to make a map. The map needs to be interactable *for the rover*. It needs to consider the unique way the rover occupies space with *its* body. The robots are anthropomorphized, but a lot of the work actually requires the opposite. Scientists employ *technomorphism* to take on and imagine the qualities of the robot's body in order to direct its movements and understand what it will sense and what actions it can perform. Before planning the rover's next driving path, scientists mentally put themselves in the rover's head and ask, "What do I know about the world?" One scientist in charge of the "Rock Abrasion Tool" described the instrument as the rover's sense of touch. He talked about the output graphs of the tool's use as how the rover "feels out the rock." Scientists describe their relationship to the rover and its instruments in one to one terms. "I am the Navcam" or "I am the rover."

Body activities play a big role in creating and understanding visualizations in general. Vertesi reference's Maurice Merleau-Ponty's idea of tools as "proxies" that extend and augment our bodies out into the world like a blind person's cane. The idea is that visualization, even when it's assisted by instruments, is always situated and embodied. Like the cane, tools can move our point of perception out from our bodies to the point of interaction between the tool and the thing being perceived. Vertesi rejects the simple idea that the rovers are just projections of our senses, however. Instead, the teams mentally adapt the rover's body and its unique set of senses in order to understand and interact with the Martian environment. "The proxy," according to Vertesi, "does not run one way: embodiment is a two-way street." (Vertesi 2015)

The two-way embodiment of rover/team and team/rover provides a convenient bridge to our second, less anthropocentric, more alien way of thinking about unmanned spacecraft. Never mind how probes extend *human* experience, what's the experience like *for the machine*? This leads to thinking about probes through the lens of Object Oriented Ontology (OOO). A branch of Speculative Realism, OOO is a philosophical point of view that does not privilege humans over any other objects. The experience and inner lives of all objects are equally worthy of philosophical inquiry. (Bogost, *Posthumanities*, Volume 20 : *Alien Phenomenology, or What It's Like to Be a Thing* 2012)

Ian Bogost wrote *Alien Phenomenology, Or, What It's Like to be a Thing*. Philosophy traditionally thinks of things as only existing when sensed by humans, OOO rejects this notion as a starting point. Bogost cites Quentin Meillassoux who coined the term *correlationism*, the idea that being exists only as a correlate between mind and world. If things exist, they only exist for us. OOO is a way of thinking about things *without* correlationism. Metaphysics doesn't need verification from experience, physics, logic, or even reason. When realist speculation is successful, it does away with the need for transcendent insight and subjective incarceration. We

need to get rid of the idea that humans sit at the center of things like an “ontological watchmaker.” (Bogost, *Posthumanities, Volume 20 : Alien Phenomenology, or What It's Like to Be a Thing* 2012)

Bogost describes it this way, “OOO puts things at the center of being. We humans are elements, but not the sole elements, of philosophical interest. OOO contends that nothing has special status, but that everything exists equally—plumbers, cotton, bonobos, DVD players, and sandstone, for example.” Posthumanism is related, but still puts humans in the central position, because it’s about how things relate to humanity, we are still the starting point. This is where our two lenses for considering unmanned spacecraft diverge. Vertesi’s model of the entanglement between rovers and their teams is form of posthumanism. OOO, on the other hand, asserts that we can’t claim our existence is special *as* existence. Everything else exists, too. Furthermore, all objects recede into themselves, they’re complex and have interrelated parts and elements that we can only partially comprehend. A relationship between two objects is just as complex and the relationship between human and object. Once we realize this, it becomes clear that human perception is only one of *many* possible ways that two objects might relate to one another. (Bogost, *Posthumanities, Volume 20 : Alien Phenomenology, or What It's Like to Be a Thing* 2012) The Rosetta space probe, sent by the European Space Agency to orbit comet 67P/Churyumov–Gerasimenko (Figure 2), has a relationship to that comet that’s just as complex and worthy of inquiry as our relation to the probe.

Probes interact with their human teams, yes, but the team is only one “object” in a sea of objects that the probe will interact with across space and time. Even the 1’s and 0’s they beam back to us require considerable processing to become intelligible to humans, so what about the experiences that have no process by which to be transmitted or translated for human understanding?

Asking what it's like to be a thing is a process of speculation Bogost calls alien phenomenology. He readily admits the limitations of this activity, saying, "When we ask what it means to be something, we pose a question that exceeds our own grasp of the being in the world. These unknown "unknowns" characterize things about an object that may or may not be obvious—or even knowable." Alien phenomenology holds that the experience of a thing is always subjective, which means that experiences can never be fully understood objectively, even though they're real. The process of performing alien phenomenology, therefore, must use analogy. (Bogost, *Posthumanities*, Volume 20 : Alien Phenomenology, or What It's Like to Be a Thing 2012)

I interviewed Ian Bogost about how this method could help us think about probes and the images they create. Asked about which analogy is appropriate when considering probes, he said, "I guess the obvious metaphor is being lost, or lonely, or ambling, that is, going somewhere but nowhere in particular. ...Maybe it's really about quiet. About meditation?" I told Bogost the images reminded me of the sublime, but that was my experience seeing them. If a machine can experience the sublime, what would that be like? "The galaxy is sort of the ultimate example of the sublime, for sure. I'd guess that the machinic sublime would be all about being disconnected from anything, and faced with the terror of that decoupling, insofar as machines experience terror, or insofar as we can metaphorize their terror on our own behalf..." (Bogost, Interview with Ian Bogost 2015)

What else could the sublime encounter of a machine entail? Can the images they produce give us a glimpse? In *The Critique of Judgement*, Kant describes two notions of the sublime, mathematically sublime and dynamically sublime. Both consist of the feeling that our faculty of reason is superior to nature. Mathematical sublime is the idea that the imagination tries, but fails, to comprehend infinity. But reason can consider infinity as a mathematical unit, therefore reason

is superior to imagination. (Kant 1892) In the case of a space probe, this process would reverse. Machines operate on mathematical units, so the sublime terror of a probe would come from existing beyond the threshold of the math it was designed to compute: hurtling along after its batteries and com links go cold, left only to “imagine” its lonely, infinite drift which cannot be measured. Reason fails because the machine built to perform logic outlasts its own capability to do so.

Dynamic sublime considers nature as “a power that has no dominion over us.” Nature is vast and terrifying, but because we can observe it from a position where we’re not threatened by it, we can contemplate its vastness, and through that contemplation, reason triumphs. (Kant 1892) Again, for space probes this would reverse. Far from being in a safe space from which to contemplate nature’s vast terror, space probes are doomed to fates that challenge our comprehension of time, space, and gravity. Without atmospheric erosion of any kind, a probe cruising through interstellar space—like Voyagers 1 and 2—will easily last over a billion years, as long as they avoid crashing into a star or other body. Kant’s triumphant Reason doesn’t look so good when considered through the experience of a machine tumbling through space long after all reasoning minds have turned to dust.

Considering the experience of an unmanned spacecraft, particularly its sublime terror in the face of infinite space and time, is a good way to be reminded that we’re also a speck whizzing through empty darkness. On February 14, 1990, Voyager 1 turned its camera back toward Earth and took a photo at the request of astronomer and author Carl Sagan. Voyager 1 had completed its tour of the solar system and was headed to interstellar space, which it reached in 2012. The photo was taken at a distance of 3.7 billion miles from Earth. It depicts a pale blue speck, hardly visible in the middle of a sunbeam. (Figure 3)

A less famous “pale blue dot” image was taken in 2013. Voyager 1 was spotted from Earth by the National Radio Astronomy Observatory's 5,000-mile-wide Very Long Baseline Array radio telescope. Rather than visible light, it renders radio signals visible, and it can “see” Voyager 1’s communication signal, which is about 22 watts (similar to a refrigerator light bulb). This faint hum is painted as a smudge of blue light among the infinite black of space. (Figure 4).

Taken together, the two pale blue dots offer a portrait of the distance—in terms of space, time, and ontology—between ourselves and the machines we hurl into space. We design these machines to translate their experiences back to us, but we can only catch glimpses of their journeys. They hum along with their own internal systems, pulled by gravity and pushed by solar winds. They are perhaps the ultimate human artifact, objects that will not only outlast those who made them, but even the human species itself. From the perspective of the impossibly long existence of these machines, the journey is just beginning.



(Figure 1) First TV Image of Mars (Hand Colored), 1964 - Image Credit: NASA/JPL-Caltech

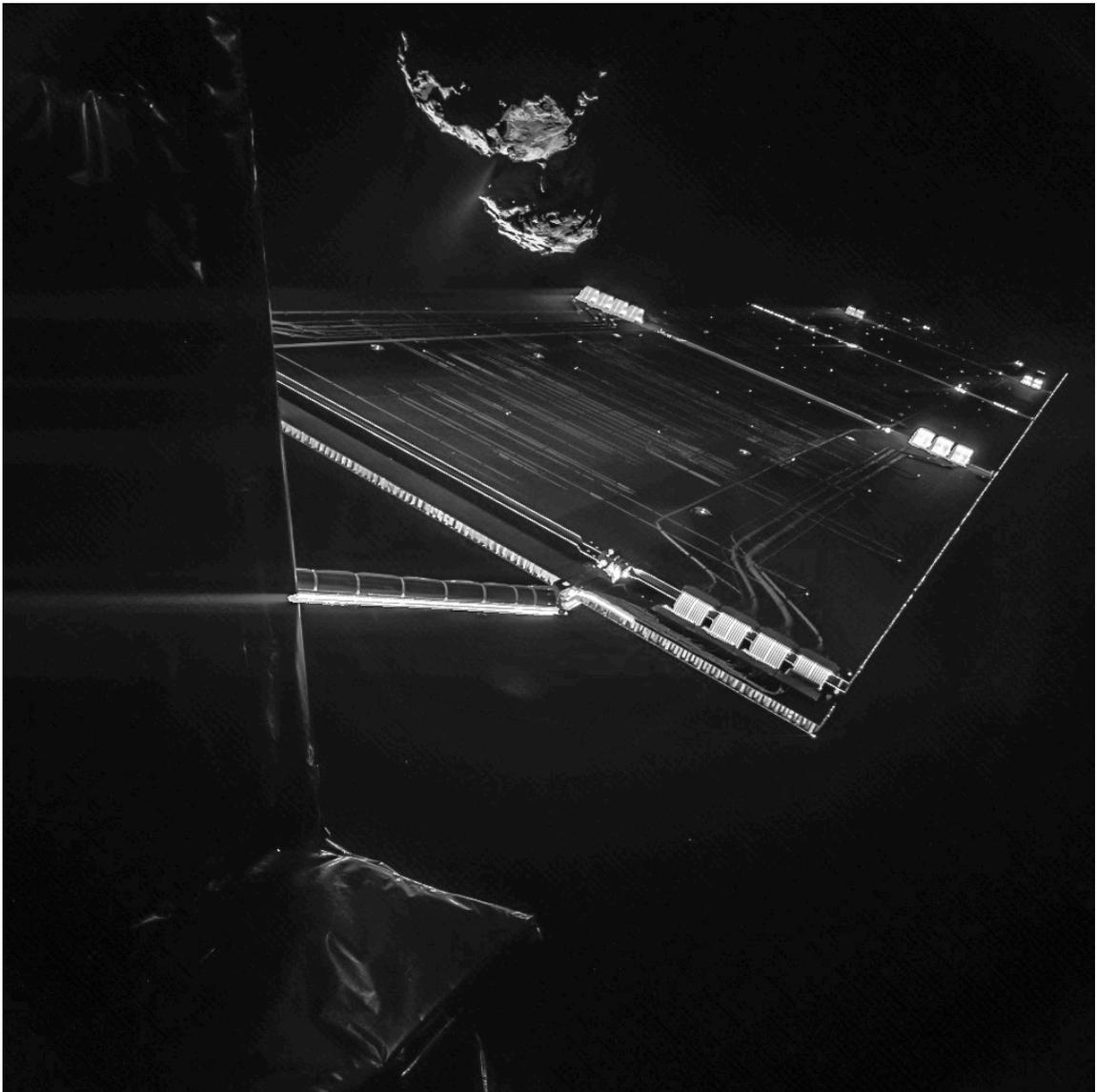


Figure 2: Rosetta mission selfie at 16 km – image: ESA/Rosetta/Philae/CIVA

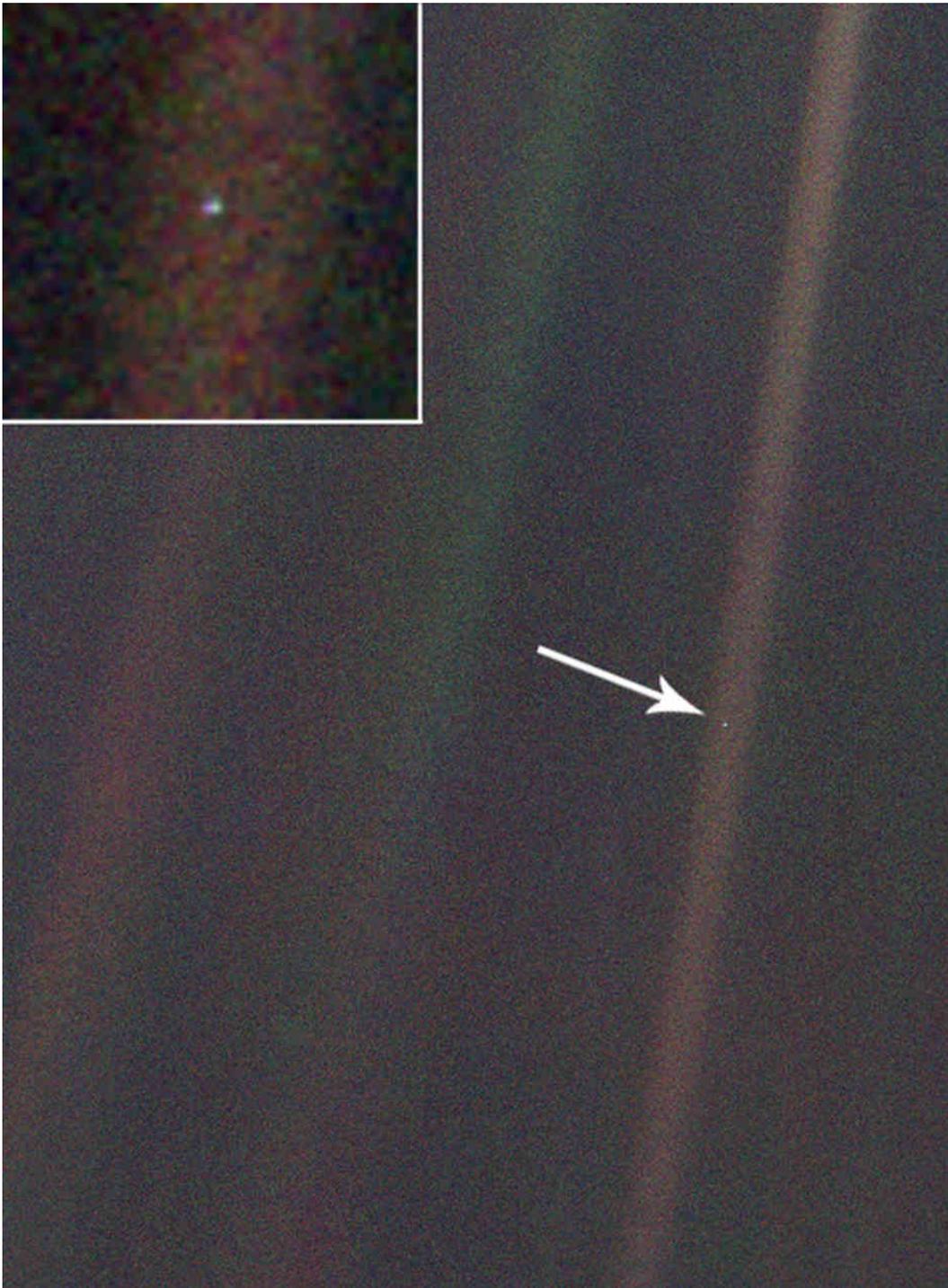


Figure 3: Pale Blue Dot, photograph of Earth by Voyager 1, 1990 – Image: JPL / NASA



Figure 4: Radio image of Voyager 1 from Earth, 2012 – Image: NRAO

Bibliography

- Bogost, Ian, interview by Kevin Buist. *Interview with Ian Bogost* (November 7, 2015).
- Bogost, Ian. *Posthumanities, Volume 20 : Alien Phenomenology, or What It's Like to Be a Thing*. Minneapolis: University of Minnesota Press, 2012.
- Bradbury, Ray. *They Have Not Seen the Stars: The Collected Poetry of Ray Bradbury*. New York: Stealth Press, 2002.
- Kant, Immanuel. *Kant's Critique Of Judgement. 2*. London: MacMillian, 1892.
- NASA.gov. *First TV Image of Mars (Hand Colored)*. July 6, 2015. <http://mars.nasa.gov/multimedia/images/?ImageID=7319> (accessed November 10, 2015).
- Vertesi, Janet. *Seeing Like a Rover : How Robots, Teams, and Images Craft Knowledge of Mars*. Chicago: University of Chicago Press, 2015.
- Cook, Jia-Rui C. *NASA Spacecraft Embarks on Historic Journey Into Interstellar Space*. September 12, 2013. http://www.nasa.gov/mission_pages/voyager/voyager20130912.html (accessed November 10, 2015).