We Are Stardust

CAROLINE PICARD

> *Inyan* (Rock) had no beginning for he was when there was no other. His spirit was *Wakan Tanaka* (The Great Mystery), and he was the first of the superior Gods. Then he was soft and shapeless like a cloud, but he had all the powers and was everywhere. *Han* was then, but she is not a being; she is only the black of darkness.[1]

I wake up early to write an essay about the cosmos and art; mulling it over in the last several weeks, I told myself I was making a mental outline, to such an extent that when the text was finally to be written it would unfold easily, and fully formed, like an already familiar myth. Instead I am absorbed by the late winter sun falling through our windows. Pre–rush hour traffic flows smoothly in the streets below, lined as they are with a stubborn, black residual snow. When we set our clocks back next week, these mornings will be dark again.

Procrastinating, I Google my father's name. He lived most of his life before the Internet existed, and so there is something nice about finding his 2002 obituary. It's not material, exactly, but a coded translation of his person in a virtual, collective database. My mother must have written it. My grandmother used to read the obit pages of newspapers looking for old friends every week. Now, I guess, people go online. Someone said once that the sky in my mind's eye was larger than the real physical sky, but I'm not convinced. The Internet must be equally vast and is thus similarly daunting.

A group of psychologists asked children between six and eleven years of age about the shape of the Earth; agreeing the Earth was round, they nevertheless exhibited difficulty when asked to draw the sky in relation to a round Earth.[2] Our learned knowledge—spherical planetary roundness—is incongruous with daily experience. The ground we stand on is flat. We experience the sky in relation to that flatness; our generic sunny day blue provides a constant ceiling for day–to–day existence. It has a presence. We have a relationship to it. It's therefore difficult for anyone unpracticed to draw a model of how our experience fits in relation to a three–dimensional diagram of infinitely expanding outer space. The night time troubles that certainty of course, for the blue ceiling we hold as constant is suddenly punctuated with variously bright punctures of light.

I leaf through a library book on our kitchen counter and find a sentence by accident; it seems useful. "Nowhere does confusion do harm," Manilius admits when describing the effort required to look at constellations.

> These then are the stars which are spread over the whole sphere of heaven and occupy in the vast ether their several abodes. Only look not for shapes like bodily shapes or think to see all the members shining with equal brilliance with nothing missing or any where left devoid of light. The heavens will be unable to endure the heat of so intense a conflagration, if the full form of every constellation is figured in flame.[3]

The constellations are not like material bodies, nor do their exterior points burn equally bright. Instead we must look for the outlines they provide; if each star revealed

itself completely, suggests Manilius, the heavens would explode. He is thus enamored with a general obscurity, to such an extent that the 1st Century AD poet wrote five books about astrology in an attempt to parse not only celestial logic but also its influence on individual life. First he establishes the stars, offering insight about how to see them in the sky; he describes their circular movements, favoring the formal repetition of circles. The sun and the moon drive their chariots across the sky in familiar patterns, around the Earth. Thereafter he describes every house in the zodiac, delving into the various properties of each house and how it influences life on Earth. The fifth book ends with the myth of Perseus and Andromeda. Manilius's books are strange and epic. I take some comfort knowing they exist. Because even if I don't read them all, at least he provides one example of how the effort of *looking* into a universe is tied to the stories we convey to one another.

Joseph Albers dedicated his life to a similar, arguably more terrestrial enterprise. In his book, *The Interaction of Color*, published in 1963 after thirty years of study, Albers illustrates the reciprocal relationship of colors using a series of exercises. The same gray square responds differently when surrounded by larger green or red boxes, so differently in fact that that each gray changes according to its context. Juxtaposed against a green square, the gray takes on a reddish hue; when surrounded by a proportionate red square, the gray turns ever so slightly green. Albers demonstrates the relativity of color, emphasizing its subjective, reactionary habits.

Carrie Gundersdorf weaves color theory together with Manilius's love of the stars in her abstract paintings Pages 40–41. Often made with color pencil, each waxy, burnished surface is smooth and bright, revealing the mark of her hand as it filled in color. These works embrace the limit of human sight.

Visually speaking the human eye sees a very narrow window of light's spectrum. Most electromagnetic waves in outer space are not only physically inaccessible to earthlings, but would also be invisible. The source material Gundersdorf uses for her compositions is therefore typically manipulated to highlight scientific data. Despite being modified, that imagery nevertheless informs the popular imagination, helping humankind visually conceive itself within an infinite sea of dark space.

> One child of water and sand was Nareau the Younger, who called on the others to rise up and live. Because Sky was so heavy on Earth, however, they could not get up. Nareau the Younger therefore killed his father, made the sun and the moon out of his eyes, and placed his spine on the end of Samoa. This became the world tree or axis mundi. [4]

Origin stories help locate us as well—whether personal or familial, or as they extend beyond an intimate group of people into a class, a nationality, or an entire species. Stories impose a sense of space and scale, carving out points of reference against which the individual imagination defines itself. The entire universe is Micronesia in the above story. In *The Odyssey*, Odysseus's epic years–long journey home takes place within the space of the Greek Islands. It wasn't until the advent of trains that different cities and towns had to synchronize their watches; in so doing, they locked one another into a fixed temporal relationship.

In 1969, the first color photograph of Earth was published. "It was the most beautiful, heart–catching sight of my life," Frank Borman, Apollo 8's Commanding Officer,

reflected when seeing the Earth for the first time, "one that sent a torrent of nostalgia, of sheer homesickness, surging through me. It was the only thing in space that had any color to it. Everything else was either black or white, but not the Earth." [5] Despite NASA's ambivalence about reproducing the image, [6] it catalyzed a global imagination, illustrating not only the vast expanse of space, but also the fragility of our planet. It was as if the individual feeling experienced by those astronauts spread through our human population with the help of that single photograph. "There is a sublimity in images which can change us and move us to action, far more than reasoned persuasion can. Moreover, the sublime can do more than affect us momentarily and discretely, as individuals; it can produce new commonplaces for social mobilization." [7] The photograph, *Earthrise*, demonstrates the ability for images to transform an entire cosmological and mythological framework.

I'm listening to Jefferson Pinder's audio track, *Funknik*, on a loop Page 48. The morning light has long since settled into a deeper afternoon haze. On my headphones I hear men's voices singing together followed by a rhythmic clank—also in unison; the sound of work and steel feels iconic, like something out of an historical movie. Fading in and out of this is an intermittent beep from when Sputnik 1 —the first artificial satellite launched into outer space by the USSR in 1957—circled the Earth broadcasting radio waves. Reproduced in this context, alongside Pinder's other sonic threads, one begins to understand how the artist collapses multiple ranges of space and time—not only outer space, but also the familiar human world with its rugged histories and sociopolitical dynamics. The collage facilitates a listener's astral projection as sonic space fluidly expands from the terrestrial plane to an interstellar depth of mechanical, echoing beeps. That texture would seem especially futuristic, until interrupted by a barking dog. More electro-technic tapestries fuzz in and out, like choreographed voices of various machines. "Free your mind … and your ass will follow," says a human voice from a 1970s Funkadelic record. The clip's original album suggests the kingdom of heaven is inside oneself. Domestic sounds emerge as well; I hear a *thunk* of what might be a plate or glass set on a table. Perhaps it is the sound of the artist in his studio. Its everydayness makes the sound easy to overlook.

Pinder has managed to locate himself in this psycho-geo-social-historic landscape. These threads don't occur discretely, but all at once, in an interacting sound collage. Clips influence one another like Albers's colors, building a narrative as they go along. The sound is part of a larger installation including a sculptural reproduction of USSR's Sputnik satellite. Situated in the gallery, these objects—sculpture and sound—remind us that history is not a fixed story. Though the archetypes we engage are potent and powerful, they are not omnipotent, but rather fluid, dynamic assemblages of popular belief.

My father rowed in the 1964 Olympics as a spare, and won a bronze medal with his team. I didn't know about his achievement until I was about nine years old when I looked for my own name in an encyclopedia of Olympic participants. I looked myself up as a joke, or a disbelieving hope, or both: to see into the future. Instead I found my dad. Given his understated pride, it seems funny that his rowing times appear posthumously on a sports reference website. There is an error, however, because the post would lead you to believe that he is still alive. I write an email to the site with

a link to the newspaper obituary I found earlier. Encountering my father this way isn't haunted exactly, but feels tied to an impersonal kindness—a general Wikipedia-style population invested in the archive of its history. Many countries have national holidays during which citizens travel to cemeteries in order to tend the graves of their ancestors. Perhaps the Internet has become another site for such concerns.

Delft, an essay by Albert Goldbarth, pays homage to the flea. For him, the flea represents a limit of unassisted human sight. We can see fleas, most of us, but anything smaller than a flea is impossible—or was impossible. Early on in his essay, Goldbarth describes Antony van Leeuwenhoek, a draper who learned to grind lenses and created the first microscope. Suddenly the flea-as-limit changed. If *Earthrise* offered one kind of insight, the microscope provided another.

> But Leeuwenhoek is the reverse-Galileo from whom it's most tempting to date the birth of a wholly new understanding. Before him, sight stopped at the dot of a flea. It wasn't of course that sight could not go further so much as that "further" did not exist … The flea that had been the final black wall of the world, became the door to a new world. There, the flea was a looming leviathan. [8]

Jeremy Bolen spent a summer at CERN—the European Organization for Nuclear Research Pages 34-35. There, scientists produce high-speed particle collisions in order to reproduce the same conditions created by the Big Bang.

> When the Large Hadron Collider (LHC) is running, 600 million collisions occur every second: 600 million

reproductions of what we understand to be the beginning of the universe. [9]

Bolen described an initial awkwardness; he was not immediately welcome into the scientific laboratory, nor was he present in any official capacity. Every three days he had to check himself in as a different CERN employee's guest. Although he has since received special permission to work with scientific laboratories, (for instance with his work in this exhibit, where he was the first artist to have scheduled access to the photon laser at Argonne National Laboratory), at CERN he was an interloper, wandering around the facility with a large self–made camera. It was the camera that ingratiated him to others; they asked about it as Bolen explored the property's crumbling, modernist buildings. How ironic and strange, he said, to visit a site dedicated to the pursuit of a scientific origin story that was visibly underfunded. Meanwhile a constant, expensive energy churned below ground, as humans in lab coats tried to recreate the beginning of the universe like detectives reenacting a crime scene. Invisible particles smash together again and again and again while sheep graze above in surrounding meadows. At lunch Bolen listened to scientists discuss the real possibility of time travel, and whether or not one or another of their experiments might produce a black hole. Imagine it might just slip above ground and then what? Would such a thing lead to the apocalypse? Bolen continued to photograph the landscape out of doors, purposefully leaving roles of undeveloped film behind in the below–ground facilities. When developed the photographs bear strange traces of otherwise invisible phenomenon: the footprints of atoms hurtling through space. They remain enigmatic, refusing our human attempt to extract a story.

It has been thirteen years since we spread my father's ashes in a lake. Eleven years ago my mother also died and we spread her ashes similarly. In their absence I watch the sky. I go online. I look through magnifying glasses; for what I'm not sure. Neither of my parents show up on Google image searches, but Jean–Luc Picard does.

> People say that the world was created from a drop of milk. First there was a huge drop of milk. The god Doondari came out of it and made stone. The stone created iron, the iron made fire, the fire created water, and the water made air. Next, Doondari came down to Earth a second time and made a man. The man, however, was arrogant, so the god created blindness to humble the man. Blindness became proud, so Doondari created sleep to defeat blindness, and when sleep got out of hand, Doondari created worry to disturb sleep. When worry became too strong, he made death to defeat worry. When death became arrogant, Doondari came down for a third time as Gueno, the holy one, and Gueno overcame death. [10]

The sun has set now. I drink a glass of water and imagine all of the pieces of everyone and everything that has ever lived swimming invisibly in my glass. An old friend wrote an equation on a napkin years ago at a bar. Her hand is course and the napkin has since softened considerably—it's an object that surfaces from time to time in my life. I'll lose it for years, only to find it again wedged inside an old book when I least expect it. On this particular occasion I found it on purpose. My friend was in graduate school at the time. I think I dared her to write the formula out, pretending

I didn't believe she could. I didn't doubt her so much as I wanted to possess evidence of this thought, and even though I don't understand it, I keep it with me. Like Manilius, it gives some comfort. The equation describes how many particles of Galileo's last breath you are breathing.

1. First you have to estimate how big the volume of a normal breath is, which in this case we will assume is 1 liter.

2. Then you have to estimate how many molecules are in a single breath. To do this you have to use the Ideal Gas Law given by:

$$N = \frac{PV}{kT}$$

Where N is the number of particles, P is the pressure, V is the volume, k is the Boltzmann constant, and T is temperature. P is about 10^5 N/m², V is about 1 liter, k is 1.38×10^{-23} joules/K, and room temperature, T, is about 300 K.

3. We have to convert our liter volume to meters:

$$1L = 10^3 mL \times \frac{1cm^3}{mL} \times \frac{1m^2}{(10^2)^3\,cm^3} = 10^{-3} m^3$$

4. We can put all of these numbers into the equation now:

$$N = \frac{PV}{kT} = \frac{10^5 \times 10^{-3}}{1.38\times10^{-23}\times300}$$

$$\sim 2.4\times10^{22} \text{ molecules in 1 breath}$$

5. Now we have to find the number of molecules in the entire atmosphere. To do this we balance the forces keeping the atmosphere up with the forces pulling the atmosphere down:

$$\text{Pressure}\times\text{Area} = \text{Mass}\times\text{Acceleration}$$

$$PA = Ma$$

6. The pressure is 10^5 N/m² and the Area is $4\pi^2$. The radius of the Earth, r, is ~6400 km which has to be converted to meters so,

$$PA = 10^5\times4\pi\times(6400\times10^3)^2 \sim 5.1\times10^{19}\text{N}$$

7. The acceleration is just gravity, g=9.81, so solving for the total mass of the atmosphere we get:

$$\frac{PA}{g} = M = \frac{5.1\times10^{19}}{9.81} \sim 5.3\times10^{18} kg$$

8. Now the majority of molecules in the atmosphere are nitrogen molecules. Nitrogen is diatomic so it comes in twos. There are 14 protons and neutrons in one nitrogen atom and 28 in a nitrogen molecule so the molecular mass of nitrogen is:

$$28\times m_p = 28\times1.67\times10^{-27} kg$$
$$= 4.676\times10^{-27} \text{ kg per molecule}$$

9. The total number of molecules in the atmosphere is the ratio of the total mass of the atmosphere to the mass per particle in the atmosphere:

$$\frac{M_{atmosphere}}{M_{proton}} = \frac{5.3\times10^{18}kg}{4.676\times10^{-27}kg} \sim 1.1\times10^{44} \text{ molecules}$$

10. Finally we have to find out what fraction of all molecules in the atmosphere were also in Galileo's breath:

$$\frac{N_{Galileo}}{N_{total}} = \frac{2.4\times10^{22}}{1.1\times10^{44}} \sim 2\times10^{-22}$$

11. If we assume that our breath is the same size as Galileo's breath, then the probability that we will breathe in one molecule that Galileo breathed in his dying breath is:

$$2\times10^{-22}\times2.4\times10^{22} \sim 5 \text{ molecules}$$

This number can range from 1–10 molecules depending on the volume of the breath you choose (which is determined by size and how in–shape you are). There are a number of assumptions that go into this problem, like for instance, that the molecules don't go under a bunch of physical processes before they reach our breath. This of course is not true, but it is O.K. since nitrogen is the #1 element in the atmosphere and is relatively stable unlike oxygen, which reacts with everything.

Also we have to assume that the air is circulating around the world. This is a good assumption since we do have something called wind and air current,

which pushes all of the air around—otherwise we cannot assume that the air in Europe would ever reach us (me) in the US.

Notes

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